Temporary Registration No. : TPN / 111996

सत्यमेव जयते
Ministry of Science & Technology
Government of India

Project Proposal On

"Design and development of sustainable dismantling PV solar modules with eco-friendly chemical processing for material recovery"

Submitted to

Division : Climate, Energy and Sustainable Technology (CEST)

Programme or Scheme : Recovery and Recycling of End of Life Solar PV Panels/Modules

Submitted by

Project Investigator:

Dr. Tippanaboyina Venkata Deepthi

MALLA REDDY ENGINEERING COLLEGE(AUTONOMOUS)-Hyderabad

Part 1 : General Information

General Information:

Name of the Institute/University/Organisation submitting the Project Proposal :

MALLA REDDY ENGINEERING COLLEGE(AUTONOMOUS)

State	Telangana
Principal Investigrator Name:	Dr. Tippanaboyina Venkata Deepthi
Category:	General
Type of the Institue :	Academic Institutions (Private)
Project Title :	Design and development of sustainable dismantling PV solar modules with eco-friendly chemical processing for material recovery
Division :	Climate, Energy and Sustainable Technology (CEST)
Programme Or Scheme :	Recovery and Recycling of End of Life Solar PV Panels/Modules
Academic Area :	Chemical Science, Material Science & Engineering, Mechanical Engineering,
Application Area :	Basic Science, Climate Change, Energy, Entrepreneurship and Innovation,
Goverment National Initiative :	Make in India, Swachh Bhart, Startup India,
Type of Proposal :	Proposal Against Call
Project Duration :	3 Years
Proposal Submit Date :	15/07/2024
Project Keywords :	Sustainable, Solar PV panels, Dismantling, recycling

Project Summary :

To dismantle the materials from the used Solar Panels
To design and develop flexible mechanism for removing the aluminum frames from Solar panels
To prepare optimum chemical process for debonding the silicon cells and metals
To segregate the materials for reuse and recycle.
Flexibility in accommodating different numbers of EOL panel sizes
Reducing overall processing costs with efficient material recovery and separation.
Development of new products with recycled materials for industry requriment.
Improved processing efficiency for developing by-products from the recovered materials.

The dismantling process consists of actuators for removing the aluminum frame from the panel. Based on the panel size the vacuum cups are activated to hold the panel in aligned position. The actuators interfaced with the Stepper motors for optimized pulling force and holding accuracy.
The frames removed panels are further directed to the conveyor system which has a rollers fitted to press the panels for breaking the glass layer present on the panel. It passes through 4 rollers for complete removal of the glass. The remaining PVA sheet is passed for chemical processing

Part 2: Particulars of Investigators

Principal Investigator:

1. Name:	Dr. Tippanaboyina Venkata Deepthi
Gender:	Female
Date of Birth:	22/01/1983
Designation :	Associate Professor
Department:	Mechanical Engineering
Institute/University:	MALLA REDDY ENGINEERING COLLEGE(AUTONOMOUS)
State:	Telangana
District:	MEDCHAL MALKAJGIRI
City/Place:	Hyderabad
Address:	Maisammaguda, Dhulapally, (post via Kompally), Secundarabad, Telangana.
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Alternate Email:	venkatadeepthi@mrec.ac.in
Mobile:	9985589596
Phone:	
Fax:	
Category:	General

Co-Investigator:

1. Name:	Dr. Soumi Laha
Gender:	Female

Date of Birth:	18/12/1977
Designation :	Associate Professor
Department:	Chemistry
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State:	Telangana
District:	MEDCHAL MALKAJGIRI
City/Place:	Secundarabad
Address:	Malla Reddy Engineering College
Pin:	500100
Communication Email:	soumilaha@mrec.ac.in
Alternate Email:	
Mobile:	9440523248
Phone:	
Fax:	
Category:	General

2. Name: Dr. Deena Babu Mandru

Gender:	Male
Date of Birth:	05/07/1980
Designation :	Professor
Department:	Information Technology
Institute/University:	MALLA REDDY ENGINEERING COLLEGE(AUTONOMOUS)
State:	Telangana
District:	MEDCHAL MALKAJGIRI
City/Place:	Secundarabad
Address:	Malla Reddy Engineering College

Pin:	500100
Communication Email:	dbmandru@gmail.com
Alternate Email:	
Mobile:	9491369993
Phone:	
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Category:	SC

3. Name: Mrs. Sowjanya Naidu

Gender:	Female
Date of Birth:	31/05/1989
Designation :	Assistant Professor
Department:	Computer Science Engineering
Institute/University:	MALLA REDDY ENGINEERING COLLEGE(AUTONOMOUS)
State:	Telangana
District:	MEDCHAL MALKAJGIRI
City/Place:	Secundarabad,
Address:	Malla Reddy Engineering College
Pin:	500100
Communication Email:	sowjanya.k31@gmail.com
Alternate Email:	
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Fax:	
Category:	OBC

4. Name: Mr. Kesava Vamsi Krishna Vajjala

Gender:	Male

Date of Birth:	29/05/1979
Designation :	Associate Professor
Department:	Physics
Institute/University:	MALLA REDDY ENGINEERING COLLEGE(AUTONOMOUS)
State:	Telangana
District:	MEDCHAL MALKAJGIRI
City/Place:	Secundarabad
Address:	Malla Reddy Engineering College
Pin:	500100
Communication Email:	mrecphysics@gmail.com
Alternate Email:	
Mobile:	9030234705
Phone:	
Fax:	
Category:	General

Part 3: Suggested Refrees

Suggested Refrees: NA

Part 4: Financial Details

Financial Details:

A. Non - Recurring

Equipment

S.	Equipments	Qty.	Justification	1 Year	Total
1 .	A C motor	10	For holding solar panels	177000	177000
2 .	Conveyer belt	3	to move solar panels	1416000	1416000
3 .	Double beam polarized atomic absorption Spectro photometer	1	To know the metal content both in qualitative and quantitate	3000000	3000000
4 .	Furnace	2	For melting	919456	919456

5 .	Industrial Air compressor	1	to provide a steady flow of compressed air for vacuum pump	413000	413000
			Total	**5925456**	**5925456**

Other NonRecurring

S.	Description	Justification	1 Year	2 Year	3 Year	Total
1 .	chemical processing	chemical processing for recovery of raw materials	0	2500000	0	2500000
2 .	construction	construction of plant for installation production and inventory	15000000	0	0	15000000
3 .	Fabrication	Fabrication and installing the Equipments	3500000	0	0	3500000
		Total	**18500000**	**2500000**	**0**	**21000000**

B. Recurring

Project Staff

S.	Project Staff	No.	Justification	1 Year	2 Year	3 Year	Total
1 .	Junior Research Fellow (JRF)	1	monitoring of project	401760	401760	401760	1205280
2 .	Laboratory Assistant/Technician/Technical Assistant/Field Assistant	4	provides an office with reports ,feed back on procedures products and operations	1097280	1097280	1097280	3291840
3 .	Project Associate-I	1	Responsible for monitoring of project	472440	472440	472440	1417320
			Total	**1971480**	**1971480**	**1971480**	**5914440**

Consumables

S.	Items	Qty.	Justification	1 Year	2 Year	3 Year	Total
1 .	Different Sensors, Grippers, Chemicals, Glass Box, Vacuum pump, Furniture's, Electrical Wiring and Control Accessories	1	items used exclusive in support of project objectives	2800000	2000000	1500000	6300000
			Total	**2800000**	**2000000**	**1500000**	**6300000**

Contingency

S.	Description	Justification	1 Year	2 Year	3 Year	Total
1 .	unforeseenexpenses, patents, report preparations etc	Uncertainty and dependence on other future events for existence	400000	400000	400000	1200000
		Total	**400000**	**400000**	**400000**	**1200000**

Travel

S.	Description	Justification	1 Year	2 Year	3 Year	Total
1 .	Travel	For purchasing of consumables, collecting the used solar panels	400000	400000	400000	1200000
2 .	Travel	To attend Review meetings	150000	150000	150000	450000
		Total	**550000**	**550000**	**550000**	**1650000**

Overhead

S.	Description	Justification	1 Year	2 Year	3 Year	Total
1 .	overhead	usage of electricity, lab facilities and other facilities	400000	400000	400000	1200000
		Total	**400000**	**400000**	**400000**	**1200000**

Budget Head Summary in (INR)

Budget Head	Year-1	Year-2	Year-3	Total
1- Non-Recurring				
Equipment	5925456	0	0	**5925456**
Other NonRecurring	18500000	2500000	0	**21000000**

Subtotal (Capital)	24425456	2500000	0	**26925456**
2- Recurring				
Project Staff	1971480	1971480	1971480	**5914440**
Consumables	2800000	2000000	1500000	**6300000**
Contingency	400000	400000	400000	**1200000**
Travel	550000	550000	550000	**1650000**
Overhead	400000	400000	400000	**1200000**
Subtotal (General)	6121480	5321480	4821480	**16264440**
Total Project Cost (Capital + General)	**30546936**	**7821480**	**4821480**	**43189896**

Part 5: PFMS Details

PFMS Unique Code Available: Yes

PFMS Unique Code : TLML00000156

Part 6: Current Ongoing Project

Current Ongoing Project: NA

List of Uploaded Documents:-

1. Complete Project proposal
2. Biodata
3. Certificate from PI
4. Conflict of interest
5. Endorsement from head of Institute
6. Quotation for Equipments

SOLAR ENERGY SYSTEM

RECOVERY AND RECYCLING OF END-OF-LIFE SOLAR PV PANELS/MODULES

FORMAT FOR SUBMISSION OF PROPOSAL

Please choose research area before applying:

(i) Development of Equipment : √
(ii) Development of effective and economic process :

CONTENTS

I. Proposal Summary

	Ref no	***(to be filled by DST)***	
1.	Project Title	Design and development of sustainable dismantling PV solar modules with eco-friendly chemical processing for material recovery	
2.	Project cost *(Amount in lakhs)*	DST:500	Collaborator(s) *(if any):*
3.	Duration *(in months)*	36	
4.	PI Name Date of Birth	Dr. T. Venkata Deepthi	
5.	Co-PI (s) Name Date of Birth	Dr. Soumi Laha :	
6.	Lead Organisation	Malla Reddy Engineering college	
7.	Status of Lead Organisation	*Academic Institution*	
8.	Collaborator/Consortium partner name(s), *if any*	*NA*	
9.	Collaborators'/ Consortium partners' Status	*NA*	
10.	Objectives	*1. To dismantle the materials from the used Solar Panels* *2.To design and develop flexible mechanism for removing the aluminum frames from Solar panels* *3.To prepare optimum chemical process for debonding the silicon cells and metals* *4.To segregate the materials for reuse and recycle.*	
11	Unique selling proposition(USP) of development	*(with in 50 words)*	
12.	Deliverables	*(Deliverables should include targeted specification)* *1. Flexible mechanism for dismantling the materials from different sizes of solar panels* *2. Eco friendly chemical process for reducing the pollutants* *3. segregation of major and minor materials from the processed solar panels* *4. Materials for reusing and recycling*	

I. Proposal Summary

	Ref no	***(to be filled by DST)***	
1.	Project Title	Design and development of sustainable dismantling PV solar modules with eco-friendly chemical processing for material recovery	
2.	Project cost *(Amount in lakhs)*	DST:500	Collaborator(s) *(if any):*
3.	Duration *(in months)*	36	
4.	PI Name Date of Birth	Dr. T. Venkata Deepthi & 22-01-1983	
5.	Co-PI (s) Name Date of Birth	Dr. Soumi Laha & 18-12-1977 Dr.Deena Babu Mandru & 5-07-1980 K. Sowjanya Naidu &31-05-1989 Kesava Vamsi Krishna Vajjala &29-07-1979	
6.	Lead Organisation	Malla Reddy Engineering college	
7.	Status of Lead Organisation	*Academic Institution*	
8.	Collaborator/Consortium partner name(s), *if any*	*NA*	
9.	Collaborators'/ Consortium partners' Status	*NA*	
10.	Objectives	1. To dismantle the materials from the used Solar Panels 2.To design and develop flexible mechanism for removing the aluminum frames from Solar panels 3.To prepare optimum chemical process for debonding the silicon cells and metals 4.To segregate the materials for reuse and recycle.	
11	Unique selling proposition(USP) of development	Unique Selling Proposition for development: **"EcoSmart Solar Dismantling: Pioneering Sustainable Solar Panel Recycling for a Greener Tomorrow."** the unique benefits of our service, emphasizing environmental sustainability, comprehensive service, compliance, cost-effectiveness, innovation, and a commitment to a sustainable future.	

12.	Deliverables	1.Flexibility in accommodating different numbers of EOL panel sizes and reducing overall processing costs with efficient material recovery and separation. 2. Provide end-to-end dismantling and recycling services for solar panels, including removal, transportation, and material recovery at a recovery rate of over 80%, significantly higher than the current global average of approximately 70%. 3. Controlling the environmental impact of the dismantling and recycling process with 30% carbon footprint reduction and waste diversion metrics compared to traditional disposal methods 4. Generating revenue through the sale of recovered materials such as silicon, glass, and metals for worth of Rs. 30,000-45,000/- per ton of solar panels including the operational costs. 4. conduct training programs for 30 employees and 10 clients on best practices for solar panel dismantling and recycling per year. 5.Development of new products with recycled materials for industry requirements. 6.Improved processing efficiency for developing by-products from the recovered materials

13. Budget details:

A.	Project Manpower *(Post & Nos Research group/ institution-wise if more than one institutions are involved)*	DST: Junior Research Fellow: 01 Research Associate*: 01* Project Assistant*: 02*	Collaborator(s): NA
B.	List of Equipments required *(Research group/ institution-wise if more than one institutions are involved)*	DST:	Collaborator(s): NA
C.	Fabricated system /prototype, if any	DST: Dismanteling system, crushing system, separator, chemical processing	Collaborator(s): NA
D	Nature of Contribution from Collaborators	In Cash & Kind *(Please elaborate)*	

14. Funds requirements from DST:

S. No	Item Head	1st Year	2nd Year	3rd Year	Total (Rs.)
A	**Non-recurring (Capital Items)**				
1	Permanent Equipments	5925456			5925456
2.	Plant cost /Fabricated systems/ Demonstration models	18500000	2500000		21000000
	Sub total (capital items)	24425456	2500000		26925456
B	**Recurring Items (General)**				
1.	Manpower	1971480	1971480	1971480	5914440
2.	Consumables	2800000	2000000	1500000	6300000
3.	Contingencies	400000	400000	400000	1200000
4.	Travel	550000	550000	550000	1650000
5.	Other Costs (Outsource work etc),if any				
6.	Overhead	400000	400000	400000	1200000
	Sub total (General)	6121480	5321480	4821480	16264440
C	**Total cost of the project (A+B)**	30546936	7821480	4821480	43189896

Total requirement of funds from DST = 43189896

Contribution of participating institution(s), if any= NA

Total project cost = 43189896

II. CORE PROPOSAL

(Kindly ensure to read the Guidelines (in italics fonts) and fill the text accordingly)

1. **Project Title:** Design and development of sustainable dismantling PV solar modules with eco-friendly chemical processing for material recovery

2. **Lead Organization Principal Investigator(PI)***

Name: Dr. T. Venkata Deepthi
Designation: Associate Professor
Complete Address *(with city pin code)*: ***Malla Reddy Engineering College, Maissammaguda, Medchal-Malkajgiri, Secunderabad, Telangana -500100***
Telephone & Mobile No. : 9985589596
E-mail: venkatadeepthi.t@gmail.com

Co-Principal Investigators(Co-PI)

Name: Dr. Soumi Laha
Designation: Associate Professor
Complete address *(with city pin code)*: ***Malla Reddy Engineering College, Maissammaguda, Medchal-Malkajgiri, Secunderabad, Telangana -500100***
Telephone & Mobile No. :9440523248
E-mail: soumilaha@mrec.ac.in

Name: Dr.Deena Babu Mandru
Designation: Professor
Complete Address *(with city pin code)*: ***Malla Reddy Engineering College, Maissammaguda, Medchal-Malkajgiri, Secunderabad, Telangana -500100***
Telephone & Mobile No. : 9491369993
E-mail: dr.deenababumandru@mrec.ac.in

Name: K. Sowjanya Naidu
Designation:Assistant Professor
Complete Address *(with city pin code)*: ***Malla Reddy Engineering College, Maissammaguda, Medchal-Malkajgiri, Secunderabad, Telangana -500100***
Telephone & Mobile No. : 7780622583
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Name: Kesava Vamsi Krishna Vajjala
Designation:Associate Professor
Complete Address *(with city pin code)*: ***Malla Reddy Engineering College, Maissammaguda, Medchal-Malkajgiri, Secunderabad, Telangana -500100***
Telephone & Mobile No. : 9030234705
E-mail: mrecphysics@gmail.com

3. **Consortium partner organization(s) / collaborator(s):**

(No project shall be considered in absence of Co- PIs . Lead Principal Coordinating Investigator is nodal contact point for DST in case of Consortium Projects)*

4. **Collaborating Agencies/Industries** *(If any)*

(Consortia may be formed wherever necessary. In sections 11 and 12 of the proposal, clearly explain the need for forming the consortia and the roles and responsibilities of each partner.)

