THE PATENTS ACT, 1970

(39 of 1970)

&

The Patent Rules, 2003

COMPLETE SPECIFICATION

(See section 10 and rule 13)

“TITLE OF THE INVENTION”

"HYBRID SOLAR-WIND ENERGY CONVERSION SYSTEM WITH ADAPTIVE CONTROL MECHANISM"

Applicant:

Vels Institute of Science, Technology & Advanced Studies (VISTAS),

Pallavaram, Chennai – 600117, Tamil Nadu.

The following specification particularly describes the nature of the invention and the manner in which it is performed:

FIELD OF THE INVENTION

[001] The present invention pertains to the field of **renewable and hybrid energy systems**, particularly focusing on the integration and optimization of **solar and wind energy conversion technologies** through intelligent control methodologies. More specifically, the invention relates to a **Hybrid Solar-Wind Energy Conversion System with Adaptive Control Mechanism** designed to ensure continuous, efficient, and reliable power generation by dynamically adjusting system parameters in response to real-time environmental variations. The field encompasses areas such as **power electronics, energy management systems, adaptive control algorithms, and intelligent grid interfacing**. By utilizing advanced computational techniques such as **machine learning, fuzzy logic, and predictive modeling**, the invention addresses the fundamental challenges of intermittency and instability associated with renewable energy sources, providing a robust and scalable solution for sustainable energy generation across residential, industrial, and off-grid applications.

BACKGROUND OF THE INVENTION

[002] The rapid depletion of fossil fuels and the escalating environmental impact of greenhouse gas emissions have accelerated the global transition toward renewable energy technologies. Solar and wind energy, being abundant and environmentally friendly, have emerged as leading candidates for sustainable power generation. However, each of these sources suffers from inherent intermittency—solar energy availability depends on sunlight intensity and weather conditions, while wind energy generation is influenced by wind

speed and direction. This variability poses a major obstacle to achieving stable, continuous, and reliable power supply from standalone renewable systems.

[003] To overcome the limitations of single-source renewable systems, researchers and engineers have explored **hybrid energy systems** that combine multiple renewable sources to complement each other's variability. The combination of solar photovoltaic (PV) panels and wind turbines has shown promising potential in maintaining balanced energy generation. When solar irradiance is low during cloudy or nighttime conditions, wind energy can often compensate, and vice versa. Despite this complementarity, the efficiency of hybrid systems largely depends on how effectively they are controlled and managed under dynamically changing environmental conditions.

[004] Existing hybrid solar-wind systems generally rely on **fixed or rule-based control strategies** that are unable to adapt to fluctuating resource availability in real time. These systems often apply static thresholds for switching between energy sources or controlling the flow of energy into storage units. As a result, significant power losses occur due to suboptimal utilization of available energy. Moreover, such systems fail to maintain voltage and frequency stability when sudden changes in wind speed or solar irradiance occur, leading to inconsistent performance and reduced energy conversion efficiency.

[005] Another challenge in current hybrid systems is the **lack of intelligent coordination** between energy sources, energy storage units, and load demand. For instance, when both solar and wind sources are generating power simultaneously, improper synchronization can cause overcharging of batteries or overload of inverters. Similarly, during periods of low energy generation, the

system might be unable to prioritize critical loads effectively. This inefficiency not only affects system performance but also reduces the operational lifespan of energy storage components such as batteries.

[006] The existing Maximum Power Point Tracking (MPPT) algorithms, which are commonly used to maximize energy extraction from renewable sources, are typically designed for individual technologies—either solar PV or wind turbines. Integrating both under a unified control mechanism introduces complexity due to their distinct electrical characteristics and environmental dependencies. For example, solar PV output is nonlinear with irradiance and temperature, while wind turbine output depends on the cube of wind speed. A static or non-adaptive MPPT approach is therefore insufficient to manage both simultaneously in a hybrid configuration.

[007] Additionally, the current systems lack **predictive intelligence** capable of forecasting power generation potential based on historical and real-time data. Predictive capabilities are crucial for balancing generation, storage, and consumption efficiently. Without this, hybrid systems cannot proactively adjust control parameters or manage energy flow optimally, leading to underperformance during rapidly changing weather conditions. Integrating machine learning or artificial intelligence could provide the ability to learn from operational data and predict future patterns of energy availability, thus enhancing overall reliability.

[008] Communication and monitoring infrastructure also present significant limitations in traditional hybrid systems. Many setups operate in isolation without real-time feedback or remote control capabilities. This makes it difficult

to diagnose faults, manage performance, or adjust parameters dynamically. With the growing trend toward smart grids and IoT-enabled devices, there is a clear need for hybrid systems that support intelligent monitoring, data-driven decision-making, and automated control using wireless communication protocols such as Zigbee, LoRa, or Wi-Fi.

