PROJECT IDEAS · M.TECH · EEE AND POWER ELECTRONICS · 2026-27

# M.Tech projects for *EEE and power electronics*

These 28 M.Tech projects for EEE and power electronics each start from an open-access IEEE paper published from 2023 to 2026, checked against its DOI record. They cover EV chargers, solar PV and inverters, motor drives, power systems and battery management. Each card is marked **simulation only or simulation plus low-cost hardware** and names one change to measure.

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Every paper on this page was checked against its DOI record on Crossref on 17 November 2026, so the title, first author, journal and year are as IEEE registered them, and all 28 are open access. For our M.Tech service for ECE and EEE students, see M.Tech projects for ECE. For VLSI, wireless, embedded and more power electronics papers, see the IEEE base papers for ECE.

An M.Tech project in EEE or power electronics is judged on numbers: efficiency, harmonic distortion, ripple, settling time, and tracking or estimation error. Each idea below rebuilds a recent IEEE paper, then makes one change that you measure against it on the same model or the same prototype.

## Simulation or hardware: which M.Tech EEE project suits you?

Decide this before you choose a paper, because it sets your tools, your costs and your Stage-II plan. Every card below is marked **Simulation** or **Simulation + low-cost hardware**.

**Simulation-only and hardware M.Tech EEE projects compared**

| QUESTION | SIMULATION | SIMULATION + LOW-COST HARDWARE |
|---|---|---|
| **Suits** | Power systems, protection, stability, forecasting, machine learning on grid or battery data, and converters too large or too high in voltage to build safely | DC-DC converters, motor drives, MPPT on the DC side, battery monitoring and balancing, all at low voltage |
| **Tools** | MATLAB/Simulink, PLECS, PSIM or PSCAD; Python for the machine learning ideas | The same simulation tools, plus a TI C2000 LaunchPad, an STM32 board or an Arduino, gate drivers, voltage and current sensors, and the lab's oscilloscope |
| **Evidence in the thesis** | Simulated waveforms, efficiency from device loss models, THD from an FFT, and comparison tables | Measured waveforms and an efficiency curve from measured input and output power, beside the simulation that predicted them |
| **Main risk** | Results that hold only for your model's parameters; match the base paper's own figures first | Weeks lost to a damaged board or noisy measurements; order parts in Stage-I and buy spares |
| **Safety** | No special risk | Keep the prototype at low voltage and isolated from the mains, and never connect a student-built inverter to the grid |

MATLAB/Simulink, PLECS, PSIM and PSCAD are commercial tools; some offer student, demo or free editions with limits, so check what your lab has before you plan around one. Ask your department which ones it has before you choose a paper that depends on one. Python and its libraries are free.

A simple rule: choose simulation if your college has no power electronics lab or your Stage-II is short, and choose hardware if your guide expects a prototype or you want measured waveforms in your paper. A middle path also works: the full design in simulation, and a scaled-down, low-voltage version on the bench.

# Which M.Tech EEE and power electronics project ideas can you build?

28 ideas in five groups: DC-DC converters and EV charging (5), solar PV and inverters (6), motor drives (5), power systems and smart grid (7), and batteries and BMS (5). Each card gives the problem and what you build. Open "The base paper

and the M.Tech extension" for the paper, the tools, whether it needs hardware, and one change with the comparison table your thesis would contain.

**Topic ideas, not delivered projects**

Each card is built on a published, open-access IEEE paper from 2023 to 2026, checked against its DOI record on Crossref, and describes only what the paper's abstract states. The project around it is an idea to discuss with your guide. Our 8 delivered case studies are M.Tech and M.E. projects, each shown with its real paper pages, screens and results.

## DC-DC converters and EV charging

These ideas sit between the grid, the battery and the motor. Each can be proved in simulation first. A scaled-down converter at a safe low voltage, run from a TI C2000 or STM32 board, turns the efficiency curve into a measured one.

TOPIC IDEA · M.TECH · EV CHARGING

### Two-stage on-board charger with power factor correction for a 48 V EV battery

**Base paper: IEEE Access, 2025**

**Problem:** Electric two-wheelers and e-rickshaws in India are often charged from an ordinary 230 V single-phase socket, and a charger that draws a distorted current pushes harmonics into a low-voltage feeder shared with many other loads.