Not Applicable

5. **Target Beneficiaries:** *(with in solar sector/ potential outside solar sector for other applications)*
   - Residential solar system owners
   - Small scale industries
   - Electronic recycling companies
   - Education & Research institutes

6. **Objectives of the Proposal**

(Precise and quantified: Estimated possible values, Use bullet form)

- To dismantle the materials from the used Solar Panels
- To design and develop flexible mechanism for removing the aluminum frames from Solar panels
- To prepare optimum chemical process for debonding the silicon cells and metals
- To segregate the materials for reuse and recycle.

7. **Critical Review of Status Identifying Gaps**

7.1 National Status Review

Solar photovoltaic (PV) energy has emerged as a pivotal segment within renewable energy due to its potential to combat global warming and achieve CO_2 reduction targets set by national and international mandates. The PV industry has seen substantial growth in recent years, evidenced by increasing production capacities, expanding networks of solar installers, and global financing initiatives. As of 2018, global cumulative installed PV capacity reached nearly 480 GW, contributing approximately 2% of the world's electricity generation [1]. Projections suggest that by 2030, global PV capacity could soar to 2840 GW, escalating to 8500 GW by 2050 [2].

However, with this rapid expansion comes the challenge of managing end-of-life (EOL) PV waste. Current estimates anticipate significant volumes of PV panel waste accumulating by 2030 and 2050, ranging from 1.7-8 million tons to 60-78 million tons, respectively [3]. Historically, the PV industry has operated under a linear "take-make-use-dispose" model, where panels are manufactured, utilized, and often disposed of in landfills, posing risks to soil and groundwater [4].

To address these challenges sustainably, a shift towards a circular economy approach is imperative. This transition requires holistic lifecycle considerations across the PV value chain, encompassing product design, manufacturing, usage, and end-of-life management. Collaboration among diverse stakeholders—including businesses, governments, consumers, and academia—is essential to foster innovation and implement effective recycling and reuse strategies. By adopting a circular economy perspective, the PV industry can not only mitigate environmental impacts but also unlock economic opportunities and enhance resource efficiency in the renewable energy sector. The study of the photovoltaic (PV) value chain is essential for several reasons. Firstly, existing research has often treated the PV value chain as fragmented, focusing primarily on segments such as polysilicon production, cell and module manufacturing, PV system installation, and recycling. There has been less emphasis on viewing the PV value chain as a cohesive entity and exploring the diverse stakeholders involved [5,6]. However, there is a growing recognition of the importance of other critical stages in the value chain, such as research and development for circular product design, circular business models, as well as PV refurbishing, reuse, and recycling.

Secondly, understanding the dynamics that shape the evolution of PV systems and anticipating their large-scale deployment in the future necessitates a comprehensive view of the industry's value chain. Ignoring the interconnected networks within the PV ecosystem can hinder policymakers and new market players from realizing the impact of changes in public policy, technology advancements, market conditions, and shifts in consumer behavior [7]. These factors significantly influence the attractiveness and adoption trajectories of various PV technologies and the feasibility of different circular pathways for PV systems.

In essence, studying the PV value chain holistically enables a deeper understanding of how the industry functions, evolves, and responds to external influences, thereby facilitating informed decision-making and strategic planning for sustainable PV deployment.

To effectively manage PV waste, innovation across product design and recovery processes is crucial. The renewable energy sector's innovation is increasingly decentralized and interconnected, involving collaboration among incumbent and start-up firms, governments, research institutions, and service providers [8]. Understanding these diverse value chain structures and interactions offers opportunities for collaborative value discovery and creation [9,10].

Furthermore, the anticipated scarcity of critical materials like tellurium, gallium, indium, selenium in thin-film solar cells, and lithium, cobalt, nickel, natural graphite in EV batteries underscores the importance of a comprehensive value chain perspective. Identifying risks and vulnerabilities along PV and EV battery value chains enables stakeholders to prepare for potential supply disruptions and ensure sustainability and resilience [11,12].

Lastly, achieving high-value PV reuse and recycling requires integrating circular product design and business model strategies into industry practices. Current PV panel designs often hinder effective material separation upon disposal, leading to low-value recycling or landfilling. Similarly, existing product-centric business models typically lack provisions for maintenance, refurbishment, take-back, or recycling. Adopting a circular mindset throughout the PV value chain, beyond individual firm boundaries, is essential to secure secondary raw material availability and minimize environmental impact.

7.2 International Status Review

Considering the ever-increasing attention given to PV energy and PV waste, this study’s main goals are:

Certainly, addressing early failures in photovoltaic (PV) modules through reuse is an effective strategy, especially in extending their lifecycle rather than prematurely discarding them. Second-hand, repaired, or refurbished PV modules can still serve useful purposes in markets where high efficiency isn't critical, such as e-bike charging stations, highway electronic signs, and off-grid systems. This approach not only reduces waste but also makes solar technology more accessible in low-income markets.

While reducing and reusing are valuable options, recycling is often emphasized by researchers as the preferred choice for end-of-life PV modules. Photovoltaic panels are complex devices composed of various materials: silicon cells for converting light into electricity, polymers and glass for protection and insulation, aluminum frames, and wiring for electricity transport. When properly disassembled, most components of PV panels (glass, metals, wiring) can be recycled independently and reused in other applications. However, silicon cells present a challenge due to their composition and require specialized treatments—mechanical, thermal, and chemical processes—depending on the type of solar panel to recover valuable metals. Despite these challenges, modern recycling technologies can recover over 90% of materials from solar panels, with some processes achieving up to 95% recovery rates. This high percentage underscores the feasibility and importance of recycling in minimizing waste and maximizing resource efficiency in the solar industry. In summary, while reuse offers immediate benefits, recycling remains crucial for recovering valuable materials from PV panels, ensuring sustainability and reducing environmental impact in the renewable energy sector.

Managing photovoltaic (PV) waste in India presents several challenges and requires specific strategies to address environmental and regulatory concerns effectively:

1. **Informal Handling of PV Waste:** Despite efforts to extract and recycle some portions of PV panels, a significant amount of waste is handled informally. This informal handling leads to waste accumulation in landfills and contributes to environmental pollution.
2. **Limited Market for Reusing Recycled PV Waste:** There is a small market for reusing recycled PV waste in India, primarily due to insufficient incentives and investment schemes for businesses. Without a robust market, recycling efforts may not be economically viable.
3. **Lack of Specific Guidelines:** Current guidelines often treat PV waste similarly to other forms of e-waste, which can lead to confusion and ineffective management practices. Specific provisions tailored to PV waste within existing e-waste guidelines are necessary to ensure proper handling and recycling.
4. **Hazardous Waste Classification:** PV module waste is classified as hazardous waste in India, necessitating careful handling and disposal to prevent environmental and health risks. Awareness campaigns and educational programs are crucial to promote proper waste management practices among stakeholders.
5. **Limited Local Manufacturing:** India's reliance on imported PV panels underscores the need for domestic research and development (R&D) efforts. Developing local capabilities for manufacturing and recycling PV panels can enhance resource efficiency and reduce dependency on foreign markets.

To overcome these challenges, concerted efforts are required from government bodies, industry stakeholders, and the public:

- **Regulatory Framework:** Establishing clear regulations and guidelines specifically for PV waste management within the broader e-waste framework.
- **Incentives and Support:** Introducing incentives and funding schemes to encourage investment in PV waste recycling technologies and infrastructure.
- **Awareness and Education:** Conducting awareness campaigns to educate stakeholders about the importance of proper PV waste management and the environmental benefits of recycling.
- **Research and Development:** Supporting local R&D initiatives to develop innovative technologies for PV waste recycling and recovery of critical materials.

By addressing these challenges systematically, India can improve its PV waste management practices, minimize environmental impact, and promote sustainable development in the renewable energy sector.

References:

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2. IRENA. *Global Energy Transformation: A Roadmap to 2050*, 2019 ed.; IRENA: Abu Dhabi, United Arab Emirates, 2019. [**Google Scholar**]
3. IRENA. End-of-Life Management: Solar Photovoltaic Panels International Renewable Energy Agency. 2016. Available online: **http://www.irena.org/DocumentDownloads/Publications/IRENA_IEAPVPS_End-of-Life_Solar_PV_Panels_2016.pdf** (accessed on 8 September 2018).
4. Kumar, A.; Holuszko, M.; Espinosa, D.C.R. E-waste: An overview on generation, collection, legislation and recycling practices. *Resour. Conserv. Recy.* **2017**, *122*, 32–42. [**Google Scholar**] [**CrossRef**]
5. Besiou, M.; Wassenhove, L.N. Closed-Loop Supply Chains for Photovoltaic Panels: A Case-Based Approach. *J. Ind. Ecol.* **2016**, *20*, 929–937. [**Google Scholar**] [**CrossRef**]

6. Jia, F.; Sun, H.; Koh, L. Global solar photovoltaic industry: An overview and national competitiveness of Taiwan. *J. Clean. Prod.* **2016**, *126*, 550–562. [**Google Scholar**] [**CrossRef**]
7. Olson, E.L. Green Innovation Value Chain analysis of PV solar power. *J. Clean. Prod.* **2014**, *64*, 73–80. [**Google Scholar**] [**CrossRef**] [**Green Version**]
8. Zobel, A.-K.; Balsmeier, B.; Chesbrough, H. Does patenting help or hinder open innovation? Evidence from new entrants in the solar industry. *Ind. Corp. Chang.* **2016**, *25*, 307–331. [**Google Scholar**] [**CrossRef**]
9. Overholm, H. Collectively created opportunities in emerging ecosystems: The case of solar service ventures. *Technovation* **2015**, *39*, 14–25. [**Google Scholar**] [**CrossRef**]
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11. Bustamante, M.L.; Gaustad, G. Challenges in assessment of clean energy supply-chains based on byproduct minerals: A case study of tellurium use in thin film photovoltaics. *Appl. Energy* **2014**, *123*, 397–414. [**Google Scholar**] [**CrossRef**]
(include important references & IPR survey)

8. Unique Selling proposition of Development

Unique Selling Proposition for development : **"EcoSmart Solar Dismantling: Pioneering Sustainable Solar Panel Recycling for a Greener Tomorrow."** the unique benefits of our service, emphasizing environmental sustainability, comprehensive service, compliance, cost-effectiveness, innovation, and a commitment to a sustainable future.

9. Outline of the Project

(*Define the problem and give technical details including schematics wherever necessary)*

The use of solar panels plays an important role in electricity usage as it solves the environmental and economic problems caused by the disposal of old solar panels. As electrical facilities continue to expand around the world, many solar panels will end their useful life and create waste in the coming years. seize opportunities and create hope for green jobs. By recycling panels, we save resources used to produce new panels, weaken the supply chain and reduce the need for raw materials. This type of panel consists of aluminum frame, glass, copper wire, polymer layer and backsheets, silicon solar cells and plastic junction box. The polymer layer protects the panel from the weather but can make reattaching and removing the panel difficult because the adhesive often requires warmth to loosen.

Most of these items are recyclable. Glass makes up most of the weight of the solar panel (about 75%), and glass recycling is an established industry. Other materials that are easy to recycle include aluminum frame s, copper wires and plastic containers.

The best recycling system will recover as much information as possible from solar panels. There are many ways to recycle solar panels; these may include some or all of the following three steps:

1. Removal of the frame and junction box;
2. Separation of the glass and the silicon wafer through thermal, mechanical or chemical processes; and/or
3. Separation and purification of the silicon cells and specialty metals (e.g., silver, tin, lead, copper) through chemical and electrical techniques.

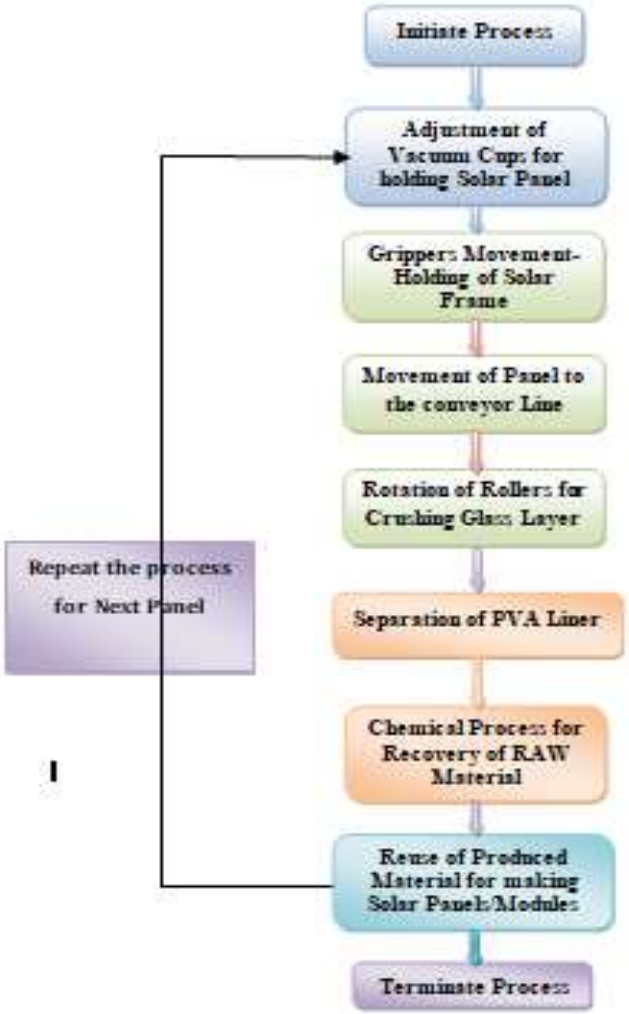


Fig. Flowchart for Dismantling Process Model

The heating process is based on air. First, the solar panel is slowly heated to 250 degrees Fahrenheit to separate the aluminum frame from the solar panel. The panel is heated to 480°C to separate the different la yers; these layers includean EVA front layer between the glass and the solar cellsand an EVA layer behind the solar cell.

The EVA layer was first destroyed at260 to 370 °C, releasing acetic acid. In the αposition relative to the te rtiary carbon. After heat treatment, no good cracks appear in the glass. Finally, tocollect the solar cells and copper wire. To dissolve all the metal and copper metal in the solar cells, we put them in a 5 M nitric acid solution for 1 hour at room temperature. The solution was stirred with a polytetrafluoroethylene stirring ba r at a speed of 200 rpm. To be more efficient, we removed Si, Cu, Ag, Pb and Al respectively. First,we ex plain the recycling process of Si and Al, and then the recycling process of other materials. We first explain the recovery processfor Si and Al and then that for the other elements. First, we applied a simple filtration process to obtain Si, because Si was in the form of a wafer or a broken wafer. The wafers contain impurities such as silicon nitride a constituent of the anti-reflection coating layer, and Al electrode in the rear contact. To recover the wafers, removing the SiNx, and Al electrode was necessary. The removal

process consists of two steps: (1) immersion of Si wafers in 90% phosphoric acid solution at 160 ^{0}C for 60 min to remove SiN_x, and (2) immersion of the Si wafers in 45% potassium hydroxide (KOH)solution at 80 °C for 10 min. Al recovery consists of two steps: (1) recovery of Al frame via a thermal process, the detachment step and (2) recovery ofAl in the form of aluminum hydroxide ($Al(OH)_3$) in potassium hydroxide (KOH) solution using simple filtration, followed by heating at 1200°C for 3 h. This process allowed easy recovery of aluminum oxide (Al_2O_3).Cu recovery involves three steps: (1) We used 20% LIX84-1 (2- hydroxy-S-nonyl acetophenone oxime) to extract Cu from the leaching solution. We then divided the solutions into two, one of which contains LIX84-I and Cu, and the other containing HNO_3 solution. (2) sulpuric acid concentration of 150 g/L to the LIX84-I fraction to strip the Cu.This step causes Cu to move from the LIX84-1 layer to the sulpuric acid solution by forming CuSO4. (3) We applied a 24 helectrowinning method to recover Cu metal, using 200 L of sulpuric acid solution containing 50 g/L of Cu at 50 ^{0} C.