[009] Therefore, there exists a strong technological and industrial need for a **Hybrid Solar-Wind Energy Conversion System with Adaptive Control Mechanism** capable of integrating intelligent algorithms, predictive analytics, and real-time adaptive control. Such a system should dynamically adjust its operational behavior based on environmental variations, load demand, and energy storage status. By combining adaptive control with data-driven intelligence, the invention aims to ensure stable, efficient, and continuous renewable energy generation, thereby addressing the key limitations of conventional hybrid systems and contributing toward the advancement of sustainable energy solutions.

SUMMARY OF THE INVENTION

[010] The present invention introduces a **Hybrid Solar-Wind Energy Conversion System with Adaptive Control Mechanism** designed to intelligently integrate and manage energy harvested from both solar photovoltaic (PV) panels and wind turbine generators. The system employs an adaptive control architecture that continuously monitors environmental conditions such as solar irradiance, wind speed, temperature, and load demand to dynamically optimize power generation and distribution. By combining these renewable energy sources under a unified, intelligent control framework, the

invention ensures continuous power supply, enhanced energy efficiency, and minimized wastage even under fluctuating environmental conditions.

[011] The core of the invention lies in its **adaptive control mechanism**, which utilizes a combination of **fuzzy logic control and machine learning algorithms** to achieve real-time optimization of system performance. This control mechanism analyzes incoming sensor data, predicts generation trends, and adjusts parameters such as converter duty cycles, inverter switching frequency, and energy routing priorities. Unlike conventional systems that operate based on static thresholds, the proposed adaptive controller evolves continuously with environmental variations, ensuring that the energy output remains stable and consistent regardless of unpredictable changes in wind or sunlight intensity.

[012] The invention further includes an **intelligent energy storage management subsystem (ESMS)** that coordinates charging and discharging operations of battery units based on system status and energy forecasts. By integrating predictive analytics, the ESMS can determine the optimal time to store excess power or supply stored energy to the load. This functionality not only prevents overcharging or deep discharge of batteries but also extends their operational life and enhances the reliability of the entire hybrid system. The storage subsystem operates synergistically with the adaptive controller, enabling smooth transitions between power sources and maintaining uninterrupted energy delivery.

[013] In addition to its control and storage optimization features, the system is equipped with a **power conditioning unit** incorporating **Maximum Power**

Point Tracking (MPPT) for both solar and wind modules. The adaptive controller dynamically modifies MPPT reference points in real time based on cross-compensation between solar and wind contributions. This ensures that the system always operates at maximum energy conversion efficiency. The invention also integrates a **smart communication interface** using IoT-enabled sensors that allow for remote monitoring, fault detection, and performance analytics through a web-based or mobile dashboard.

[014] Overall, the invention provides a **self-regulating, intelligent, and scalable renewable energy solution** that can be implemented in grid-connected, off-grid, or hybrid energy infrastructures. By combining real-time data analytics, adaptive control, and smart communication, the system achieves superior performance in terms of reliability, energy utilization, and environmental sustainability. The hybrid architecture not only maximizes renewable energy conversion efficiency but also ensures long-term operational stability, making it ideal for residential, industrial, and rural electrification applications where consistent and sustainable energy supply is critical.

BRIEF DESCRIPTION OF THE DRAWINGS

[015] The accompanying figures included herein, and which form parts of the present invention, illustrate embodiments of the present invention, and work together with the present invention to illustrate the principles of the invention Figures:

[016] *Figure 1* illustrates a schematic block diagram of the **Hybrid Solar-Wind Energy Conversion System with Adaptive Control Mechanism**.

[017] *Figure 2* represents the **functional workflow of the adaptive control mechanism**, highlighting the sequence of operations from data acquisition to intelligent decision-making.

DETAILED DESCRIPTION OF THE INVENTION

[018] System Overview

The present invention discloses a **Hybrid Solar-Wind Energy Conversion System with Adaptive Control Mechanism** that integrates two primary renewable energy sources—solar and wind—under a unified adaptive control framework to ensure reliable and efficient power generation. The system is designed to operate in both **grid-connected** and **standalone modes**, depending on application requirements. The invention comprises a **solar photovoltaic (PV) array**, **wind turbine generator**, **power conditioning unit**, **adaptive control unit**, and **intelligent energy storage management subsystem (ESMS)**. The system employs real-time data acquisition from sensors monitoring solar irradiance, wind speed, ambient temperature, and load demand, which serve as the basis for adaptive optimization and intelligent decision-making.

[019] Solar Energy Conversion Subsystem

The solar subsystem consists of a high-efficiency **photovoltaic array** designed to capture solar irradiance and convert it into direct current (DC) electricity. The generated DC power passes through a **DC-DC converter** that regulates voltage output using **Maximum Power Point Tracking (MPPT)** algorithms. The MPPT ensures that the PV array operates at its optimal power point under

varying sunlight and temperature conditions. The converter is connected to the adaptive controller, which dynamically adjusts duty cycles to compensate for fluctuations in irradiance and temperature. The solar subsystem is also equipped with protective circuits to prevent reverse current flow and safeguard against overvoltage.

