



AAVARTAN'25-26



VIGYAN

DEPARTMENT OF ELECTRICAL ENGINEERING

PROBLEM STATEMENTS

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**EE01: Fire Detection and Automatic Suppression System for Electrical Panels**

Design a compact, retrofit-able protection unit that continuously monitors an electrical panel for early fire indicators—rapid temperature rise, persistent smoke, or arcing—and automatically deploys an internal clean-agent suppression module when a verified threat is detected. The system must send an immediate, tamper-proof alert containing panel ID, timestamp and event type via Wi-Fi or GSM, provide local visible/audible indication, include a manual/remote override, and be safe for operation inside enclosed electrical panels. For evaluation, teams should demonstrate the detection → suppression → alert sequence in a controlled simulation and show recorded logs.

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**EE02: Underwater Inspection Robot for Dam and Reservoir Structures**

Develop a fully waterproof, remotely controlled robot capable of stable multi-directional propulsion, clear low-light video capture, and accurate depth measurement for inspection of submerged infrastructure. The robot must stream live visuals plus depth telemetry to an external display, allow operators to record time-stamped footage, and be manoeuvrable enough to inspect cracks, erosion, sediment build-up, and obstructions in confined or turbid conditions. Demonstrations should show navigation control, image clarity, and data logging in a test tank or pool.

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**EE03: Drone-Based Autonomous Power Line Inspection and Fault Observation**

Create an autonomous aerial inspection system that surveys overhead lines and hardware, acquires stable, geotagged high-resolution imagery from multiple angles, and automatically flags visible defects—broken

fittings, hotspots, vegetation encroachment, or excessive sag. The system must produce an inspection report/dashboard with images, GPS coordinates, and timestamps for each flagged item and allow operator review and manual annotation. Evaluation will judge image quality, autonomous coverage, fault detection clarity, and the readiness of the generated inspection outputs.

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#### **EE04: Smart Protective Wearable for Electrical Hazard Detection**

Design a smart safety helmet that continuously detects hazardous electrical events such as arc flashes, electrical discharges, and unsafe proximity to energized conductors. The helmet must deliver an immediate alert to the wearer using vibration, audible alarm, and visual indication, and it must securely log each event with its timestamp, hazard type, and severity. All logged events must be transmitted to a supervisory system for review. The helmet must operate reliably during normal field movements, include a built-in test mode for safe demonstration, and maintain consistent comfort and performance under simulated working conditions.

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#### **EE05: Wearable EEG Monitoring and Real-Time Seizure Alert System**

Develop a comfortable, dry-electrode EEG headband that continuously records brain activity, reduces motion and environmental artifacts, and detects seizure-like patterns in real time. On validated abnormal activity the device must immediately alert caregivers via local vibration and/or wireless notification and log the event with a timestamp and basic waveform snippet for review. Demonstrations should include artifact-robust signal capture and detection behaviour using provided or simulated EEG data.

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#### **EE06: Intelligent Electricity Theft Detection and Grid Trust Analytics Platform**

Build an analytics platform that cross-compares time-series readings from multiple meters and distribution nodes to detect anomalies indicative of theft—pole tapping, meter bypass, unusual load sharing, or timed manipulation—and estimates likely locations. The platform must quantify confidence for each alert, visualize suspected hotspots on a map/grid, and distinguish normal load variance from malicious patterns using explainable indicators. The solution will be judged on detection accuracy using simulated grid datasets and clarity of actionable outputs.

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**EE07: Wireless Power Transfer Pad for Solar-to-EV Energy Delivery**

Design a contactless wireless power transfer pad that accepts solar input and reliably charges a receiver placed above it despite minor misalignment, while continuously monitoring for foreign metallic objects and instantly cutting power if detected. The prototype should show power transfer efficiency for a prototype EV or small load, include basic alignment guidance/indicator and safety interlocks, and demonstrate controlled shut-down on foreign object detection. Evaluation includes measured transfer stability, safety response, and operational robustness.

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**EE08: Intelligent EV Charging and Multi-User Management System**

Create a smart charging station solution that monitors voltage/current and safety parameters, dynamically schedules multiple users via an automated queue/booking policy, and prevents supply overload by intelligent load allocation. The system must display live session status (user ID, state-of-charge, remaining time), allow safe handover between users, and log sessions for audit. Demonstrations should simulate multiple simultaneous users and show safe, fair management under constrained supply.

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**EE09: Digital Twin–Enabled Predictive Maintenance for Electrical Machines**

Develop a live digital twin of an electrical machine (motor or transformer) that ingests real-time sensor data (temperature, vibration, current), mirrors operating behaviour, and issues health classifications (Normal / Warning / Critical) with trend visualizations and early fault predictions. The twin must allow scenario simulation (e.g., rising vibration) to validate predictions and produce easily interpretable maintenance recommendations. Demonstrations should show real-time updating, fault prediction on simulated anomalies, and a clear UI for operators.

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**EE10: AR-Guided Maintenance Toolkit with Live Equipment Data Overlay**

Build a mobile AR application that recognizes equipment via the camera, overlays essential data (component labels, live sensor readings, safety warnings) and presents clear step-by-step maintenance procedures in

the camera view. The app must pull live IoT telemetry, confirm task completion (user input / sensor feedback), and auto-generate a short maintenance report with timestamps and actions performed. Judging will consider recognition accuracy, clarity of overlaid instructions, and correctness of generated reports.

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**EE11: Secure Peer-to-Peer Energy Trading Platform Using Distributed Ledger**

Design a secure P2P energy marketplace where small solar producers and consumers can post offers and execute trades, with every transaction immutably recorded on a distributed ledger that shows producer, consumer, quantity, price, and updated balances. The platform must demonstrate role separation (producer/consumer/admin), ensure transaction integrity, and provide a clear UI for trade lifecycle (offer → match → transfer → record). Evaluation uses a simulated microgrid scenario to show correctness and auditability.

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**EE12: Solar–Wind Hybrid Microgrid with Intelligent Energy Management**

Construct a compact hybrid microgrid combining solar panels, wind generator and battery storage, governed by intelligent energy management that monitors irradiance, wind speed and battery state to select sources, store excess energy, and maintain stable output to a load. The controller should automatically switch between sources, avoid over-discharge, and display active source, battery level, and load consumption in real time; demonstrations must include changing sunlight/wind conditions and show uninterrupted, safe operation. Performance will be judged on reliability, switching logic and clarity of system telemetry.