Ag recovery consisted of five steps: (1) A 5 M HCl solution was added to the HNO_3, leaching solution containing Ag and Pb to precipitate AgCl, which was then simply filtered. (2) We transferred the AgCl precipitates to a 5 M sodium hydroxide (NaOH) solution at room temperature to obtain silver oxide (Ag_2O) . We used a hydrazine hydratesolution in distilled water and ethanol (2:1 volume ratio) .The resulting Ag powder of 1 g was transferred to Teflon beaker. The nitric acid of 20 mL was added into the Teflon beaker and followed by heating the sample to remove nitric oxide. The solution was transferred into a 50 mL volumetric flask. The solution was diluted with water to 50 mL. Four kinds of standards containing Ag were prepared.

Pb recovery consisted of three steps: (1) we 5 M NaOH solution to a leaching solution containing Pb 2+ ions at room temperature. Pb2+ reacted with OH in the solution, forming lead II hydroxide precipitate, which we then removed by Filtration. (2 Pb (OH) $_2$ was heated at 500^{0}C for 1 h to obtain lead oxide (PbO). added 5 M sodium sulfide solution to the HNO_3, solution to remove the remaining Pb in solution. This step led to precipitation of lead sulfide (PbS), which we removed by filtration.

Poly(ethylene-co-vinyl acetate) (EVA) is a widely used copolymer, built from ethylene (Et) and vinyl acetate (VAc) blocks, varying in physical and chemical properties depending on the mass ratio of the Et and VAc . Vinyl acetate block, a polar group, introduces the EVA copolymer amorphous phase and rubber-like character. It is responsible for certain properties such as flexibility, solubility in organic solvents and good adhesiveness, toluene and xylene are the best solvents to remove the EVA. The second series of tests were carried out using only toluene and optimizing the process after finding the optimal conditions: 60 °C, residence time less than 60 min, ultrasound, and no thermal pre-treatment. Or three solvents, including toluene, hexane, and benzene, at different time and temperature indicated that toluene showed great efficiency for EVA removal; around 72% can be recovered at 80 °C within 2 h, while hexane was observed to form hazardous compounds based on the gas chromatography.

Next, Fe_3O_4 particles (Fe_3O_4MPs) were synthesized via a solvothermal method, which were then coated with a thin layer of silica through a sol–gel process to obtain silica–Fe_3O_4composites (Fe_3O_4 @SiO_2 MPs).After that, the hydroxyl groups in Fe_3O_4@SiO_2MPs were hydrolyzed with siloxane groups in 3-(trimethoxysilyl)propyl methacrylate (3-MPS) to prepare 3-MPS-coated MPs. Subsequently, the unsaturated bonds in 3-MPS-coated MPs were co-polymerized with styrene/divinybenzen to prepare magnetic poly(styrene-divinylbenzene) microspheres (PSt-DVBMPs) in an aqueous suspension. After the final sulfonation process, the sulfonated magnetic microspheres (PSt-DVB-SNa MPs) were prepared as strong acid cation-exchange resin. Its removal ability for Cd and Te in the acid leaching solution was evaluated subsequently, and the adsorption properties of removal process were also clarified.After that a detailed study on the separation of valuable components in CIGS by pyrometallurgy. First, spent CIGS targets were oxidized and roasted in a tubular furnace. Studies showed that the selenium in CIGS targets could be separated when the roasting temperature exceeded 500°C, and almost all the selenium in CIGS targets was separated when the roasting temperature was 800°C for 1 h. The selenium dioxide obtained by volatilization and condensation can be reduced to high-purity selenium.

The reduction effects of the Riley reaction (an organic molecule was used as the reducing agent) and sulfur dioxide were compared, and the yield of selenium was 90.7% and 93.8%, respectively. The reduction effect of sulfur dioxide was more substantial, and the purity of selenium can reach 5N . This

approach should be reapplied in preparing solar-level materials.

10. **Deliverables of the project** *(Deliverables should include target performance and projected cost when Commercialized, and mention how these targets compare with existing national and international ones)*

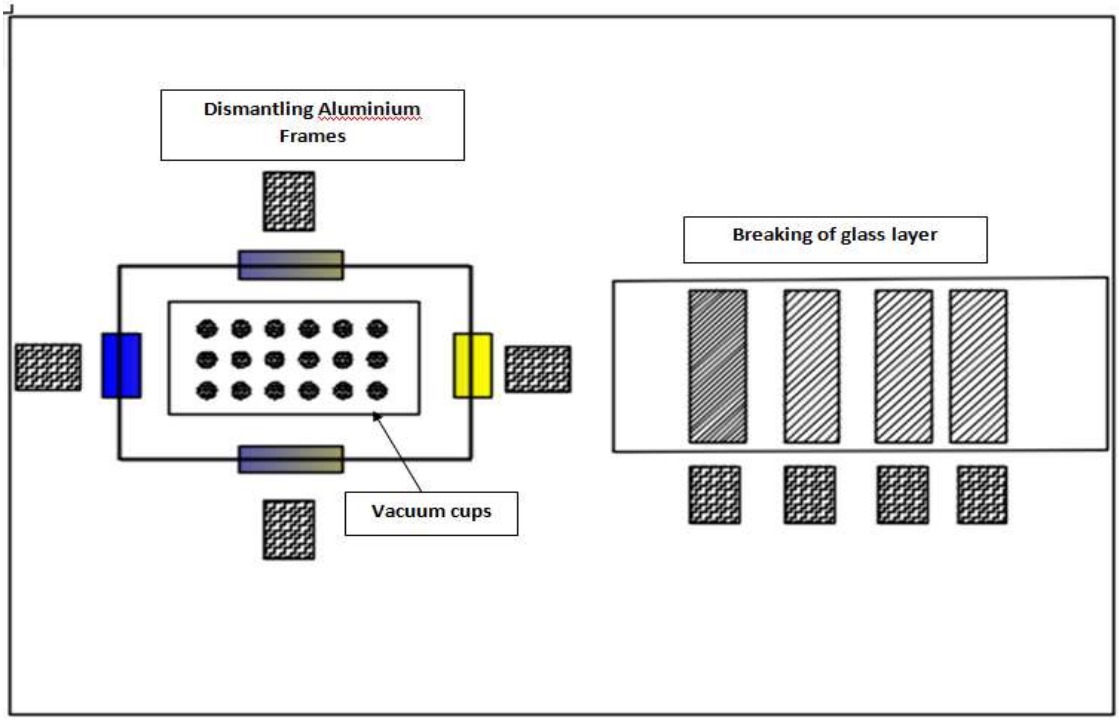
1. Flexibility in accommodating different numbers of EOL panel sizes and reducing overall processing costs with efficient material recovery and separation.
2. Provide end-to-end dismantling and recycling services for solar panels, including removal, transportation, and material recovery at a recovery rate of over 80%, significantly higher than the current global average of approximately 70%.
3. Controlling the environmental impact of the dismantling and recycling process with 30% carbon footprint reduction and waste diversion metrics compared to traditional disposal methods
4. Generating revenue through the sale of recovered materials such as silicon, glass, and metals for worth of Rs. 30,000- 45,000/- per ton of solar panels including the operational costs.
4. conduct training programs for 30 employees and 10 clients on best practices for solar panel dismantling and recycling per year.
5..Development of new products with recycled materials for industry requirements.
6.Improved processing efficiency for developing by-products from the recovered materials

11. Methodology

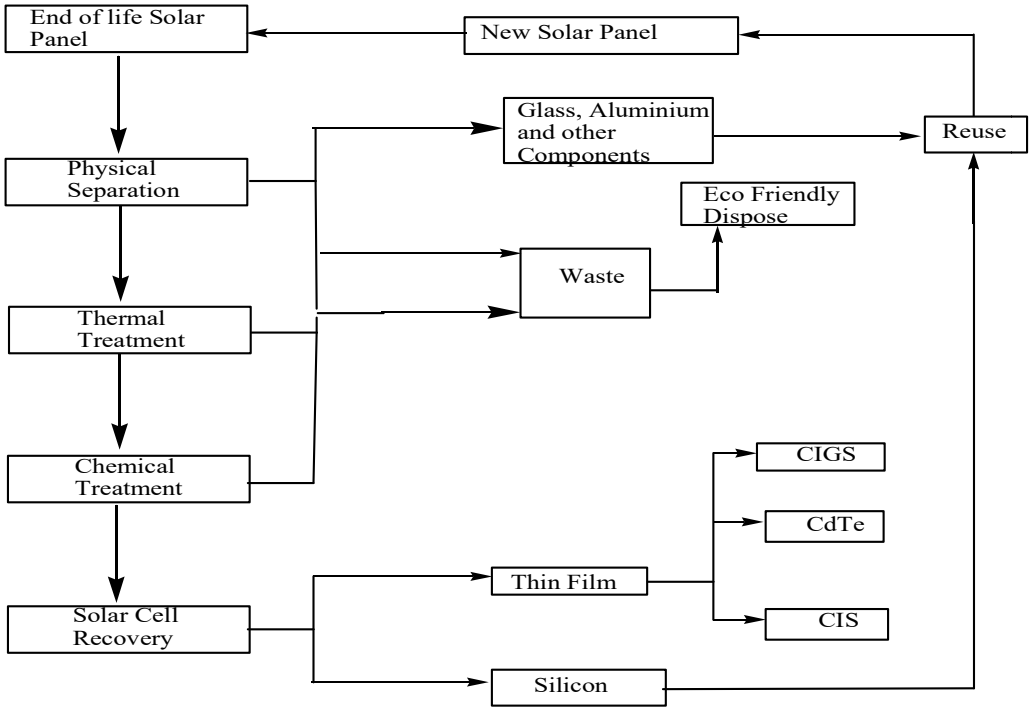
(This section should also include base work ready by the investigators, which is relevant to the project. The description of methodology should adequately demonstrate the pathways, main work element etc and highlight the capability of the investigators to work on base work

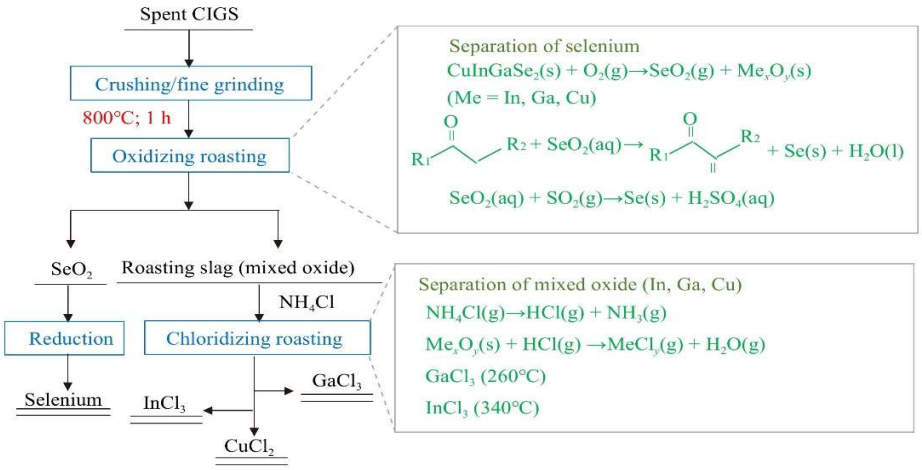
Methodology:

The dismantling process consists of actuators for removing the aluminum frame from the panel. Based on the panel size the vacuum cups are activated to hold the panel in aligned position. The actuators interfaced with the Stepper motors for optimized pulling force and holding accuracy.
The frames removed panels are further directed to the conveyor system which has a rollers fitted to press the panels for breaking the glass layer present on the panel. It passes through 4 rollers for complete removal of the glass. The remaining PVA sheet is passed for chemical processing

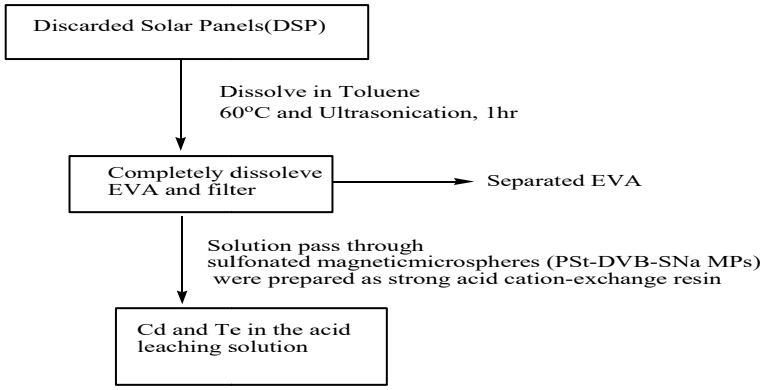


As depicted in figure there are three main categories of recycling methods utilized on solar PV panel as physical thermal and chemical methods flow.





Flow chart for process for dissolving metals



Process flow for raw metal recovery form solar cell

12. Work Plan (*mention project activities and Highlight Milestones)*

Sl no.	***Activity/Milestone***	***1st year***		***2nd year***		***3rd year***	
		1-6 M	***6-12 M***	***13-18 M***	***19-24 M***	***25-30 M***	***31-36 M***
A1	Recruitment of JRF, Project Associate and field worker and infrastructure setup, procurement of equipment						
A2	Fabrication , training for staff and establish operational work flow						
-	Installation ,collection of solar panels and testing						
	Dismantling of solar panels ,processing for dissolving materials						
	Developing of by-product from segregated materials and improving recycling technologies						
	Draft completion report for review, consulting and training services						

13. Names of 5 Experts/Agencies/ Institutions working in the similar area

(Please give complete Name, Designation, Email, Address with pin code, telephone number)

14. Any other information relevant to the Project proposal/ execution of the project

(Importance of the proposed R & D to India, Group strength, site details, economic analysis, Institutional Details etc)

Importance of the Proposed R&D to India

- **Environmental Impact:** India faces significant e-waste challenges, and solar panel waste is a growing concern. Developing efficient recycling methods reduces environmental pollution and conserves natural resources.
- **Sustainability Goals:** Supports India's commitment to renewable energy and

sustainability goals, contributing to the circular economy and reducing landfill waste.

- **Technological Advancement:** Promotes innovation in recycling technologies, positioning India as a leader in sustainable practices within the renewable energy sector.
- **Economic Benefits:** Creates new job opportunities and stimulates economic growth in the recycling and waste management industries.

Group Strength

- **Expertise:** The project team comprises experts in environmental science, chemical engineering, renewable energy, and waste management, ensuring a comprehensive approach to solar panel dismantling and recycling.
- **Experience:** Proven track record in managing large-scale recycling projects, with successful collaborations with government bodies and private sectors.
- **Innovation:** Strong focus on R&D with access to state-of-the-art laboratories and facilities, driving continuous improvement and technological advancement

Phase 1: Planning and Setup (0-6 months)

- Conduct feasibility studies and secure necessary permits and licenses.
- Finalize site selection and infrastructure setup.
- Procure and install dismantling and recycling equipment.
- Develop detailed project plans, including timelines and resource allocation.

Phase 2: Pilot Testing (6-12 months)

- Initiate pilot projects to test dismantling and recycling processes.
- Refine protocols based on pilot results, ensuring efficiency and safety.
- Train staff and establish operational workflows.

Phase 3: Full-Scale Operation (12-24 months)

- Launch full-scale dismantling and recycling operations.
- Implement marketing and outreach programs to attract clients.
- Monitor and evaluate project performance, making adjustments as needed.

Phase 4: Continuous Improvement and Expansion (24+ months)

- Invest in ongoing R&D to improve recycling technologies and processes.
- Expand capacity to handle increased volume of solar panels.
- Explore additional revenue streams, such as consulting and training services.

15. **Facilities and Infrastructure already available to the PI(s) at their Institute for Implementing the project**.

S.no	Equipment Name / Funding Source	For which purpose it would be utilised in current project

III. BUDGET ESTIMATES

Break-up of Total Budget

I. Funds requirement from DST All amount in lakh

Institute name in consortium	Capital Items (A) (Non- recurring) (Rs.)	Other items (B) Recurring head (Rs.)	Total (C = A+B) (Rs.)
	26925456	16264440	43189896
Total	26925456	16264440	43189896

II) Nature of Contribution from Collaborators, if any: Cash / Kind*(Please elaborate)*

III) Total cost = Rs. (DST) + Rs. (Cash amount provided by Collaborator, if any) = Rs.