[020] Wind Energy Conversion Subsystem

The wind subsystem comprises a **horizontal-axis wind turbine** coupled to a **permanent magnet synchronous generator (PMSG)**, which converts mechanical energy from wind into electrical energy. The generated AC output is rectified into DC using a **three-phase rectifier** and fed into a DC-DC converter for conditioning. Similar to the solar subsystem, the wind turbine operates under an independent MPPT algorithm that tracks optimal rotor speed for maximum power extraction. The adaptive controller continuously monitors wind speed and generator output, adjusting the converter parameters in real time to ensure efficient energy harvesting even under varying wind profiles. The integration of both MPPT systems allows seamless coordination between the two renewable sources.

[021] Adaptive Control Mechanism

The **adaptive control mechanism** is the core component of the invention, integrating **fuzzy logic and machine learning-based predictive models** for optimal decision-making. The controller processes data from environmental sensors and electrical outputs to predict energy availability and load demand. It dynamically adjusts operational parameters such as converter switching

frequency, inverter modulation index, and power routing between sources. Fuzzy logic control ensures rapid response to short-term variations, while the machine learning component handles long-term predictive adjustments based on historical patterns. The adaptive controller also decides when to prioritize solar or wind energy and when to engage the storage subsystem to balance supply and demand. This multi-layer control structure ensures continuous, stable, and efficient energy output under all environmental conditions.

[022] Power Conditioning and Distribution Unit

The **power conditioning unit** ensures that the combined output from solar and wind sources meets the voltage and frequency requirements of the load. It includes **DC-DC converters, DC-AC inverters, and grid interfacing circuits**. The adaptive controller modulates inverter operation to maintain a stable output waveform, ensuring that power quality parameters such as total harmonic distortion (THD) remain within acceptable limits. In standalone mode, the inverter maintains constant voltage and frequency using voltage source inverter (VSI) control. In grid-connected mode, it synchronizes with the grid and exports surplus energy when generation exceeds consumption. The system also incorporates fault detection and automatic disconnection mechanisms to ensure safe operation under abnormal conditions.

[023] Intelligent Energy Storage Management Subsystem (ESMS)

The **energy storage subsystem** plays a vital role in maintaining power stability by storing excess energy during peak generation and supplying it during low generation or high demand periods. The ESMS includes **lithium-ion or flow**

batteries connected through bidirectional DC-DC converters. The adaptive controller monitors **state of charge (SOC)**, **depth of discharge (DOD)**, and temperature of the storage units to optimize charging and discharging cycles. The controller's predictive analytics anticipate future energy availability based on weather patterns and load forecasts, ensuring that the battery operates within optimal parameters. This approach enhances battery lifespan, prevents overcharging, and improves the overall system reliability and performance.

[024] Communication and Monitoring System

The invention integrates a **smart communication and monitoring interface** using IoT-based wireless communication technologies such as Zigbee, Wi-Fi, or LoRa. The system transmits real-time data regarding generation, storage, and consumption to a central dashboard or cloud-based platform. This allows remote monitoring, data logging, and fault diagnostics. Users can visualize system performance, receive alerts in case of abnormalities, and remotely adjust parameters. The adaptive control unit also uses cloud-stored historical data to improve prediction accuracy and control strategies over time. The inclusion of communication capabilities ensures scalability and facilitates integration into **smart grid infrastructure**.

[025] Safety and Protection Mechanisms

The system incorporates several safety features to ensure secure and reliable operation. These include **overvoltage, overcurrent, short-circuit, and thermal protection** circuits integrated within the control and power conditioning units. In case of abnormal conditions, the adaptive controller

triggers protective relays and initiates controlled shutdown procedures to prevent damage to system components. The invention also includes surge protection devices and insulation monitoring systems to enhance durability and operational safety in harsh environmental conditions. Additionally, an intelligent fault diagnostic system identifies component failures and logs maintenance alerts for operators.

[026] Operational Advantages and Applications

The proposed hybrid energy system offers several advantages over conventional renewable setups, including **higher energy conversion efficiency, better reliability, reduced power fluctuations, and extended storage life**. Its adaptive control enables real-time optimization, making it suitable for applications in **residential power systems, remote area electrification, smart grids, microgrids, and industrial renewable power plants**. The modular design allows scalability and customization based on energy requirements. Furthermore, the predictive intelligence embedded in the control mechanism provides superior adaptability to environmental changes, ensuring consistent power availability even in extreme or variable climatic conditions.

[027] The **Hybrid Solar-Wind Energy Conversion System with Adaptive Control Mechanism** provides a significant advancement in renewable energy technology by effectively integrating two variable energy sources under a single intelligent control framework. Through its adaptive control algorithms, predictive analytics, and smart energy management, the invention successfully addresses the longstanding issues of intermittency, instability, and inefficiency commonly

associated with conventional hybrid energy systems. The system not only enhances energy conversion efficiency but also ensures continuous, stable power delivery across varying environmental conditions. Furthermore, the incorporation of intelligent storage management, IoT-based monitoring, and automated protection mechanisms makes the invention highly reliable, efficient, and suitable for both grid-connected and standalone applications.

[028] In the future, the proposed hybrid system can be expanded to integrate **additional renewable energy sources** such as biomass, tidal, or geothermal energy to form multi-source adaptive grids. The incorporation of **artificial intelligence and deep learning algorithms** can further enhance predictive accuracy and enable autonomous fault diagnosis and self-healing network operations. Integration with **blockchain technology** can support peer-to-peer energy trading and decentralized grid management, while **vehicle-to-grid (V2G)** integration could enable bidirectional energy exchange between electric vehicles and the hybrid system. Additionally, advancements in **energy storage technologies** such as solid-state batteries and supercapacitors can further improve storage efficiency and system responsiveness. These extensions will make the system a vital part of next-generation smart and sustainable power infrastructure.

[029] In summary, the invention represents a **comprehensive, intelligent, and scalable hybrid renewable energy solution** that bridges the gap between fluctuating natural energy resources and consistent power demand. By harmonizing solar and wind energy through adaptive control, the system ensures optimized energy utilization and long-term operational sustainability.

Its flexible architecture, combined with advanced control intelligence, enables deployment across diverse geographic regions and load profiles. Thus, the **Hybrid Solar-Wind Energy Conversion System with Adaptive Control Mechanism** stands as a pivotal innovation in the field of renewable energy engineering, contributing significantly to global sustainability goals and the advancement of autonomous, eco-friendly energy systems.

We Claim:

1. A **Hybrid Solar-Wind Energy Conversion System with Adaptive Control Mechanism** comprising a solar photovoltaic array, a wind turbine generator, an adaptive controller, a power conditioning unit, and an energy storage subsystem configured to operate collectively for efficient and continuous power generation under variable environmental conditions.
2. The system as claimed in claim 1, wherein the **adaptive controller** utilizes a combination of **fuzzy logic and machine learning algorithms** to dynamically adjust operational parameters such as converter duty cycles, inverter modulation index, and power flow distribution in real time.
3. The system as claimed in claim 1, wherein the controller continuously receives input from sensors measuring **solar irradiance, wind speed, ambient temperature, voltage, current, and load demand**, and processes the data to predict power generation trends and adjust energy allocation accordingly.
4. The system as claimed in claim 1, wherein the **power conditioning unit** comprises DC-DC converters and DC-AC inverters configured to regulate voltage and frequency output, maintaining optimal power quality in both grid-connected and standalone operational modes.
5. The system as claimed in claim 1, further comprising an **intelligent energy storage management subsystem (ESMS)** that monitors state of charge (SOC), depth of discharge (DOD), and temperature of batteries to optimize charge and discharge cycles for enhanced energy utilization and battery lifespan.
6. The system as claimed in claim 1, wherein **Maximum Power Point Tracking (MPPT)** algorithms are employed independently for the solar photovoltaic and

wind turbine units, with the adaptive controller dynamically coordinating their reference points to maximize combined energy conversion efficiency.

7. The system as claimed in claim 1, wherein the adaptive controller incorporates **predictive analytics** based on historical and real-time data to forecast energy generation availability and load requirements, ensuring proactive power management and minimal transition losses.
8. The system as claimed in claim 1, including a **smart communication module** utilizing IoT-based wireless communication technologies such as Zigbee, Wi-Fi, or LoRa to enable remote monitoring, control, and data logging through a centralized interface.
9. The system as claimed in claim 1, wherein integrated **safety and protection mechanisms** are implemented to safeguard against overvoltage, overcurrent, short-circuit, and thermal anomalies, ensuring reliable and secure system operation.
10. The system as claimed in claim 1, wherein the adaptive control mechanism ensures **real-time coordination between solar and wind inputs**, energy storage, and load demand, providing continuous, stable, and efficient renewable energy supply for residential, industrial, and remote area applications.