Budget

(* To be given institution/ research group-wise in case of consortium projects)

Name of the Institute: Malla Reddy Engineering College

a) DST Support: 500 (All Amount in Lakh)

S. No	Item Head	1st Year	2nd Year	3rd Year	Total (Rs.)
A	**Non-recurring (Capital Items)**				
1	Permanent Equipment	5925456			5925456
2.	Plant cost /Fabricated systems/ Demonstration models	18500000	2500000		21000000
	Sub total (capital items)	24425456	2500000		26925456
B	**Recurring Items (General)**				
1.	Manpower	1971480	1971480	1971480	5914440
2.	Consumables	2800000	2000000	1500000	6300000
3.	Contingencies	400000	400000	400000	1200000
4.	Travel	550000	550000	550000	1650000
5.	Other Costs (Outsource work etc),if any				
6.	Overhead	400000	400000	400000	1200000
	Sub total (General)	6121480	5321480	4821480	16264440
C	**Total cost of the project (A+B)**	30546936	7821480	4821480	43189896

Details of Itemized Budget

(To be given separate for each institution/ research group-wise in case of consortium projects)*

Name of the Institute : Malla Reddy Engineering College

A. Non-recurring (Capital Items) A1. Equipment*

Budget for Permanent Equipment (To be borne by DST**)**

Description of Equipment	**Unit Landed Price (CIF+ Custom Duty/ Taxes + others charges etc)* (Rs.in lakh)**	**Nos. of Equipment**	**Total Cost (Rs. in lakh)**	**Justification in context of proposed work.**
A C motor	17700	10	1.77	For holding solar panels
Industrial Air compressor	413000	1	4.13	to provide a steady flow of compressed air for vacuum pump
Conveyer belt	472000	1	4.72	to move solar panels
Furnace	459728	2	9.19456	For melting
Double beam polarized atomic absorption Spectro photometer	3000000	1	3.0	To know the metal content both in qualitative and quantitate
		Gross total = 5.925456Lakhs		

Page/sheet indicating the total landed cost in Indian rupees(**Ensure to mention Currency Exchange rate considered in case of imported equipments, freight , taxes, spares, special installation, etc) **Please project the actual cost taking into account reliable cost estimates as no cost revision would be admissible***

A2. Fabrication system: Tailor made models/ experimental set up (if any)

i) Budget for Fabrication system/Tailor made items

Description of fabricated system	**Unit Landed Price (CIF+ Custom Duty+ others charges)* (Rs in lakh)**	**Nos. of Equipment**	**Total Rupees (Rs. in lakh)**	**Justification in context of proposed work**
Dismantling system	40	1	40	Removal of Aluminum frame
Crushing system	35	1	35	Removal of glass layer from solar panel
Chemical Processing system	7.5	10	75	Recovery of raw material from solar cells for recycling
	Gross total :150 **lakhs**			

Page/sheet indicating the total landed cost in Indian rupees(**Ensure to*

mention Currency Exchange rate considered in case of imported equipments, *freight , taxes, spares, special installation, etc)* ***Please project the actual cost taking into account reliable cost estimates as no cost revision would be admissible***

Recurring Items (General)

B1. Manpower

Designation*	**Educational Qualification**	**Experience in years, if applicable**	**Justification**
JRF	ME/M.Tech		Monitoring of project
Project Associate	ME/M.Tech		Responsible for monitoring of project
Field worker	Any degree/ Diploma/ITI	3 years	Provides an office with reports ,feed back on procedures products and operations

(*Emoluments shall be provided as per DST Guidelines for Research fellow, Research Scientist and Project Assistant .In case any special manpower is needed ,enclosed your Institute manpower order)

Manpower Budget

JRF /SRF/ Research Associates/ Project Assistants Details (applicable for the given category)

Designation	**Total Emoluments (in Rupees)**				**No. of persons**	**Total Amount (Rs.) (Inclusive of all Allowances)**
	1st Year	2nd Year	3rd Year	Total (1st +2nd+3rd Years)		
JRF (Rs. 31000 + 8% HRA)	401760	401760	401760	1205280	1	12,05,280
Project Associate (Rs. 31,000 + 27% HRA)	472440	472440	472440	1417320	1	14,17,320
Field Assistant (Rs. 18,000 + 27% HRA)	274320	274320	274320	822960	4	32,91,840
	Gross amount required for manpower budget head =					59,14,440

Please mention category/ class of city for admissible HRA along with %. _____

B2. Consumables

Budget for Consumable Materials (*To be borne by DST)*

Items	**Unit Price**	**Qty Needed**	**Amount (Rs. in lakh)**	**Justification**
Different Sensors, Grippers, Chemicals, Glass Box, Vacuum pump, Furniture's, Electrical Wiring and Control Accessories,	63	01	63	Items used exclusive in support of project objectives
Gross total = Rs 63 lakh				

B3. Contingencies

Budget for Contingencies (*To be borne by DST***)**

Items *(unforeseen expenses, patents,report preparations etc)*	**Amount (Rs. in lakh)**	**Justification**
unforeseen expenses, patents,report preparations etc	12	*Uncertainty and dependence on other future events for existence*
Total	**12 Lakhs**	

B4. Domestic Travel*

Budget for Domestic Travel (To be borne by DST**)**

Items (to attend)	**Total Amount**	**Detailed Justification (In case of extensive field visits needed in project indicating breakup of cost w.r.t. to journeys, mode and class of transport needed)**
Travel	12 lakhs	For purchasing of consumables, collecting the used solar panels
Review meetings	4.5 lakhs	To attend Review meetings
Total	**16.5 lakhs**	

(*) Foreign travel is generally not permitted under DST grants. Class and mode of transportation should be as per the entitlement of the concerned staff in the institute.

B5. Other Costs, if applicable

Budget for Other Costs (To be borne by DST**)**

Item	**Total (Rs. in lakh)**	**Detailed Justification (derived cost calculation and relevant Quotation at Annexure- / page no*)**
Overhead	12	
Other items,if any		
Gross total =	Rs. 12 **Lakhs**	

Principal Investigator(s) (PI)

a. Name : Dr.T.Venkata Deepthi

b. Gender : Female

c. Date of Birth:22-01-1983

d. E-mail ID:venkatadeepthi.t@gmail.com

e. Qualifications

S. No.	Degree	Institution	Year	Division/Class
1	Ph.D	K LUniversity	2021	
2	M.Tech	K LUniversity	2011	First
3	B.Tech	C R Reddy College of Engineering	2007	First

f. Employment Experience

S. No.	Position & Organisation	Nature of Job	Period
1	Associate Professor,Malla Reddy Engineering College	Teaching	2021-Till Date
2	Associate Professor, Narasaraopet Engineering College	Teaching	2020-2021
3	Associate Professor,Chebrolu Engineering College	Teaching	2015-2020
4	Assistant Professor,KLUniversity	Teaching	2009-2015
5	Assistant Professor& Sri Mittapalli college of Engineering	Teaching	2007-2009

g. **Selected List of Ten Best Publications** *(relevant to the proposed project)*

1.Conjugate Heat Transfer Analysis of a Rectangular Cooling Channel With different Orientation of Ribs-AIP Journal

2.Research on Performance of Multi-Skilled Workers for Sustainable Production Planning in Seru Production Systems. IJITEE – Vol 8 issue 10,Aug 2019

3.Investigating the performance improvement by conversion of assembly line configuration to a pure cell system in manufacturing industry—European Journal of Industrial Engineering (2019)

4. Reconfiguration of Networked Seru Production systems in an Indian Perspective--IEEE (2015)

5.Study on Parallel Robots and Its Applications International Journal Of Multidisciplinary Research And Advances In Engineering (IJMRAE) April 2012.

h. **Patents filed/Granted with details** *(relevant to the proposed project)*

1.Conjugate heat transfer analysis of a rectangular cooling channel
2.Effect of Eccentricity Ratio on Journal Trajectory in Three-Lobe Journal Bearing

i. **Books Published /Chapters contributed** ***(relevant to the proposed project)***

1.Energy Dissipation in WC-CO coated A3536.21/RHA composities
2.Design Automotive AC system using energy from an IC engine cycle
3.Fatigue Failure Analysis of Steam Turbine Shaft Using Fem Technique
4.Parametric Optimization & Analysis of PAM using Taguchi Techiniques,RSM

j. Sponsored Research Projects (last five years)

S. No	Title	Sponsoring Agency and Officer Concerned	Period	Amount	Achievements

i. Consultancy Projects (last five years)

S. No	Title	Sponsoring Agency	Period	Amount

ii. Sponsored Research/Consultancy Projects submitted for approval

S.No.	Title	Funding Agency	Duration	Amount

k. Awards and Honours:

A. National list
B. International list:

12 Technologies Developed / Transferred:

(please provide details of technologies transferred to industry, technologies commercialized)

Date : 15-07-2024 (Signature of PI)

KONERU LAKSHMAIAH EDUCATION FOUNDATION

(Deemed to be University)

Estd. u/s. 3 of the UGC Act, 1956
NAAC Accredited "A++" Grade

Aadhaar/Passport/Citizenship. : 4689 3536 6326

Faculty of Mechanical Engineering

Sl.No. : 125057

Regd No. : 13307006

By the authority of Board of Management

This is to certify that

Venkata Deepthi T

has been duly conferred the degree of

Doctor of Philosophy

he / she having been declared to be qualified to receive the same

Given under the seal of the University this day of Thirty First December Two Thousand and Twenty

Thesis Title: *Seru System for Productivity Enhancement and Sustainable Planning*

Vice - Chancellor

Co- Principal Investigator(s) (Co PI)

a. Name: Dr. Soumi Laha

b. Gender: Female

c. Date of Birth: 18-12-1977

d. E-mail ID: soumilaha@mrec.ac.in

e. Qualifications

S. No.	Degree	Institution	Year	Division/Class
1.	B.Sc	Visva-Barati University	1999	1st Division
2.	M.Sc	Visva-Barati University	2001	1st Division
3.	Ph.D	IICT, Hyderabad (Degree awarded by Jadavpur University)	2011	

f. Employment Experience

S. No.	Position & Organization	Nature of Job	Period
1.	Neuland Laboratories (P) Limited, Hyderabad	Assistant Manager	9/2009-6/2010
2.	Researcher (Post doc) (2 years 6 months) Institute Catala d'Investigacio Quimica (ICIQ) Av. Paissos Catalans, 16, 43007 Tarragona, Spain Research Group of Prof. M. A Pericas, Director ICIQ, Tarragona, Spain and Prof. Ricard G. Valls, URV, Tarragona, Spain.	Researcher	10/2011-04/2014
3.	University of Pennsylvania, USA Research Group of Prof. Patrick. J. Walsh, Department of Chemistry, University of Pennsylvania, Philadelphia, USA.	Postdoctoral Research Associate	15/05/13 - 15/08/13
4.	Indian Institute of Chemical Technology (IICT), Hyderabad, India.	DST-Woman Scientist	02/2016-03/2019
5.	Bulk Chemicals Process Development Indian Institute of Chemical Technology (IICT), India	Reseach Scientist	4/2019-5/2022
6.	Malla Reddy Engineering College	Associate Professor	2/2024- till now

g. **Selected List of Ten Best Publications** *(relevant to the proposed project)*

1. Pd-Catalyzed One-Pot Sequential Sonogashira Coupling and Dual Annulations Cascade for the Synthesis of Benzofuro[3,2- c]-Triazalo/Pyrrolo-Quinolines. Dipak B. Deokar, **Soumi Laha**, B. Sridhar, Dharmendra Kumar Tiwari, Pravin R. Likhar*Advanced Synthesis and Catalysis, Volume364, Issue22, 2022, 3867 3873. (Journal Impact Factor: 5.981)
2. Copper-Impregnated Magnesium-Lanthanum Mixed Oxide: A Reusable Heterogeneous Catalyst for Allylation of Aldehydes and Ketones. Jaya Pogula, **Soumi Laha**, Bojja Sreedhar, Pravin R. Likhar.* Advanced Synthesis and Catalysis 2020, 362, 5, 1176-1183. (Journal Impact Factor: 5.981)
3. Nano copper(0)-stabilized on alumina: Efficient and recyclable heterogeneous catalyst for Chemoselective synthesis of 1, 2-disubstituted benzimidazoles and quinoxalines in aqueous medium. Jaya Pogula, **Soumi Laha**, Pravin R. Likhar.* Catalysis Letters. 2017, 147, 2724-2735. (Journal Impact Factor: 2.936)
4. Multi-component Reaction for the Synthesis of Pyrido[1, 2-b]isoquinoline derivatives via [3+2] Cycloaddition Reaction between Alkynes and in situ Generated Isoquinoliumylides, Sundar S.Shinde, **Soumi Laha**, Dharmendra K.Tiwari, B. Sridhar, and Pravin R. Likhar, Org. Biomol. Chem., 2019, 17, 4121-4128. (Journal Impact Factor: 3.2)
5. Pd/Mg–La mixed oxide catalyzed oxidative sp2 C-H bond acylation with alcohols. R. Kishore, M. Lakshmi Kantam,, J. Yadav, M. Sudhakara, **Soumi Laha**, A. Venugopal, Journal of Molecular Catalysis A: Chemical 379, 213– 218, 2013. (Journal Impact Factor: 5.08)
6. Synthesis of 2-Indolyl-1-nitroalkane Derivatives Using Nanocrystalline Titanium(IV) Oxide. M. Lakshmi Kantam, **Soumi Laha**, Jagjit Yadav, and P. Srinivas. Synthetic Communications, 39: 4100–4108, 2009, (Journal Impact Factor: 1.937)
7. Nanocrystalline copper(II) oxide catalyzed aza-Michael and insertion of α-diazo compounds to N-H bonds of amines. M. Lakshmi Kantam, **Soumi Laha**, Jagjit Yadav and Shailendra Jha Tetrahedron Letters 50 (31), 4467-4469, 2009. (Journal Impact Factor: 2.032)
8. Synthesis of propargylamine by three-component coupling of aldehydes, amines and alkynes catalyzed by magnetically separable copper ferrite nanoparticles. M. Lakshmi Kantam, Jagjit Yadav, **Soumi Laha**, Sailendra Jha SYNLETT 11, 1791-1794, 2009. (Journal Impact Factor: 2.206)
9. Magnetically Recoverable and Reusable Copper Ferrite Nanoparticles as Catalyst for Asymmetric Hydrosilylation of ketones at Room Temperature. M. Lakshmi Kantam, Jagjit Yadav, **Soumi Laha**, P. Srinivas B. Sreedhar, F. Figures. Journal of Organic Chemistry; 74 (12), 4608-4611, 2009. (Journal Impact Factor: 3.6)
10. Nanocrystalline Magnesium Oxide-Stabilized Molybdenum: An Efficient Heterogeneous Catalyst for the Aerobic Oxidation of Alcohols to Carbonyl Compounds. M. Lakshmi Kantam, Jagjit Yadav, **Soumi Laha**, B. Sreedhar, S. Bhargava, Advanced Synthesis and Catalysis 350, 2575-2582, 2008. (Journal Impact Factor: 5.981)
11. An efficient synthesis of propargylamines via three-component coupling of aldehydes, amines and alkynes catalyzed by nanocrystalline copper (II) oxide. M. Lakshmi Kantam, **Soumi Laha**, Jagjit Yadav, S. Bhargava, Tetrahedron Letters 49, 19, 3083-3086, 2008. (Journal Impact Factor: 2.032)
12. An Efficient Copper−Aluminum Hydrotalcite Catalyst for Asymmetric Hydrosilylation of Ketones at Room Temperature. M. Lakshmi Kantam, **Soumi Laha**, Jagjit Yadav; P. R. Likhar, B. Sreedhar, S. Jha, S. Bhargava, M. Udayakiran, B. Jagadeesh, Organic Letters ; 10, 14, 2979 2982, 2008. (Journal Impact Factor: 5.2)
13. N-arylation of heterocycles with activated chloro- and fluoroarenes using nanocrystalline copper(II) oxide. M. Lakshmi Kantam, Jagjit Yadav, **Soumi Laha**, B. Sreedhar, S. Jha, Advanced Synthesis and Catalysis 349, 1938-1942, 2007. (Journal Impact Factor: 5.981)

14. Asymmetric hydrosilylation of prochiral ketones catalyzed by nanocrystalline copper(II) oxide. M. L. Kantam, **Soumi Laha**, Jagjit Yadav, P. R. Likhar, B. Sreedhar, B. M. Choudary, Advanced Synthesis and Catalysis 349, 1797-1802, 2007. (Journal Impact Factor: 5.981)
15. Friedel-Crafts alkylation of indoles with epoxides catalyzed by nanocrystalline titanium(IV) oxide. M. Lakshmi Kantam, **Soumi Laha**, Jagjit Yadav, B. Sreedhar, Tetrahedron Letters 47, 35, 6213-6216, 2006. (Journal Impact Factor: 2.032)
16. Nanocrystalline titanium(IV) oxide as an efficient heterogeneous catalyst for tandem Michael and nucleophilic 1,2-addition to enones. M. Lakshmi Kantam, **Soumi Laha**, Jagjit Yadav, B. M. Choudary, B. Sreedhar, Advanced Synthesis and Catalysis, 348, 867-872, 2006. (Journal Impact Factor: 5.981)
17. Expanded graphite as an electrode material for an alcohol fuel cell. A. Bhattacharya, A. Hazra, S. Chatterjee, P. Sen, **Soumi Laha**, I. Basumallick, Journal of Power Source 136, 208-210, 2004. (Journal Impact Factor: 9.2)
18. Improved Catalyst for Methanol Fuel Cell. P. Sen, **Soumi Laha**, I. N. Basumallick, Bulletin of Electrochemistry 20 (3) 125 128, 2004. (Journal Impact Factor: 1.777)

h. **Patents filed/Granted with details** *(relevant to the proposed project)*

1. ENHANCING EFFICIENCY THROUGH PHOTOVOLTAIC CELLS UTILIZING NANO-MATERIALS, Application No.202441037252 A, Publication Date : 17/05/2024

i. **Books Published /Chapters contributed** ***(relevant to the proposed project)***

None

j. Sponsored Research Projects (last five years)

S. No	Title	Sponsoring Agency andOfficer Concerned	Period	Amount	Achievements
1.	Design and Synthesis of Novel HeterogeneousN-Heterocyclic Carbene based Catalysts and theirApplications in Selective and Enantioselective OrganicTransformations	DST (WOS-A)	23/3/2016-23/3/2019	27,83,000/-	One publication

i. Consultancy Projects (last five years)

S. No	Title	Sponsoring Agency	Period	Amount

ii. Sponsored Research/Consultancy Projects submitted for approval

S.No.	Title	Funding Agency	Duration	Amount

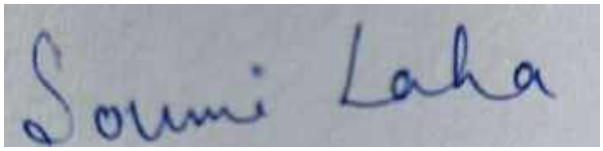
k. Awards and Honors:

A. National list:

- Junior Research Fellowship (CSIR-UGC based on national aptitude screening test conducted by Govt. of India) for the period of 2 years. January 2004 to January 2006.
- Senior Research Fellowship (CSIR-UGC based on national aptitude screening test conducted by Govt. of India) for the period of 3 years. February 2006 to January 2009.