Dated this 15th day of November 2025

Applicant
Vels Institute of Science,
Technology & Advanced Studies
(VISTAS)

ABSTRACT

HYBRID SOLAR-WIND ENERGY CONVERSION SYSTEM WITH ADAPTIVE CONTROL MECHANISM

[030] The invention titled **"Hybrid Solar-Wind Energy Conversion System with Adaptive Control Mechanism"** discloses a novel renewable energy system designed to intelligently integrate solar and wind energy sources for continuous, efficient, and stable power generation. The system comprises a **solar photovoltaic array**, a **wind turbine generator**, and an **adaptive control mechanism** that utilizes **fuzzy logic and machine learning algorithms** to optimize energy conversion and distribution in real time. By continuously monitoring environmental parameters such as solar irradiance, wind speed, and load demand, the controller dynamically adjusts converter and inverter operations to maintain maximum efficiency. An **intelligent energy storage management subsystem (ESMS)** optimizes battery charging and discharging cycles, extending storage life and ensuring uninterrupted energy availability. Additionally, IoT-based communication enables remote monitoring, predictive maintenance, and fault diagnostics. The invention effectively overcomes the limitations of conventional hybrid systems by providing adaptive, self-regulating, and sustainable energy management suitable for both **grid-connected** and **off-grid applications**, contributing to the advancement of smart and reliable renewable energy infrastructures.

Accompanied Drawing **[FIGS. 1-2]**

Dated this 15th day of November 2025

Applicant

Vels Institute of Science,
Technology & Advanced Studies
(VISTAS)

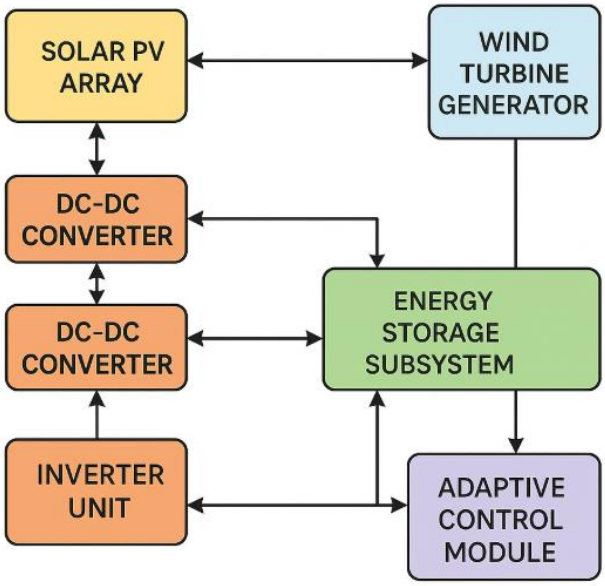
SOLAR PV ARRAY
WIND TURBINE GENERATOR
DC-DC CONVERTER
DC-DC CONVERTER
ENERGY STORAGE SUBSYSTEM
INVERTER UNIT
ADAPTIVE CONTROL MODULE

Fig. 1

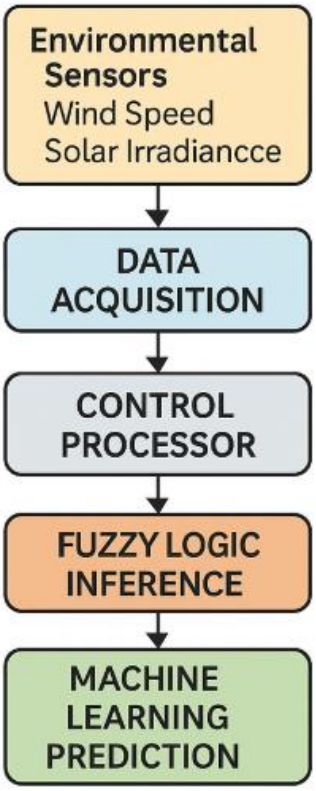

Fig. 2

Dated this 15th day of November 2025

"**FORM 1** THE PATENTS ACT 1970 (39 of 1970) and THE PATENTS RULES, 2003 **APPLICATION FOR GRANT OF PATENT** (See section 7, 54 and 135 and sub-rule (1) of rule 20)			(FOR OFFICE USE ONLY)		
		Application No.			
		Filing date:			
		Amount of Fee paid:			
		CBR No:			
		Signature:			
1. APPLICANT'S REFERENCE / IDENTIFICATION NO. (AS ALLOTTED BY OFFICE)					
2. TYPE OF APPLICATION [Please tick (✓) at the appropriate category]					
Ordinary (✓)		Convention ( )		PCT-NP ( )	
Divisional ( )	Patent of Addition ( )	Divisional ( )	Patent of Addition ( )	Divisional ( )	Patent of Addition ( )
3A. APPLICANT(S)					
Name in Full		Nationality	Country of Residence	Address of the Applicant	
Vels Institute of Science, Technology & Advanced Studies (VISTAS)		Indian	India	Pallavaram, Chennai – 600117, Tamil Nadu	
3B. CATEGORY OF APPLICANT [Please tick (✓) at the appropriate category]					
Natural Person ()		Other than Natural Person			
		Educational Institutions ((✓)	Startup ()	Others ()	
4. INVENTOR(S) [Please tick (✓) at the appropriate category]					
Are all the inventor(s) same as the applicant(s) named above?		Yes ()		No (✓)	
If "No", furnish the details of the inventor(s)					
Na e in Full		Nationality	Country of Residence	Address of the Inventor	
1. Dr. P Brindha Devi		Indian	India	Associate Professor, Department of Bioengineering, Vels Institute of Science Technology & Advanced Studies, Chennai, Tamil Nadu	