B. International list:

12 Technologies Developed / Transferred:
(please provide details of technologies transferred to industry, technologies commercialized)



(Signature of Co-PI)

Date: 15.07.2024

Jadavpur University

Certified that

Smt. Soumi Laha

was awarded the Degree of Doctor of Philosophy in Science of the University on 17/01/2011 and that the degree was conferred on her/him at the Convocation held on December 2011 with all the rights and privileges thereto appertaining.

In Witness whereof the Signatures of the Vice-Chancellor of Jadavpur University is hereunto affixed.

JADAVPUR UNIVERSITY
The 24th December, 2011

Vice-Chancellor

Co- Principal Investigator

1. **Name : Dr.Deena Babu Mandru**
2. **Gender: Male**
3. **Date of Birth:05/07/1980**
4. **E-mail ID: dr.deenababumandru@mrec.ac.in**
5. **Qualifications:**

S. No.	Degree	Institution	Year	Division/Class
1	PhD	Krishna University, Machilipatnam, Andhra Pradesh	2019	--

Employment Experience

S. No.	Position & Organisation	Nature of Job	Period
1	Professor, Malla Reddy Engineering College (A) , Hyderabad, Telangana	Teaching, Administration and Research	2020 to Till Date
2	Malla Reddy Institute of Technology, Hyderabad, Telangana	Teaching	May, 2016 To June,2020
3	Narsimha Reddy Engineering College, Hyderabad, Telangana	Teaching	June, 2014 To May, 2016

7. **Selected List of Ten Best Publications** *(relevant to the proposed project)*

1. Gatla, "Optimizing Edge AI for Tomato Leaf Disease Identification", Eng. Technol. Appl. Sci. Res., vol. 14, no. 4, pp. 16061–16068, Aug. 2024.

2. Seshadri Ramana, K., Bala Chowdappa, K., Obulesu, O., Mandru, D. B., & Kallam, S. (2022). Deep convolution neural networks learned image classification for early cancer detection using lightweight. Soft Computing, 26(12), 5937-5943. Mandru, Deena Babu, et al. "Assessing deep neural network and shallow for network intrusion detection systems in cyber security." Computer Networks and Inventive Communication Technologies: Proceedings of Fourth ICCNCT 2021. Springer Singapore, 2022.

3. Mandru, Deena Babu. "A comparative study on Covid-19 cases in top 10 states/UTS of India in using machine learning models." Turkish Journal of Computer and Mathematics Education (TURCOMAT) 12.10 (2021): 4514-4524.

4. Madhusekhar, Y., Sandhya Priyanka, P., Mandru, D. B., & Srikanth, T. (2023). Blockchain: A Safe Way to Transfer Signatures in a Distributed Intrusion Detection System. In Intelligent Manufacturing and Energy Sustainability: Proceedings of ICIMES 2022 (pp. 261-273). Singapore: Springer Nature Singapore.

5. Vani, Meruva Sandhya, Rajupudi Durga Devi, and Deena Babu Mandru. "An Efficient Intrusion Detection Framework in Software-Defined Networking for Cyber Security Applications." Soft Computing and Signal Processing: Proceedings of 5th ICSCSP 2022 313 (2023): 461.

h. **Patents filed/Granted with details** *(relevant to the proposed project)*

A. International Patent/Grant:

1. *Published an Australian Patent entitled "A Classifier for Attack Detection in Cloud Environment and Data Computing for Smart Cities and Smart Healthcare System Using Internet of Things" with Patent Number: 2021101959 on 15 April 2021.*
2. *Published a German Patent entitled "Artificial Intelligence Based Approach to Analyze the Effective Means of Human Computer Interaction Interfaces" with Application Number 202022106410 (DE202022106410U1) on 26.01.2023.*

B. National Patents:

1. "A Method and a System for Emotion Recognition from a Speech" with Application No: 202041052252 on 11/12/2020.
2. "An Efficient MRF Models for Detection of Brain Abnormality Based on MR Images" with Application No:202041052994 on 11/12/2020
3. "Attendance System Using QR-Code", with Application No 202141060067A on 28/01/2022
4. "Artificial Intelligence Based Approach to Analyze the Effective Means of Human Computer Interaction Interfaces" with Application No 202241027909A on 03/06/2022.
5. "Cloud Based Smart System for Smart City" with Application No.202241058670A on 21/10/2022.
6. "Enhanced Polymeric Plywood" with Application No 202241075141A on 30/12/2022.

7. “The Special Kit” with Application No 202241075140A on 30/12/2022.
8. “Ground Personnel Monitoring Tool” with Application No 202341053971 on 01/09/2023.
9. “Real-time Bus Tracking System” with Application No 202341052795 on 01/09/2023.
10. “Code-chef Cards” with Application No 202341052794 on 01/09/2023.
11. “SecureShield (A Phishing Detection Solution using AI and Machine Learning)” with Application No 202341052796 on 01/09/2023.

i. **Books Published /Chapters contributed** ***(relevant to the proposed project)***

1. Published a book titled, **“OOP through JAVA”**, 1st Edition, ISBN No: 978-93-88096-12-6, Seven Hills International Publishers.
2. Published a Book titled **“ Data Science at Glance” ,Walnut Publications, with ISSN.No:** 978-93-55742-50-6, August-2022

j. Sponsored Research Projects (last five years)

S. No	Title	Sponsoring Agency and Officer Concerned	Period	Amount	Achievements

i. Consultancy Projects (last five years)

S. No	Title	Sponsoring Agency	Period	Amount

ii. Sponsored Research/Consultancy Projects submitted for approval

S.No.	Title	Funding Agency	Duration	Amount

K.Awards and Honours:

A. National list

B. International list:

12 Technologies Developed / Transferred:
(please provide details of technologies transferred to industry, technologies commercialized)

Date: (Signature of Co- PI)

Sl.No. 00005

13PHD/005/00005

KRISHNA UNIVERSITY

కృష్ణా విశ్వవిద్యాలయం

H.T.No : 1304PH101004
Aadhar No : 742651372382

Faculty of Engineering & Technology

Deenababu Mandru

S/o / D/o : Dharmarao
&
Mandru Sundaramma

Having Fulfilled the academic requirements in January-2020 has this day been admitted by the Executive Council to the Degree of

Doctor of Philosophy

In

COMPUTER SCIENCE AND ENGINEERING

For the Thesis entitled,

"ATTRIBUTE SIMILARITY-INDEX BASED ENHANCED FEATURE SELECTION MULTI-VIEW CLUSTERING APPROACH USEING MACHINE LEARNING TECHNIQUES "

Date of Viva-Voce : 02/01/2020

Given under the Seal of the University

విశ్వవిద్యాలయ అధికార ముద్రతో జారీచేయబడినది.

Dt. 06/11/2021

Machilipatnam,
A.P., India.
Pin: 521004

Vice-Chancellor

Co- Principal Investigator(s) (Co PI)

a. **Name: K. Sowjanya Naidu**
b. **Gender: Female**
c. **Date of Birth: 31-05-1989**
d. **E-mail ID: sowjanya.k31@gmail.com**
e. **Qualifications: B.Tech, M.Tech,(Ph.D)**

S. No.	Degree	Institution	Year	Division/Class
1	B.Tech	MVGR College of Engineering	2008	First
2	M.Tech	Andhra University College of Engineering	2010	First

g. Employment Experience

S. No.	Position & Organisation	Nature of Job	Period
1	Assistant Professor, Malla Reddy Engineering College	Teaching	June 2023 to Till date
2	Assistant Professor, Dr.L.B.College of Engineering	Teaching	June 2019 to May 2023
3	Assistant Professor, GVP College of engineering	Teaching	Aug 2015 to Dec 2018
4	Lecturer, JNTUK College of Engineering	Teaching	Aug 2010 to Feb 2013

h. **Selected List of Ten Best Publications** *(relevant to the proposed project)*

i. **Patents filed/Granted with details** *(relevant to the proposed project)*

j. **Books Published /Chapters contributed** ***(relevant to the proposed project)***

k. Sponsored Research Projects (last five years)

S. No	Title	Sponsoring Agency and Officer Concerned	Period	Amount	Achievements

ii. Consultancy Projects (last five years)

S. No	Title	Sponsoring Agency	Period	Amount

ii. Sponsored Research/Consultancy Projects submitted for approval

S.No.	Title	Funding Agency	Duration	Amount

k. Awards and Honours:

C. National list

D. International list:

12 Technologies Developed / Transferred:

(please provide details of technologies transferred to industry, technologies commercialized)

K. Sanjhan

Date

(Signature of PI)

0091720005

ANDHRA UNIVERSITY

FACULTY OF ENGINEERING

This is to certify that

Kaparapu Sowjanya Naidu

has been duly admitted to the Degree of Master of Technology in Computer Science & Technology in this University, he having been declared to have passed in the First Class with Distinction the Examination prescribed therefor held in October 2010.

Given under the Seal of the University

Visakhapatnam

The 26th November 2011.

Registrar

Co- Principal Investigator(s) (Co PI)

a. Name : Kesava Vamsi Krishna Vajjala
b. Gender : Male
c.Date of Birth :29 – 05 – 1979
d:E-mail ID:mrecphysics@gmail.com
e :Qualifications:M. Sc., M. Phil.

S. No.	Degree	Institution	Year	Division/Class
1	M. Phil.	Sri Venkateswara University	2018	First
2	M. Sc.	Sri Venkateswara University	2002	First
3	B. Sc.	Sri Venkateswara University	1999	First

h. Employment Experience

S. No.	Position &Organisation	Nature of Job	Period
1	Associate Professor, Malla Reddy Engineering College Hyderabad	Teaching	2009 – till date
2	Assistant Professor, Malla Reddy Engineering College Hyderabad	Teaching	2004 – 2009
3	Lecturer in Physics, New Nobel Degree College, Hyderabad	Teaching	2003 – 2004
4	Lecturer in Physics, Vagdevi Degree College, Proddatur	Teaching	2002 - 2003

i. **Selected List of Ten Best Publications** *(relevant to the proposed project)*

f. Suitability of Sb-doped SnS thin films for PV applications, synthesized chemically, Kesava Vamsi Krishna V., et al, European Chemical Bulletin 2023,12(issue 8), 9489-9497.

g. Chemically synthesized Cu-doped SnS thin films for PV applications, Kesava Vamsi Krishna V., et al, Journal of Propulsion Technology, Vol 44, Issue 4 (2023).

j. **Patents filed/Granted with details** *(relevant to the proposed project)*

k. **Books Published /Chapters contributed** ***(relevant to the proposed project)***

i. **Book chapter titled 'Thin film deposition by Chemical Bath Deposition method' got published in the book titled 'Advances in Renewable energy engineering Vol – 5', published by Akinik publications.**

ii. **Book chapter titled 'Preparation and characterization of carbon black reinforced natural rubber composite materials' got published in the book titled 'Emerging trends in scientific research Vol – 2' published by Integrated Publications.**

l. Sponsored Research Projects (last five years) **Not Applicable**

S. No	Title	Sponsoring Agency and Officer Concerned	Period	Amount	Achievements

iii. Consultancy Projects (last five years) **Not Applicable**

S. No	Title	Sponsoring Agency	Period	Amount

iii. Sponsored Research/Consultancy Projects submitted for approval
Not Applicable

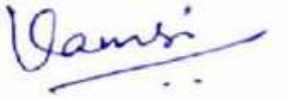
S.No.	Title	Funding Agency	Duration	Amount

l. Awards and Honours:

E. National list

F. International list:

12 Technologies Developed / Transferred: **Not Applicable**
(please provide details of technologies transferred to industry, technologies commercialized)



Date (Signature of PI)

Disposal No. B IX/ M.Phil./20 18 Register No. 2421603003

SRI VENKATESWARA UNIVERSITY

Sl.No. 4312

PROVISIONAL CERTIFICATE

This is to certify that Sri/Smt. Kesava Vamsi Krishna V

has qualified himself / herself for the Degree of Master of Philosophy he/she having passed in the First *class the M. Phil. Degree Examination held in* October *20*16 *in* Physics *and that he / she has done all that is necessary for the formal presentation for the Degree of Master of Philosophy.*

TIRUPATI – 517 502

Dated 11 JUN 2018

K. Prattia
CONTROLLER OF EXAMINATIONS
Assistant Administrative Officer (Exams)
Sri Venkateswara University

Written by: Compared by: Supdt.:

CERTIFICATE FROM THE INVESTIGATOR(S)

Project Title: : Design and Development of sustainable dismantling PV solar modules with eco-friendly chemical processing for material recovery

1. I/We have carefully read the terms and conditions of the Clean Energy Research Initiative (CERI) Programme and I/We agree to abide by them.
2. I/We have not submitted this or a similar Project proposal elsewhere for financial support.
3. I/We have explored and ensured that the equipment and the basic facilities described in the Research Proposal, will actually be available as and when required for the purpose of the Project. I/We shall not request financial support under this project, for procurement of these items.
4. I/We undertake that spare or idle capacity of the permanent equipment procured under the project will be made available to other legitimate users from parent and other organizations.
5. I/We have enclosed the following :

A Endorsement from the Heads of the Institution
(on letter head)

B Undertaking for the Collaborator(s)
(on letter head)

C Complete Project Proposal with all enclosures

Date 15/7/2024
Place Hyderabad

Dr. T. Venkata Deepthi

Name(s) and Signature(s) of the Investigators*

(To be signed by PI and Co-PI of each Participating Institution)

1. Dr. Soumi Laha — Slaha
2. Dr. Deena Babu Mandru
3. K. Sowjanya Naidu — K. Sl
4. KESAVA VAMSI KRISHNA V. — Vamsi

ENDORSEMENT FROM THE HEAD OF THE ORGANISATION

Project Title : Design and Development of sustainable dismantling PV solar modules with ecofriendly chemical processing for material recovery

1. Certified that the organization welcomes the participation of Dr T Venkata Deepthi as The PI and Dr. Soumi Laha, Dr. Deeenababu Mandru, Mrs K. Sowjnya Naidu and Kesava Vamsi Krishna Vajjala as the Co-PI for the project and that in the unforseen and legitimate event of discontinuation by the PI, the Co-PI will assume full responsibility for completion of the project. Information to this effect, endorsed by me, will be promptly sent to the DST
2. Certified that the equipment, other basic facilities and other administrative facilities as per the terms and conditions of the award of the Project, will be extended to the investigator(s) through out the duration of the project
3. The Organization shall ensure that financial and purchase procedures are followed as per the prevailing norms of the organization, with in the allocated budget.
4. The Organization shall provide timely the Statement of Expenditure and the Utilisation Certificate of the grant as required by the DST in the prescribed format.
5. The grant for the proposal, if approved, the funds shall be transferred to following organization account:

1	Name of A/c holder (as Per Bank record)	Principal, Malla Reddy Engineering College
2	Bank Account No.	769401000078
3	Bank Branch Name &Address	ICICI Bank Ltd, MREC Campus, Admin Block, Maisammaguda, Gundla Pochampally, Medchal-Malkajgiri Dist.
4	MICR Code	**500229130**
5	IFSC Code	ICIC0007694
6	E-mail (Agency/PI)	principal@mrec.ac.in
7	Mobile No.(Agency/PI)	9348161125
8	Unique agency code*	

Date:15.07.24
Place: Hyderabad

Malla Reddy Engg. College (A) 500 100 Hyderabad

(Head of the Institute)
Seal/Stamp

Principal
Malla Reddy Engineering College
Maisammaguda, Dhulapally,
(Post Via Kompally), Sec-bad-500

VIII. Terms& Conditionsofthe Grant

1. Approval of the Research Proposal and the grant released for it is for the specific Projectsanctioned and the released grant should be exclusively spent on the Project within thestipulatedperiod.TheInstitutionmayusefundsobtainedfromanyotherOrganisationwiththe concurrence of DST, for the Project. **Any un-spent balance out of the amountsanctionedmustbesurrenderedtotheGovernmentofIndiabydepositinginbharat kosh accountbyusing link**(www.bharatkosh.gov.in)
2. For permanent, semi-permanent assets acquired solely or mainly out of the project grant,an audited record in the form of a register shall be maintained by the Institute. The term"Assets" include (a) the immovable property acquired out of the grant; and (b) movableproperty of capital nature where the value exceeds Rs 1000/-. The Institute is required tosend to the Department of Science & Technology a list of Assets acquired from the grant.The grant shall not be utilised for construction of any building unless specific provision ismade for that purpose. Full infrastructural facilities by way of accommodation, water,electricity,communication,etc.forsmoothimplementationoftheprojectshallbeprovide dbytheInstitute.
3. AlltheAssetsacquiredfromthegrantwillbethepropertyoftheGovernmentofIndiaandshouldno tbedisposedofforencumberedorutilisedforpurposesotherthanthoseforwhichthegrant had been sanctioned,without the prior sanction ofthe DST.
4. At the conclusion/ termination of the project, the Government of India will be free to sellorotherwisedisposeofftheAssetswhicharethepropertyoftheGovernment.TheInstitutesha ll render to the Government necessary facilities for arranging the sale of these assets.The Government of India has the discretion to gift the Assets to the Institutions or transferthemto anyotherInstitution if it isconsidered appropriate.
5. The Institution/ PI will furnish Half Yearly Progress Report(5 copies) of the work on theProject on half-yearly basis (i.e. if the date of start of a project is 12.09.20 the first SixMonthly Technical Progress report shall be for the period 12.09.20 to 31.03.21, the nextwill be from 01.04.20 to 30.09.20 and so on). In addition, the DST may designate aScientist/ Specialist or an Expert Panel to visit the Institution periodically to review theprogressoftheworkbeingcarriedoutandtosuggestsuitablemeasurestoensurerealisationof the objectives of the Project. During the implementation of the Project the Institutionwill provide all facilities to the visiting scientist/ specialist or the Expert Panel by way ofaccommodation,etc.atthetimeoftheirvisit.Incaseofexceptionalcircumstances,requestfor extension for time period must be submitted to DST six months prior to the approveddate of completion of the project. On completion of the Project, submit the final statementof Expenditure along with utilization certificate and ten copies of self-contained ProjectCompletionReport as per DST format.
6. At the time of seeking further instalment of the grant, The Institution/ PI has to furnishthefollowingdocuments:
   a) StatementofExpenditure(SE)andUtilisationCertificate(UC)forfinancialyearupto31st March (in original orcopyif sent earlier)
   b) Anauthenticatedup-to-dateStatementofExpenditureincludingCommittedExpenditureforthe Project on thedate ofseekingfurtherinstalment.
7. Request for specific approval of the Department to **carry forward** the unutilised grant tothe next financial year for utilisation for the same Project, should be sent along with SE &UC,after completion ofthefinancialyear.

8. Selection of Manpower, Sanctioned for Project will be done as per Govt. norms and onerepresentativefromDST shallbenominated intheSelectionCommitteeas anobserver.

9. **The Comptroller & Auditor General of India, at his discretion, shall have the right of access to the books and accounts of the Institution maintained in respect of the grant received from the Government of India.**

10. The Institution will maintain separate audited accounts for the Project. If it is foundexpedienttokeepapartorwholeofthegrantinabankaccountearninginterest,theinterestth us earned should be reported to the DST and should be reflected in the Statement ofExpenditure.

11. The Institution will not entrust the implementation of the work (except the out-sourcedpart as approved) for which the grant is being sanctioned to any other institution nor willit divert the grant receipts to other institutions as assistance. In case the Institution is notin a position to implement or complete the Project, it should refund back to the DST theentiregrant received byit or thebalance grant thru**BharatkoshPortal.**

12. PIs/granteeorganizationswillensurethatprocurementprocessinsuchcasesarecompletedwithi n the same financial year as specified in the sanction , provided that grant is releasedat least 8 Months prior to the close of financial year. Carry forward of such capital grantwill be permitted only for Immediate succeeding financial year with the approval of DSTonly.

13. PIs / Institute must ensurethatall interest gained on unspent balance inboth heads willbe deposited to Government of India account in bharatkosh by usinglink(www.bharatkosh.gov.in)beforeissuingUC/SEfor releasingofnextInstallment.

14. In no case inter head expenditure will permitted and PIs/Institute must ensure be adhere tomakeexpenditureaccordinglyas per sanction issued.

15. All the personnel including Research personnel appointed under the project, for the full/partdurationoftheproject,aretobetreatedastemporaryemployeesandwillbegovernedbyth eAdministrativerules/serviceconditions(forleave,TA/DAetc)oftheimplementingInstitute. They are not to be treated as employees of the Government of India and the DSTwill have no liability, whatsoever, for the project staff after the completion of the Projectduration. For the expeditious implementation of the research Project, the PI will take theassistance of the Institution in the process of selection and appointment of staff andpayment to them. Scale and emoluments for the posts not covered under DST's OM aregoverned by the norms prevalent in the implementing Institution or as agreed upon inconsultationwith the DST.

16. **The DST reserves the right to terminate the project at any stage if it is convinced that the grant has not been properly utilised or satisfactory progress is not being made.**

17. **The Project becomes operative with effect from the date on which the ECS/Draft/Cheque is received by the implementing Institution.**This date should be intimated bytheInstitutionauthorities/PrincipalInvestigatortotheDST.*Itwill,innocasebelaterthanonem onth after the receipt of thedraft/ chequebythe Institution.*

18. If the Principal Investigator (PI) to whom a grant for a project has been sanctioned wishestoleavetheInstitutionwheretheprojectisbased,thePI/InstitutionwillinformtheDSTofth e same at least 6 months before in advance with suitable justification and reasons and inconsultation with the DST, evolve steps to ensure successful completion of the Project,beforethePIisrelieved.

19. Thedatapertainingtotheprojectshouldbesystematicallycollected,scientificallydocumented and submitted to DST which later would be placed in public domain. Thisclause would not be applicable for the projects where legal protection of the know–howgeneratedis felt necessary.

20. Investigators wishing to publish technical/ scientific papers based on the research workdoneundertheprojectshouldacknowledgetheassistancereceivedfromtheDST,indicating the scheme. Investigators are expected to publish some of the research papersemergingout of theProject work in leadingIndianJournals.

21. If the results of research are to be legally protected, the results should not be publishedwithout securing legal protection for the research results. For projects identified to have adistinct potential for generating know-how, in the form of product/ process, that could beprotectedthroughpatenting,copyrightsetc.,thePIshouldcarefullyfollowthe"**Guidelines/ Instructions for Technology Transfer and Intellectual Property Rights"**provided in the **Guidelines for Implementing Research Projects**booklet issued by theDST. [http://www.tifac.org.in] For further information/ clarification on this subject- TheDirector, Technology Information, Forecasting and Assessment Centre (TIFAC), AI Block, 5th Floor, Technology Bhawan, New Mehrauli Road,NewDelhi-110016, E-mail:tifac@nda.vsnl.net.in, maybecontacted.

DEPARTMENT OF SCIENCE AND TECHNOLOGY
POLICY ON CONFLICT OF INTEREST

FOR APPLICANT

Issues of Conflicts of Interest and ethics in scientific research and research management have assumed greater prominence, given the larger share of Government funding in the country's R & D scenario. The following policy pertaining to general aspects of Conflicts of Interest and code of ethics, are objective measures that is intended to protect the integrity of the decision making processes and minimize biasness. The policy aims to sustain transparency, increase accountability in funding mechanisms and provide assurance to the general public that processes followed in award of grants are fair and non-discriminatory. The Policy aims to avoid all forms of bias by following a system that is fair, transparent and free from all influence/ unprejudiced dealings, prior to, during and subsequent to the currency of the programme to be entered into with a view to enable public to abstain from bribing or any corrupt practice in order to secure the award by providing assurance to them that their competitors will also refrain from bribing and other corrupt practice and the decision makers will commit to prevent corruption, in any form, by their officials by following transparent procedures. This will also ensure a global acceptance of the decision making process adopted by DST.

Definition of Conflict of Interest:

Conflict of Interest means "any interest which could significantly prejudice an individual's objectivity in the decision making process, thereby creating an unfair competitive advantage for the individual or to the organization which he/she represents". The Conflict of Interest also encompasses situations where an individual, in contravention to the accepted norms and ethics, could exploit his/her obligatory duties for personal benefits.

1. **Coverage of the Policy:**

a) The provisions of the policy shall be followed by persons applying for and receiving funding from DST, Reviewers of the proposal and Members of Expert Committees and Programme Advisory Committees. The provisions of the policy will also be applicable on all individuals including Officers of DST connected directly or indirectly or through intermediaries and Committees involved in evaluation of proposals and subsequent decision making process.

b) This policy aims to minimize aspects that may constitute actual Conflict of Interests, apparent Conflict of Interests and potential Conflict of Interests in the funding mechanisms that are presently being operated by DST. The policy also aims to cover, although not limited to, Conflict of interests that are Financial (gains from the outcomes of the proposal or award), Personal (association of relative / Family members) and Institutional (Colleagues, Collaborators, Employer, persons associated in a professional career of an individual such as Ph.D. supervisor etc.)

2. **Specifications as to what constitutes Conflict of Interest.**

Any of the following specifications (non-exhaustive list) imply Conflict of Interest if,

(i) Due to any reason by which the Reviewer/Committee Member cannot deliver fair and objective assessment of the proposal.

(ii) The applicant is a directly relative# or family member (including but not limited to spouse, child, sibling, parent) or personal friend of the individual involved in the decision making process or alternatively, if any relative of an Officer directly involved in any decision making process / has influenced interest/ stake in the applicant's form etc.

(iii) The applicant for the grant/award is an employee or employer of an individual involved in the process as a Reviewer or Committee Member; or if the applicant to the grant/award has had an employer-employee relationship in the past three years with that individual.

(iv) The applicant to the grant/award belongs to the same Department as that of the Reviewer/Committee Member.

(v) The Reviewer/Committee Member is a Head of an Organization from where the applicant is employed.

(vi) The Reviewer /Committee Member is or was, associated in the professional career of the applicant (such as Ph.D. supervisor, Mentor, present Collaborator etc.)

(vii) The Reviewer/Committee Member is involved in the preparation of the research proposal submitted by the applicant.

(viii) The applicant has joint research publications with the Reviewer/Committee Member in the last three years.

(ix) The applicant/Reviewer/Committee Member, in contravention to the accepted norms and ethics followed in scientific research has a direct/indirect financial interest in the outcomes of the proposal.

(x) The Reviewer/Committee Member stands to gain personally should the submitted proposal be accepted or rejected.

The Term "Relative" for this purpose would be referred in section 6 of Companies Act, 1956.

3. Regulation:

The DST shall strive to avoid conflict of interest in its funding mechanisms to the maximum extent possible. Self-regulatory mode is however recommended for stake holders involved in scientific research and research management, on issues pertaining to Conflict of Interest and scientific ethics. Any disclosure pertaining to the same must be made voluntarily by the applicant/Reviewer/Committee Member.

4. Confidentiality:

The Reviewers and the Members of the Committee shall safeguard the confidentiality of all discussions and decisions taken during the process and shall refrain from discussing the same with any applicant or a third party, unless the Committee recommends otherwise and records for doing so.

5. Code of Conduct

(a) The applicant must refrain from suggesting referees with potential Conflict of Interest that may arise due to the factors mentioned in the specifications described above in Point No. 2.

(b) The applicant may mention the names of individuals to whom the submitted proposal should not be sent for refereeing, clearly indicating the reasons for the same.

6. Final Appellate authority:

Secretary, DST shall be the appellate authority in issues pertaining to conflict of interest and issues concerning the decision making process. The decision of Secretary, DST in these issues shall be final and binding.

7. Declaration

I have read the above "Policy on Conflict of Interest" of the DST applicable to Applicant and agree to abide by provisions thereof.

I hereby declare that I have no conflict of interest of any form pertaining to the proposed grant *

I hereby declare that I have conflict of interest of any form pertaining to the proposed grant *

* & # (Tick whichever is applicable)

Dr. T. Venkata Deepthi

(Name /Signature with date) 15/7/24

Principal Investigator(s) (PI)

a. Name : Dr.T.Venkata Deepthi

b. Gender : Female

c. Date of Birth:22-01-1983

d. E-mail ID:venkatadeepthi.t@gmail.com

e. Qualifications

S. No.	Degree	Institution	Year	Division/Class
1	Ph.D	K LUniversity	2021	
2	M.Tech	K LUniversity	2011	First
3	B.Tech	C R Reddy College of Engineering	2007	First

f. Employment Experience

S. No.	Position & Organisation	Nature of Job	Period
1	Associate Professor,Malla Reddy Engineering College	Teaching	2021-Till Date
2	Associate Professor, Narasaraopet Engineering College	Teaching	2020-2021
3	Associate Professor,Chebrolu Engineering College	Teaching	2015-2020
4	Assistant Professor,KLUniversity	Teaching	2009-2015
5	Assistant Professor& Sri Mittapalli college of Engineering	Teaching	2007-2009

g. **Selected List of Ten Best Publications** *(relevant to the proposed project)*

1.Conjugate Heat Transfer Analysis of a Rectangular Cooling Channel With different Orientation of Ribs-AIP Journal

2.Research on Performance of Multi-Skilled Workers for Sustainable Production Planning in Seru Production Systems. IJITEE – Vol 8 issue 10,Aug 2019

3.Investigating the performance improvement by conversion of assembly line configuration to a pure cell system in manufacturing industry—European Journal of Industrial Engineering (2019)

4. Reconfiguration of Networked Seru Production systems in an Indian Perspective--IEEE (2015)

5.Study on Parallel Robots and Its Applications International Journal Of Multidisciplinary Research And Advances In Engineering (IJMRAE) April 2012.

h. **Patents filed/Granted with details** *(relevant to the proposed project)*

1.Conjugate heat transfer analysis of a rectangular cooling channel
2.Effect of Eccentricity Ratio on Journal Trajectory in Three-Lobe Journal Bearing

i. **Books Published /Chapters contributed** ***(relevant to the proposed project)***

1.Energy Dissipation in WC-CO coated A3536.21/RHA composities
2.Design Automotive AC system using energy from an IC engine cycle
3.Fatigue Failure Analysis of Steam Turbine Shaft Using Fem Technique
4.Parametric Optimization & Analysis of PAM using Taguchi Techiniques,RSM

j. Sponsored Research Projects (last five years)

S. No	Title	Sponsoring Agency and Officer Concerned	Period	Amount	Achievements

i. Consultancy Projects (last five years)

S. No	Title	Sponsoring Agency	Period	Amount

ii. Sponsored Research/Consultancy Projects submitted for approval

S.No.	Title	Funding Agency	Duration	Amount

k. Awards and Honours:

A. National list
B. International list:

12 Technologies Developed / Transferred:

(please provide details of technologies transferred to industry, technologies commercialized)

Date : 15-07-2024 (Signature of PI)

KONERU LAKSHMAIAH EDUCATION FOUNDATION

(Deemed to be University)

Estd. u/s. 3 of the UGC Act, 1956
NAAC Accredited "A++" Grade

Aadhaar/Passport/Citizenship. : 4689 3536 6326

Faculty of Mechanical Engineering

Sl.No. : 125057

Regd No. : 13307006

By the authority of Board of Management

This is to certify that

Venkata Deepthi T

has been duly conferred the degree of

Doctor of Philosophy

he / she having been declared to be qualified to receive the same

Given under the seal of the University this day of Thirty First December Two Thousand and Twenty

Thesis Title: *Seru System for Productivity Enhancement and Sustainable Planning*

Vice - Chancellor

Co- Principal Investigator(s) (Co PI)

a. Name: Dr. Soumi Laha

b. Gender: Female

c. Date of Birth: 18-12-1977

d. E-mail ID: soumilaha@mrec.ac.in

e. Qualifications

S. No.	Degree	Institution	Year	Division/Class
1.	B.Sc	Visva-Barati University	1999	1st Division
2.	M.Sc	Visva-Barati University	2001	1st Division
3.	Ph.D	IICT, Hyderabad (Degree awarded by Jadavpur University)	2011	

f. Employment Experience

S. No.	Position & Organization	Nature of Job	Period
1.	Neuland Laboratories (P) Limited, Hyderabad	Assistant Manager	9/2009-6/2010
2.	Researcher (Post doc) (2 years 6 months) Institute Catala d'Investigacio Quimica (ICIQ) Av. Paissos Catalans, 16, 43007 Tarragona, Spain Research Group of Prof. M. A Pericas, Director ICIQ, Tarragona, Spain and Prof. Ricard G. Valls, URV, Tarragona, Spain.	Researcher	10/2011-04/2014
3.	University of Pennsylvania, USA Research Group of Prof. Patrick. J. Walsh, Department of Chemistry, University of Pennsylvania, Philadelphia, USA.	Postdoctoral Research Associate	15/05/13 - 15/08/13
4.	Indian Institute of Chemical Technology (IICT), Hyderabad, India.	DST-Woman Scientist	02/2016-03/2019
5.	Bulk Chemicals Process Development Indian Institute of Chemical Technology (IICT), India	Reseach Scientist	4/2019-5/2022
6.	Malla Reddy Engineering College	Associate Professor	2/2024- till now

g. **Selected List of Ten Best Publications** *(relevant to the proposed project)*

1. Pd-Catalyzed One-Pot Sequential Sonogashira Coupling and Dual Annulations Cascade for the Synthesis of Benzofuro[3,2- c]-Triazalo/Pyrrolo-Quinolines. Dipak B. Deokar, **Soumi Laha**, B. Sridhar, Dharmendra Kumar Tiwari, Pravin R. Likhar*Advanced Synthesis and Catalysis, Volume364, Issue22, 2022, 3867 3873. (Journal Impact Factor: 5.981)
2. Copper-Impregnated Magnesium-Lanthanum Mixed Oxide: A Reusable Heterogeneous Catalyst for Allylation of Aldehydes and Ketones. Jaya Pogula, **Soumi Laha**, Bojja Sreedhar, Pravin R. Likhar.* Advanced Synthesis and Catalysis 2020, 362, 5, 1176-1183. (Journal Impact Factor: 5.981)
3. Nano copper(0)-stabilized on alumina: Efficient and recyclable heterogeneous catalyst for Chemoselective synthesis of 1, 2-disubstituted benzimidazoles and quinoxalines in aqueous medium. Jaya Pogula, **Soumi Laha**, Pravin R. Likhar.* Catalysis Letters. 2017, 147, 2724-2735. (Journal Impact Factor: 2.936)
4. Multi-component Reaction for the Synthesis of Pyrido[1, 2-b]isoquinoline derivatives via [3+2] Cycloaddition Reaction between Alkynes and in situ Generated Isoquinoliumylides, Sundar S.Shinde, **Soumi Laha**, Dharmendra K.Tiwari, B. Sridhar, and Pravin R. Likhar, Org. Biomol. Chem., 2019, 17, 4121-4128. (Journal Impact Factor: 3.2)
5. Pd/Mg–La mixed oxide catalyzed oxidative sp2 C-H bond acylation with alcohols. R. Kishore, M. Lakshmi Kantam,, J. Yadav, M. Sudhakara, **Soumi Laha**, A. Venugopal, Journal of Molecular Catalysis A: Chemical 379, 213– 218, 2013. (Journal Impact Factor: 5.08)
6. Synthesis of 2-Indolyl-1-nitroalkane Derivatives Using Nanocrystalline Titanium(IV) Oxide. M. Lakshmi Kantam, **Soumi Laha**, Jagjit Yadav, and P. Srinivas. Synthetic Communications, 39: 4100–4108, 2009, (Journal Impact Factor: 1.937)
7. Nanocrystalline copper(II) oxide catalyzed aza-Michael and insertion of α-diazo compounds to N-H bonds of amines. M. Lakshmi Kantam, **Soumi Laha**, Jagjit Yadav and Shailendra Jha Tetrahedron Letters 50 (31), 4467-4469, 2009. (Journal Impact Factor: 2.032)
8. Synthesis of propargylamine by three-component coupling of aldehydes, amines and alkynes catalyzed by magnetically separable copper ferrite nanoparticles. M. Lakshmi Kantam, Jagjit Yadav, **Soumi Laha**, Sailendra Jha SYNLETT 11, 1791-1794, 2009. (Journal Impact Factor: 2.206)
9. Magnetically Recoverable and Reusable Copper Ferrite Nanoparticles as Catalyst for Asymmetric Hydrosilylation of ketones at Room Temperature. M. Lakshmi Kantam, Jagjit Yadav, **Soumi Laha**, P. Srinivas B. Sreedhar, F. Figures. Journal of Organic Chemistry; 74 (12), 4608-4611, 2009. (Journal Impact Factor: 3.6)
10. Nanocrystalline Magnesium Oxide-Stabilized Molybdenum: An Efficient Heterogeneous Catalyst for the Aerobic Oxidation of Alcohols to Carbonyl Compounds. M. Lakshmi Kantam, Jagjit Yadav, **Soumi Laha**, B. Sreedhar, S. Bhargava, Advanced Synthesis and Catalysis 350, 2575-2582, 2008. (Journal Impact Factor: 5.981)
11. An efficient synthesis of propargylamines via three-component coupling of aldehydes, amines and alkynes catalyzed by nanocrystalline copper (II) oxide. M. Lakshmi Kantam, **Soumi Laha**, Jagjit Yadav, S. Bhargava, Tetrahedron Letters 49, 19, 3083-3086, 2008. (Journal Impact Factor: 2.032)
12. An Efficient Copper−Aluminum Hydrotalcite Catalyst for Asymmetric Hydrosilylation of Ketones at Room Temperature. M. Lakshmi Kantam, **Soumi Laha**, Jagjit Yadav; P. R. Likhar, B. Sreedhar, S. Jha, S. Bhargava, M. Udayakiran, B. Jagadeesh, Organic Letters ; 10, 14, 2979 2982, 2008. (Journal Impact Factor: 5.2)
13. N-arylation of heterocycles with activated chloro- and fluoroarenes using nanocrystalline copper(II) oxide. M. Lakshmi Kantam, Jagjit Yadav, **Soumi Laha**, B. Sreedhar, S. Jha, Advanced Synthesis and Catalysis 349, 1938-1942, 2007. (Journal Impact Factor: 5.981)

14. Asymmetric hydrosilylation of prochiral ketones catalyzed by nanocrystalline copper(II) oxide. M. L. Kantam, **Soumi Laha**, Jagjit Yadav, P. R. Likhar, B. Sreedhar, B. M. Choudary, Advanced Synthesis and Catalysis 349, 1797-1802, 2007. (Journal Impact Factor: 5.981)
15. Friedel-Crafts alkylation of indoles with epoxides catalyzed by nanocrystalline titanium(IV) oxide. M. Lakshmi Kantam, **Soumi Laha**, Jagjit Yadav, B. Sreedhar, Tetrahedron Letters 47, 35, 6213-6216, 2006. (Journal Impact Factor: 2.032)
16. Nanocrystalline titanium(IV) oxide as an efficient heterogeneous catalyst for tandem Michael and nucleophilic 1,2-addition to enones. M. Lakshmi Kantam, **Soumi Laha**, Jagjit Yadav, B. M. Choudary, B. Sreedhar, Advanced Synthesis and Catalysis, 348, 867-872, 2006. (Journal Impact Factor: 5.981)
17. Expanded graphite as an electrode material for an alcohol fuel cell. A. Bhattacharya, A. Hazra, S. Chatterjee, P. Sen, **Soumi Laha**, I. Basumallick, Journal of Power Source 136, 208-210, 2004. (Journal Impact Factor: 9.2)
18. Improved Catalyst for Methanol Fuel Cell. P. Sen, **Soumi Laha**, I. N. Basumallick, Bulletin of Electrochemistry 20 (3) 125 128, 2004. (Journal Impact Factor: 1.777)

h. **Patents filed/Granted with details** *(relevant to the proposed project)*

1. ENHANCING EFFICIENCY THROUGH PHOTOVOLTAIC CELLS UTILIZING NANO-MATERIALS, Application No.202441037252 A, Publication Date : 17/05/2024

i. **Books Published /Chapters contributed** ***(relevant to the proposed project)***

None

j. Sponsored Research Projects (last five years)

S. No	Title	Sponsoring Agency andOfficer Concerned	Period	Amount	Achievements
1.	Design and Synthesis of Novel HeterogeneousN-Heterocyclic Carbene based Catalysts and theirApplications in Selective and Enantioselective OrganicTransformations	DST (WOS-A)	23/3/2016-23/3/2019	27,83,000/-	One publication

i. Consultancy Projects (last five years)

S. No	Title	Sponsoring Agency	Period	Amount

ii. Sponsored Research/Consultancy Projects submitted for approval

S.No.	Title	Funding Agency	Duration	Amount

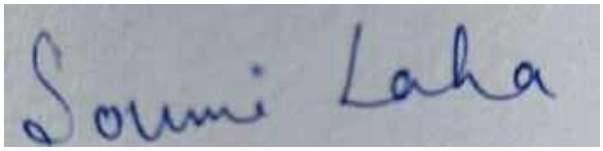
k. Awards and Honors:

A. National list:

- Junior Research Fellowship (CSIR-UGC based on national aptitude screening test conducted by Govt. of India) for the period of 2 years. January 2004 to January 2006.
- Senior Research Fellowship (CSIR-UGC based on national aptitude screening test conducted by Govt. of India) for the period of 3 years. February 2006 to January 2009.

B. International list:

12 Technologies Developed / Transferred:
(please provide details of technologies transferred to industry, technologies commercialized)



(Signature of Co-PI)

Date: 15.07.2024

Jadavpur University

Certified that

Smt. Soumi Laha

was awarded the Degree of Doctor of Philosophy in Science of the University on 17/01/2011 and that the degree was conferred on her/him at the Convocation held on December 2011 with all the rights and privileges thereto appertaining.

In Witness whereof the Signatures of the Vice-Chancellor of Jadavpur University is hereunto affixed.

JADAVPUR UNIVERSITY
The 24th December, 2011

Vice-Chancellor

Co- Principal Investigator

1. **Name : Dr.Deena Babu Mandru**
2. **Gender: Male**
3. **Date of Birth:05/07/1980**
4. **E-mail ID: dr.deenababumandru@mrec.ac.in**
5. **Qualifications:**

S. No.	Degree	Institution	Year	Division/Class
1	PhD	Krishna University, Machilipatnam, Andhra Pradesh	2019	--

Employment Experience

S. No.	Position & Organisation	Nature of Job	Period
1	Professor, Malla Reddy Engineering College (A) , Hyderabad, Telangana	Teaching, Administration and Research	2020 to Till Date
2	Malla Reddy Institute of Technology, Hyderabad, Telangana	Teaching	May, 2016 To June,2020
3	Narsimha Reddy Engineering College, Hyderabad, Telangana	Teaching	June, 2014 To May, 2016

7. **Selected List of Ten Best Publications** *(relevant to the proposed project)*

1. Gatla, "Optimizing Edge AI for Tomato Leaf Disease Identification", Eng. Technol. Appl. Sci. Res., vol. 14, no. 4, pp. 16061–16068, Aug. 2024.

2. Seshadri Ramana, K., Bala Chowdappa, K., Obulesu, O., Mandru, D. B., & Kallam, S. (2022). Deep convolution neural networks learned image classification for early cancer detection using lightweight. Soft Computing, 26(12), 5937-5943. Mandru, Deena Babu, et al. "Assessing deep neural network and shallow for network intrusion detection systems in cyber security." Computer Networks and Inventive Communication Technologies: Proceedings of Fourth ICCNCT 2021. Springer Singapore, 2022.

3. Mandru, Deena Babu. "A comparative study on Covid-19 cases in top 10 states/UTS of India in using machine learning models." Turkish Journal of Computer and Mathematics Education (TURCOMAT) 12.10 (2021): 4514-4524.

4. Madhusekhar, Y., Sandhya Priyanka, P., Mandru, D. B., & Srikanth, T. (2023). Blockchain: A Safe Way to Transfer Signatures in a Distributed Intrusion Detection System. In Intelligent Manufacturing and Energy Sustainability: Proceedings of ICIMES 2022 (pp. 261-273). Singapore: Springer Nature Singapore.

5. Vani, Meruva Sandhya, Rajupudi Durga Devi, and Deena Babu Mandru. "An Efficient Intrusion Detection Framework in Software-Defined Networking for Cyber Security Applications." Soft Computing and Signal Processing: Proceedings of 5th ICSCSP 2022 313 (2023): 461.

h. **Patents filed/Granted with details** *(relevant to the proposed project)*

A. International Patent/Grant:

1. *Published an Australian Patent entitled "A Classifier for Attack Detection in Cloud Environment and Data Computing for Smart Cities and Smart Healthcare System Using Internet of Things" with Patent Number: 2021101959 on 15 April 2021.*
2. *Published a German Patent entitled "Artificial Intelligence Based Approach to Analyze the Effective Means of Human Computer Interaction Interfaces" with Application Number 202022106410 (DE202022106410U1) on 26.01.2023.*

B. National Patents:

1. "A Method and a System for Emotion Recognition from a Speech" with Application No: 202041052252 on 11/12/2020.
2. "An Efficient MRF Models for Detection of Brain Abnormality Based on MR Images" with Application No:202041052994 on 11/12/2020
3. "Attendance System Using QR-Code", with Application No 202141060067A on 28/01/2022
4. "Artificial Intelligence Based Approach to Analyze the Effective Means of Human Computer Interaction Interfaces" with Application No 202241027909A on 03/06/2022.
5. "Cloud Based Smart System for Smart City" with Application No.202241058670A on 21/10/2022.
6. "Enhanced Polymeric Plywood" with Application No 202241075141A on 30/12/2022.

7. “The Special Kit” with Application No 202241075140A on 30/12/2022.
8. “Ground Personnel Monitoring Tool” with Application No 202341053971 on 01/09/2023.
9. “Real-time Bus Tracking System” with Application No 202341052795 on 01/09/2023.
10. “Code-chef Cards” with Application No 202341052794 on 01/09/2023.
11. “SecureShield (A Phishing Detection Solution using AI and Machine Learning)” with Application No 202341052796 on 01/09/2023.

i. **Books Published /Chapters contributed** ***(relevant to the proposed project)***

1. Published a book titled, **“OOP through JAVA”**, 1st Edition, ISBN No: 978-93-88096-12-6, Seven Hills International Publishers.
2. Published a Book titled **“ Data Science at Glance” ,Walnut Publications, with ISSN.No:** 978-93-55742-50-6, August-2022

j. Sponsored Research Projects (last five years)

S. No	Title	Sponsoring Agency and Officer Concerned	Period	Amount	Achievements

i. Consultancy Projects (last five years)

S. No	Title	Sponsoring Agency	Period	Amount

ii. Sponsored Research/Consultancy Projects submitted for approval

S.No.	Title	Funding Agency	Duration	Amount

K.Awards and Honours:

A. National list

B. International list:

12 Technologies Developed / Transferred:
(please provide details of technologies transferred to industry, technologies commercialized)

Date: (Signature of Co- PI)

Sl.No. 00005

13PHD/005/00005

KRISHNA UNIVERSITY

కృష్ణా విశ్వవిద్యాలయం

H.T.No : 1304PH101004
Aadhar No : 742651372382

Faculty of Engineering & Technology

Deenababu Mandru

S/o / D/o : Dharmarao
&
Mandru Sundaramma

Having Fulfilled the academic requirements in January-2020 has this day been admitted by the Executive Council to the Degree of

Doctor of Philosophy

In

COMPUTER SCIENCE AND ENGINEERING

For the Thesis entitled,

"ATTRIBUTE SIMILARITY-INDEX BASED ENHANCED FEATURE SELECTION MULTI-VIEW CLUSTERING APPROACH USEING MACHINE LEARNING TECHNIQUES "

Date of Viva-Voce : 02/01/2020

Given under the Seal of the University

విశ్వవిద్యాలయ అధికార ముద్రతో జారీచేయబడినది.