2. Dr. J Manjunathan	Indian	India	Assistant Professor, Department of Biotechnology, Vels Institute of Science Technology & Advanced Studies, Chennai, Tamil Nadu
3. Dr. Meenambiga Setti Sudharsan	Indian	India	Assistant Professor, Department of Bioengineering, Vels Institute of Science, Technology & Advanced Studies, Chennai, Tamil Nadu
4. Dr. R Sudha	Indian	India	Associate Professor, Department of Chemistry, Vels Institute of Science Technology & Advanced Studies, Chennai, Tamil Nadu
5. Dr. S Vijayaraj	Indian	India	Assistant Professor, Department of Electrical and Electronics Engineering, Vels Institute of Science, Technology & Advanced Studies, Chennai, Tamil Nadu
6. Dr. A. Arul Peter	Indian	India	Associate Professor, Department of Mechanical Engineering, Vels Institute of Science Technology & Advanced Studies, Chennai, Tamil Nadu
7. Dr. M. K. Soundarya	Indian	India	Assistant Professor, Department of Civil Engineering, Vels Institute of Science, Technology & Advanced Studies, Chennai, Tamil Nadu
8. Dr. M. Ruban	Indian	India	Associate Professor, Department of Mechanical Engineering, Vels Institute of Science, Technology & Advanced Studies, Chennai, Tamil Nadu
9. Mr. Vishal Yadav	Indian	India	Research Scholar, Department of Biotechnology, Vels Institute of Science, Technology & Advanced Studies, Chennai, Tamil Nadu
10. Dr. A. Sai Ramesh	Indian	India	Assistant Professor, Department of Bioengineering, Vels Institute of Science, Technology & Advanced Studies, Tamil Nadu
11. Dr. P. Prakash	Indian	India	Assistant Professor, Department of Mechanical Engineering, Vels Institute of Science, Technology & Advanced Studies, Chennai, Tamil Nadu
5. TITLE OF THE INVENTION			

"HYBRID SOLAR-WIND ENERGY CONVERSION SYSTEM WITH ADAPTIVE CONTROL MECHANISM"		
6. AUTHORISED REGISTERED PATENT AGENT(S)	IN/PA No.	
	Name	
	Mobile No.	
7. ADDRESS FOR SERVICE OF APPLICANT IN INDIA	Name	Dr. P Brindha devi
	Postal Address	Associate Professor, Department of Bioengineering, Vels Institute of Science Technology & Advanced Studies, Chennai, Tamil Nadu
	Telephone No.	
	Mobile No.	8072375039
	Fax No.	
	E-mail ID	abiresearchacademy@gmail.com

~~8. IN CASE OF APPLICATION CLAIMING PRIORITY OF APPLICATION FILED IN CONVENTION COUNTRY, PARTICULARS OF CONVENTION APPLICATION~~

~~Country~~	~~Application Number~~	~~Filing date~~	~~Name of the applicant~~	~~Title of the invention~~	~~IPC (as classified in the convention country)~~

~~9. IN CASE OF PCT NATIONAL PHASE APPLICATION, PARTICULARS OF INTERNATIONAL APPLICATION FILED UNDER PATENT CO-OPERATION TREATY (PCT)~~

~~International application number~~	~~International filing date~~

~~10. IN CASE OF DIVISIONAL APPLICATION FILED UNDER SECTION 16, PARTICULARS OF ORIGINAL (FIRST) APPLICATION~~

~~Original (first) application No.~~	~~Date of filing of original (first) application~~

~~11. IN CASE OF PATENT OF ADDITION FILED UNDER SECTION 54, PARTICULARS OF MAIN APPLICATION OR PATENT~~

~~Main application/patent No.~~	~~Date of filing of main application~~

12. DECLARATIONS

i) Declaration by the inventor(s)

(**In case the applicant is an assignee**: the inventor(s) may sign herein below or the applicant may upload the assignment or enclose the assignment with this application for patent or send the assignment by post/electronic transmission duly

authenticated within the prescribed period).

I/We, the above named inventor(s) is/are the true & first inventor(s) for this Invention and declare that the applicant(s) herein is/are my/our assignee or legal representative.

(a) Date 15/11/2025

(b) Name	(c) Signature
1. Dr. P Brindha Devi 2. Dr. J Manjunathan 3. Dr. Meenambiga Setti Sudharsan 4. Dr. R Sudha 5. Dr. S Vijayaraj 6. Dr. A. Arul Peter 7. Dr. M. K. Soundarya 8. Dr. M. Ruban 9. Mr. Vishal Yadav 10. Dr. A. Sai Ramesh 11. Dr. P. Prakash	

~~**(ii) Declaration by the applicant(s) in the convention country**~~

~~**(In case the applicant in India is different than the applicant in the convention country:** the applicant in the convention country may sign herein below or applicant in India may upload the assignment from the applicant in the convention country or enclose the said assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period)~~

~~I/We, the applicant(s) in the convention country declare that the applicant(s) herein is/are my/our assignee or legal representative.~~

~~(a) Date~~

~~(b) Signature(s)~~

(c) ~~Name(s) of the signatory~~

(iii) Declaration by the applicant(s)

I/We the applicant(s) hereby declare(s) that: -

- ☐ ~~I am/~~ We are in possession of the above-mentioned invention.
- ☐ The ~~provisional~~/complete specification relating to the invention is filed with this application.
- ☐ ~~The invention as disclosed in the specification uses the biological material from India and the necessary permission from the competent authority shall be submitted by me/us before the grant of patent to me/us.~~
- ☐ There is no lawful ground of objection(s) to the grant of the Patent to me/us.
- ☐ ~~I am~~/we are the true & first inventor(s).

- ☐ ~~I am/~~we are the assignee or legal representative of true & first inventor(s).
- ☐ ~~The application or each of the applications, particulars of which are given in Paragraph-8, was the first application in convention country/countries in respect of my/our invention(s).~~
- ☐ ~~I/We claim the priority from the above mentioned application(s) filed in convention country/countries and state that no application for protection in respect of the invention had been made in a convention country before that date by me/us or by any person from which I/We derive the title.~~
- ☐ ~~My/our application in India is based on international application under Patent Cooperation Treaty (PCT) as mentioned in Paragraph-9.~~
- ☐ ~~The application is divided out of my /our application particulars of which is given in~~Paragraph-10 and pray that this application may be treated as deemed to have been filed on DD/MM/YYYY ~~under section 16 of the Act.~~
- ☐ ~~The said invention is an improvement in or modification of the invention particulars of which are given in Paragraph-11.~~

13. FOLLOWING ARE THE ATTACHMENTS WITH THE APPLICATION

(a) Form 2

Item	Details	Fee	Remarks
Complete/ ~~Provisional~~ specification) #	No. of pages:17		
No. of Claim(s)	No. of claims: 10 No. of pages: 02		
Abstract	No. of pages: 01		
No. of Drawing(s)	No. of drawings: 02 No. of pages: 02		

In case of a complete specification, if the applicant desires to adopt the drawings filed with his provisional specification as the drawings or part of the drawings for the complete specification under rule 13(4), the number of such pages filed with the provisional specification are required to be mentioned here.

(b) Complete specification (in conformation with the international application)/as amended before the International Preliminary Examination Authority (IPEA), as applicable (2 copies).

(c) Sequence listing in electronic form

(d) Drawings (in conformation with the international application)/as amended before the International Preliminary Examination Authority (IPEA), as applicable (2 copies).

(e) Priority document(s) or a request to retrieve the priority document(s) from DAS (Digital Access Service) if the applicant had already requested the office of first filing to make the priority document(s) available to DAS.

(f) Translation of priority document/Specification/International Search Report/International Preliminary Report on Patentability.

(g) Statement and Undertaking on Form 3

(h) Declaration of Inventorship on Form 5

(i)Power of Authority

(j)**Total fee ₹…….in Cash/ Banker's Cheque /Bank Draft bearing No..... Date on ……. Bank.**

I/We hereby declare that to the best of my/our knowledge, information and belief the fact and matters slated herein are correct and I/We request that a patent may be granted to me/us for the said invention.

Dated this 15th day of November 2025

Applicant: Vels Institute of Science, Technology & Advanced Studies (VISTAS)

To,

The Controller of Patents

The Patent Office, at Chennai

Note: -

* Repeat boxes in case of more than one entry.
* To be signed by the applicant(s) or by authorized registered patent agent otherwise where mentioned.
* Tick ()/cross (x) whichever is applicable/not applicable in declaration in paragraph-12.
* Name of the inventor and applicant should be given in full, family name in the beginning.
* Strike out the portion which is/are not applicable.
* For fee: See First Schedule";

FORM- 5
THE PATENTS ACT, 1970
(39 of 1970)
&
The Patents Rules, 2003
DECLARATION AS TO INVENTORSHIP
[See Section 10(6) and Rule 13(6)]

1. NAME OF THE APPLICANT(S)

We, **Vels Institute of Science, Technology & Advanced Studies (VISTAS)**having office at, Pallavaram, Chennai – 600117, Tamil Nadu.

hereby declare that the true and first inventor(s) of the invention disclosed in the complete specification filed in pursuance of ~~my~~ / our application numbered _____ dated 15-11-2025~~is/~~are