Dt. 06/11/2021

Machilipatnam,
A.P., India.
Pin: 521004

Vice-Chancellor

Co- Principal Investigator(s) (Co PI)

a. **Name: K. Sowjanya Naidu**
b. **Gender: Female**
c. **Date of Birth: 31-05-1989**
d. **E-mail ID: sowjanya.k31@gmail.com**
e. **Qualifications: B.Tech, M.Tech,(Ph.D)**

S. No.	Degree	Institution	Year	Division/Class
1	B.Tech	MVGR College of Engineering	2008	First
2	M.Tech	Andhra University College of Engineering	2010	First

g. Employment Experience

S. No.	Position & Organisation	Nature of Job	Period
1	Assistant Professor, Malla Reddy Engineering College	Teaching	June 2023 to Till date
2	Assistant Professor, Dr.L.B.College of Engineering	Teaching	June 2019 to May 2023
3	Assistant Professor, GVP College of engineering	Teaching	Aug 2015 to Dec 2018
4	Lecturer, JNTUK College of Engineering	Teaching	Aug 2010 to Feb 2013

h. **Selected List of Ten Best Publications** *(relevant to the proposed project)*

i. **Patents filed/Granted with details** *(relevant to the proposed project)*

j. **Books Published /Chapters contributed** ***(relevant to the proposed project)***

k. Sponsored Research Projects (last five years)

S. No	Title	Sponsoring Agency and Officer Concerned	Period	Amount	Achievements

ii. Consultancy Projects (last five years)

S. No	Title	Sponsoring Agency	Period	Amount

ii. Sponsored Research/Consultancy Projects submitted for approval

S.No.	Title	Funding Agency	Duration	Amount

k. Awards and Honours:

C. National list

D. International list:

12 Technologies Developed / Transferred:

(please provide details of technologies transferred to industry, technologies commercialized)

K. Sanjhan

Date

(Signature of PI)

0091720005

ANDHRA UNIVERSITY

FACULTY OF ENGINEERING

This is to certify that

Kaparapu Sowjanya Naidu

has been duly admitted to the Degree of Master of Technology in Computer Science & Technology in this University, he having been declared to have passed in the First Class with Distinction the Examination prescribed therefor held in October 2010.

Given under the Seal of the University

Visakhapatnam

The 26th November 2011.

Registrar

Co- Principal Investigator(s) (Co PI)

a. Name : Kesava Vamsi Krishna Vajjala
b. Gender : Male
c.Date of Birth :29 – 05 – 1979
d:E-mail ID:mrecphysics@gmail.com
e :Qualifications:M. Sc., M. Phil.

S. No.	Degree	Institution	Year	Division/Class
1	M. Phil.	Sri Venkateswara University	2018	First
2	M. Sc.	Sri Venkateswara University	2002	First
3	B. Sc.	Sri Venkateswara University	1999	First

h. Employment Experience

S. No.	Position &Organisation	Nature of Job	Period
1	Associate Professor, Malla Reddy Engineering College Hyderabad	Teaching	2009 – till date
2	Assistant Professor, Malla Reddy Engineering College Hyderabad	Teaching	2004 – 2009
3	Lecturer in Physics, New Nobel Degree College, Hyderabad	Teaching	2003 – 2004
4	Lecturer in Physics, Vagdevi Degree College, Proddatur	Teaching	2002 - 2003

i. **Selected List of Ten Best Publications** *(relevant to the proposed project)*

f. Suitability of Sb-doped SnS thin films for PV applications, synthesized chemically, Kesava Vamsi Krishna V., et al, European Chemical Bulletin 2023,12(issue 8), 9489-9497.

g. Chemically synthesized Cu-doped SnS thin films for PV applications, Kesava Vamsi Krishna V., et al, Journal of Propulsion Technology, Vol 44, Issue 4 (2023).

j. **Patents filed/Granted with details** *(relevant to the proposed project)*

k. **Books Published /Chapters contributed** ***(relevant to the proposed project)***

i. **Book chapter titled 'Thin film deposition by Chemical Bath Deposition method' got published in the book titled 'Advances in Renewable energy engineering Vol – 5', published by Akinik publications.**

ii. **Book chapter titled 'Preparation and characterization of carbon black reinforced natural rubber composite materials' got published in the book titled 'Emerging trends in scientific research Vol – 2' published by Integrated Publications.**

l. Sponsored Research Projects (last five years) **Not Applicable**

S. No	Title	Sponsoring Agency and Officer Concerned	Period	Amount	Achievements

iii. Consultancy Projects (last five years) **Not Applicable**

S. No	Title	Sponsoring Agency	Period	Amount

iii. Sponsored Research/Consultancy Projects submitted for approval
Not Applicable

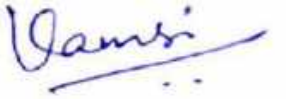
S.No.	Title	Funding Agency	Duration	Amount

l. Awards and Honours:

E. National list

F. International list:

12 Technologies Developed / Transferred: **Not Applicable**
(please provide details of technologies transferred to industry, technologies commercialized)



Date (Signature of PI)

Disposal No. B IX/ M.Phil./20 18 Register No. 2421603003

SRI VENKATESWARA UNIVERSITY

Sl.No. 4312

PROVISIONAL CERTIFICATE

This is to certify that Sri/Smt. Kesava Vamsi Krishna V

has qualified himself / herself for the Degree of Master of Philosophy he/she having passed in the First *class the M. Phil. Degree Examination held in* October *20*16 *in* Physics *and that he / she has done all that is necessary for the formal presentation for the Degree of Master of Philosophy.*

TIRUPATI – 517 502

Dated 11 JUN 2018

K. Prattia
CONTROLLER OF EXAMINATIONS
Assistant Administrative Officer (Exams)
Sri Venkateswara University

Written by: Compared by: Supdt.:

CERTIFICATE FROM THE INVESTIGATOR(S)

Project Title: : Design and Development of sustainable dismantling PV solar modules with eco-friendly chemical processing for material recovery

1. I/We have carefully read the terms and conditions of the Clean Energy Research Initiative (CERI) Programme and I/We agree to abide by them.
2. I/We have not submitted this or a similar Project proposal elsewhere for financial support.
3. I/We have explored and ensured that the equipment and the basic facilities described in the Research Proposal, will actually be available as and when required for the purpose of the Project. I/We shall not request financial support under this project, for procurement of these items.
4. I/We undertake that spare or idle capacity of the permanent equipment procured under the project will be made available to other legitimate users from parent and other organizations.
5. I/We have enclosed the following :

A Endorsement from the Heads of the Institution
(on letter head)

B Undertaking for the Collaborator(s)
(on letter head)

C Complete Project Proposal with all enclosures

Date 15/7/2024
Place Hyderabad

Dr. T. Venkata Deepthi

Name(s) and Signature(s) of the Investigators*

(To be signed by PI and Co-PI of each Participating Institution)

1. Dr. Soumi Laha — Slaha
2. Dr. Deena Babu Mandru
3. K. Sowjanya Naidu — K. Sl
4. KESAVA VAMSI KRISHNA V. — Vamsi

DEPARTMENT OF SCIENCE AND TECHNOLOGY
POLICY ON CONFLICT OF INTEREST

FOR APPLICANT

Issues of Conflicts of Interest and ethics in scientific research and research management have assumed greater prominence, given the larger share of Government funding in the country's R & D scenario. The following policy pertaining to general aspects of Conflicts of Interest and code of ethics, are objective measures that is intended to protect the integrity of the decision making processes and minimize biasness. The policy aims to sustain transparency, increase accountability in funding mechanisms and provide assurance to the general public that processes followed in award of grants are fair and non-discriminatory. The Policy aims to avoid all forms of bias by following a system that is fair, transparent and free from all influence/ unprejudiced dealings, prior to, during and subsequent to the currency of the programme to be entered into with a view to enable public to abstain from bribing or any corrupt practice in order to secure the award by providing assurance to them that their competitors will also refrain from bribing and other corrupt practice and the decision makers will commit to prevent corruption, in any form, by their officials by following transparent procedures. This will also ensure a global acceptance of the decision making process adopted by DST.

Definition of Conflict of Interest:

Conflict of Interest means "any interest which could significantly prejudice an individual's objectivity in the decision making process, thereby creating an unfair competitive advantage for the individual or to the organization which he/she represents". The Conflict of Interest also encompasses situations where an individual, in contravention to the accepted norms and ethics, could exploit his/her obligatory duties for personal benefits.

1. **Coverage of the Policy:**

a) The provisions of the policy shall be followed by persons applying for and receiving funding from DST, Reviewers of the proposal and Members of Expert Committees and Programme Advisory Committees. The provisions of the policy will also be applicable on all individuals including Officers of DST connected directly or indirectly or through intermediaries and Committees involved in evaluation of proposals and subsequent decision making process.

b) This policy aims to minimize aspects that may constitute actual Conflict of Interests, apparent Conflict of Interests and potential Conflict of Interests in the funding mechanisms that are presently being operated by DST. The policy also aims to cover, although not limited to, Conflict of interests that are Financial (gains from the outcomes of the proposal or award), Personal (association of relative / Family members) and Institutional (Colleagues, Collaborators, Employer, persons associated in a professional career of an individual such as Ph.D. supervisor etc.)

2. **Specifications as to what constitutes Conflict of Interest.**

Any of the following specifications (non-exhaustive list) imply Conflict of Interest if,

(i) Due to any reason by which the Reviewer/Committee Member cannot deliver fair and objective assessment of the proposal.

(ii) The applicant is a directly relative# or family member (including but not limited to spouse, child, sibling, parent) or personal friend of the individual involved in the decision making process or alternatively, if any relative of an Officer directly involved in any decision making process / has influenced interest/ stake in the applicant's form etc.

(iii) The applicant for the grant/award is an employee or employer of an individual involved in the process as a Reviewer or Committee Member; or if the applicant to the grant/award has had an employer-employee relationship in the past three years with that individual.

(iv) The applicant to the grant/award belongs to the same Department as that of the Reviewer/Committee Member.

(v) The Reviewer/Committee Member is a Head of an Organization from where the applicant is employed.

(vi) The Reviewer /Committee Member is or was, associated in the professional career of the applicant (such as Ph.D. supervisor, Mentor, present Collaborator etc.)

(vii) The Reviewer/Committee Member is involved in the preparation of the research proposal submitted by the applicant.

(viii) The applicant has joint research publications with the Reviewer/Committee Member in the last three years.

(ix) The applicant/Reviewer/Committee Member, in contravention to the accepted norms and ethics followed in scientific research has a direct/indirect financial interest in the outcomes of the proposal.

(x) The Reviewer/Committee Member stands to gain personally should the submitted proposal be accepted or rejected.

The Term "Relative" for this purpose would be referred in section 6 of Companies Act, 1956.

3. Regulation:

The DST shall strive to avoid conflict of interest in its funding mechanisms to the maximum extent possible. Self-regulatory mode is however recommended for stake holders involved in scientific research and research management, on issues pertaining to Conflict of Interest and scientific ethics. Any disclosure pertaining to the same must be made voluntarily by the applicant/Reviewer/Committee Member.

4. Confidentiality:

The Reviewers and the Members of the Committee shall safeguard the confidentiality of all discussions and decisions taken during the process and shall refrain from discussing the same with any applicant or a third party, unless the Committee recommends otherwise and records for doing so.

5. Code of Conduct

(a) The applicant must refrain from suggesting referees with potential Conflict of Interest that may arise due to the factors mentioned in the specifications described above in Point No. 2.

(b) The applicant may mention the names of individuals to whom the submitted proposal should not be sent for refereeing, clearly indicating the reasons for the same.

6. Final Appellate authority:

Secretary, DST shall be the appellate authority in issues pertaining to conflict of interest and issues concerning the decision making process. The decision of Secretary, DST in these issues shall be final and binding.

7. Declaration

I have read the above "Policy on Conflict of Interest" of the DST applicable to Applicant and agree to abide by provisions thereof.

I hereby declare that I have no conflict of interest of any form pertaining to the proposed grant *

I hereby declare that I have conflict of interest of any form pertaining to the proposed grant *

* & # (Tick whichever is applicable)

Dr. T. Venkata Deepthi

(Name /Signature with date) 15/7/24

ENDORSEMENT FROM THE HEAD OF THE ORGANISATION

Project Title : Design and Development of sustainable dismantling PV solar modules with ecofriendly chemical processing for material recovery

1. Certified that the organization welcomes the participation of Dr T Venkata Deepthi as The PI and Dr. Soumi Laha, Dr. Deeenababu Mandru, Mrs K. Sowjnya Naidu and Kesava Vamsi Krishna Vajjala as the Co-PI for the project and that in the unforseen and legitimate event of discontinuation by the PI, the Co-PI will assume full responsibility for completion of the project. Information to this effect, endorsed by me, will be promptly sent to the DST
2. Certified that the equipment, other basic facilities and other administrative facilities as per the terms and conditions of the award of the Project, will be extended to the investigator(s) through out the duration of the project
3. The Organization shall ensure that financial and purchase procedures are followed as per the prevailing norms of the organization, with in the allocated budget.
4. The Organization shall provide timely the Statement of Expenditure and the Utilisation Certificate of the grant as required by the DST in the prescribed format.
5. The grant for the proposal, if approved, the funds shall be transferred to following organization account:

1	Name of A/c holder (as Per Bank record)	Principal, Malla Reddy Engineering College
2	Bank Account No.	769401000078
3	Bank Branch Name &Address	ICICI Bank Ltd, MREC Campus, Admin Block, Maisammaguda, Gundla Pochampally, Medchal-Malkajgiri Dist.
4	MICR Code	**500229130**
5	IFSC Code	ICIC0007694
6	E-mail (Agency/PI)	principal@mrec.ac.in
7	Mobile No.(Agency/PI)	9348161125
8	Unique agency code*	

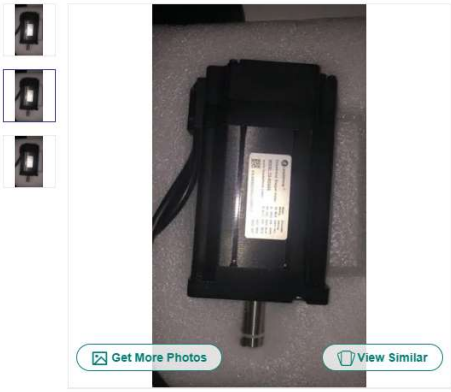
Date:15.07.24
Place: Hyderabad

Malla Reddy Engg. College (A) 500 100 Hyderabad

(Head of the Institute)
Seal/Stamp

Principal
Malla Reddy Engineering College
Maisammaguda, Dhulapally,
(Post Via Kompally), Sec-bad-500

IndiaMART > Electric Motors and Components > Brushless DC Motor > Stepper Motor



Closed Loop Stepper Motor, 230 V

₹ 15,000/ Unit Get Latest Price

Power Source	Electric
Model Name/Number	CS-M23485
Brand	Leadshine
Speed	2000-6000 RPM
Voltage	230 V

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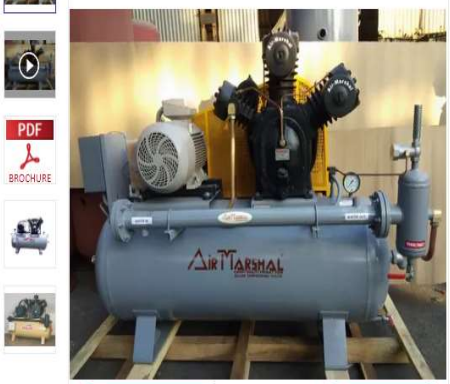

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Capacity	50 Kg/Feet
Usage/Application	Assembly Lines
Conveyor Type	Belt
Speed	60 m/min

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Material	Stainless Steel
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Type Of Furnace	Fix
Max Temperature	1000-1500 degree Celsius
Rated Power (KW)	3 KW
Input Voltage (V)	220V

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Melting Material	Iron
Power Source	Electric
Type Of Furnace	Fix
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Automation Grade	Semi-Automatic

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Electric Vacuum Pot Furnace, Max Temperature: 1000 Degree Celsius, Material Loading Capacity: 500kg

₹ 4,50,000/ Unit Get Latest Price

Power Source	Electric
Material Loading Capacity	500kg
Max Temperature	1000 Degree Celsius
Voltage	240V
Country of Origin	Made in India

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Copper Fix Continuous Muffle Furnaces, Material Loading Capacity: 1000 Kg

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Material Loading Capacity	1000 Kg
Melting Material	Copper
Max Operating Temperature	1500 degree Celsius
Power Source	Gas
Type Of Furnace	Fix
Material	Mild Steel

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