2. INVENTOR(S)

(a) NAME	**(b) NATIONALITY**	**(c) ADDRESS**
1. Dr. P Brindha Devi	Indian	Associate Professor, Department of Bioengineering, Vels Institute of Science Technology & Advanced Studies, Chennai, Tamil Nadu
2. Dr. J Manjunathan	Indian	Assistant Professor, Department of Biotechnology, Vels Institute of Science Technology & Advanced Studies, Chennai, Tamil Nadu
3. Dr. Meenambiga Setti Sudharsan	Indian	Assistant Professor, Department of Bioengineering, Vels Institute of Science, Technology & Advanced Studies, Chennai, Tamil Nadu
4. Dr. R Sudha	Indian	Associate Professor, Department of Chemistry, Vels Institute of Science Technology & Advanced Studies, Chennai, Tamil Nadu
5. Dr. S Vijayaraj	Indian	Assistant Professor, Department of Electrical and Electronics Engineering, Vels Institute of Science, Technology & Advanced Studies, Chennai, Tamil Nadu
6. Dr. A. Arul Peter	Indian	Associate Professor, Department of Mechanical Engineering, Vels Institute of Science Technology & Advanced Studies, Chennai, Tamil Nadu
7. Dr. M. K. Soundarya	Indian	Assistant Professor, Department of Civil Engineering, Vels Institute

		of Science, Technology & Advanced Studies, Chennai, Tamil Nadu
8. Dr. M. Ruban	Indian	Associate Professor, Department of Mechanical Engineering, Vels Institute of Science, Technology & Advanced Studies, Chennai, Tamil Nadu
9. Mr. Vishal Yadav	Indian	Research Scholar, Department of Biotechnology, Vels Institute of Science, Technology & Advanced Studies, Chennai, Tamil Nadu
10. Dr. A. Sai Ramesh	Indian	Assistant Professor, Department of Bioengineering, Vels Institute of Science, Technology & Advanced Studies, Tamil Nadu
11. Dr. P. Prakash	Indian	Assistant Professor, Department of Mechanical Engineering, Vels Institute of Science, Technology & Advanced Studies, Chennai, Tamil Nadu

~~3. DECLARATION TO BE GIVEN WHEN THE APPLICATION IN INDIA IS FILED BY THE APPLICANT(S) IN THE CONVENTION COUNTRY: -~~

N.A.

~~We the applicant(s) in the convention country hereby declare that our right to apply for a patent in India is by way of assignment from the true and first inventor(s).~~

Dated this 15th day of November 2025

Vels Institute of Science, Technology & Advanced Studies (VISTAS)

Applicant

To,
The Controller of Patents
The Patent Office, Chennai

FORM 3

THE PATENTS ACT, 1970
(39 of 1970)
and
THE PATENTS RULES, 2003

STATEMENT AND UNDERTAKING UNDER SECTION 8

(See section 8; Rule 12)

1. Name of the applicant.	We, **Vels Institute of Science, Technology & Advanced Studies (VISTAS)**having office at, Pallavaram, Chennai – 600117, Tamil Nadu.
2. Name, address and nationality of the joint applicant.	(i) that ~~I/~~We have not made any application for the same/substantially the same invention outside India Or (ii) ~~that I/We who have made this application No… dated alone/jointly with……, made for the same/ substantially same invention, application(s) for patent in the other countries, the particulars of which are given below:~~

Name of the Country	Date of Application	Application No.	Status of the Application	Date of Publication	Date of grant
-	-	-	-	-	-

3. Name and address of the assignee	(iii) that the rights in the application(s) has/have been assigned to …… none …… …… …… that I/We undertake that upto the date of grant of the patent by the Controller, I/We would keep him informed in writing the details regarding corresponding applications for patents filed outside India within six months from the date of filing of such application. **Dated this 15th day of November 2025**

4. To be signed by the applicant or his authorized registered patent agent.	
5. Name of the natural person who has signed.	Vels Institute of Science, Technology & Advanced Studies (VISTAS) **Name of the Applicant**
	To The Controller of Patents, The Patent Office, at Chennai
Note.- Strike out whichever is not applicable;	

FORM 9

THE PATENT ACT, 1970
(39 of 1970)
&
THE PATENTS RULES, 2003

REQUEST FOR PUBLICATION

[See section 11A (2) rule 24A]

I/We **Vels Institute of Science, Technology & Advanced Studies (VISTAS)** hereby request for early publication of my/our [Patent Application No.] TEMP/E-1/125833/2025-CHE

Dated **15/11/2025 00:00:00** under section 11A(2) of the Act.

Dated this(Final Payment Date):----------
Signature
Name of the signatory

To,
The Controller of Patents,
The Patent Office,
At Chennai

This form is electronically generated.