**Output:** A Simulink model of the paper's charger: a diode bridge and a boost power factor correction stage whose inductor current is shaped with a phase-locked loop, then a push-pull converter in buck mode that charges the battery at constant current. Check the input current harmonics against IEC 61000-3-2, the standard the paper uses.

− The base paper and the M.Tech extension

*Base paper:* A Power Quality Enhanced Push-Pull Converter-Based Two-Stage Onboard Charger for Electric Vehicle Applications, U. S. Padiyar et al., IEEE Access, 2025
*Tools and M.Tech extension:* Tools: MATLAB/Simulink.
**Simulation + low-cost hardware:** a scaled-down, low-voltage prototype controlled by a TI C2000 LaunchPad in place of the paper's dSPACE 1202 controller (the paper tested its own scaled-down prototype with a 48 V, 100 Ah battery). M.Tech extension: the paper charges in constant-current

TOPIC IDEA · M.TECH · EV CHARGING

### Bidirectional EV charger without electrolytic capacitors, using a resonant converter

**Base paper: IEEE Access, 2023**

**Problem:** A charger that can also send power back to the home or the grid (V2H or V2G) must work in both directions, and the bulky electrolytic capacitors usually used to absorb the ripple at twice the line frequency limit its life.

**Output:** A PLECS or Simulink model of the paper's half-bridge, full-bridge resonant converter and controller, showing zero-voltage switching at every switching instant in charging and discharging, active and reactive power control, and the battery current ripple with the DC-side active filter on and off.

− The base paper and the M.Tech extension

*Base paper:* Half-Bridge Full-Bridge AC–DC Resonant Converter for Bi-Directional EV Charger, B. Koushki et al., IEEE Access, 2023
*Tools and M.Tech extension:* Tools: PLECS or MATLAB/Simulink.
**Simulation.**
M.Tech extension: India's grid runs at 50 Hz, so the ripple the active filter must absorb is at 100 Hz. Add a proportional-resonant loop tuned to 100 Hz to the active filter's control, and tabulate the 100 Hz battery current ripple, the DC-side capacitance and the efficiency at several power levels in both directions, with the paper's filter control and with yours

paper charges in constant-current mode, so add the constant-voltage stage a battery needs near full charge, and tabulate input power factor, input current THD, battery current ripple and efficiency at four load points, for constant-current charging alone and for constant-current, constant-voltage (CC-CV) charging.

control and with yours.

TOPIC IDEA · M.TECH · EV CHARGING

### Bidirectional wireless EV charging with dual-phase-shift control

**Base paper: IEEE Access, 2024**

**Problem:** Wireless charging lets a parked car or bus charge without a plug, and a bidirectional link can also feed the grid, but power factor, harmonics and efficiency suffer unless the converters on both sides are controlled together.

**Output:** A simulation of the paper's 3.7 kW, 85 kHz bidirectional wireless link with dual-phase-shift PWM, with power factor, THD, losses and the bifurcation check in both the grid-to-vehicle and vehicle-to-grid directions.

**The base paper and the M.Tech extension**

*Base paper:* Efficient Bidirectional Wireless Power Transfer System Control Using Dual Phase Shift PWM Technique for Electric Vehicle Applications, M. Venkatesan et al., IEEE Access, 2024
*Tools and M.Tech extension:* Tools: MATLAB/Simulink or PLECS.
**Simulation + low-cost hardware:** a low-power bench link with two small coils and two full bridges, phase-shifted by one TI C2000 board. M.Tech extension: the paper reports 94.4% efficiency in simulation and 90.1% in experiments, in both directions. Coupling falls when a car is parked off-centre, so add a loop that retunes the phase shifts to the measured coupling, and tabulate efficiency, power factor

TOPIC IDEA · M.TECH · EV CHARGING

### High-gain bidirectional DC-DC converter for an EV drive with regenerative braking

**Base paper: IEEE Access, 2024**

**Problem:** City traffic in India is stop-start, so an EV that returns braking energy to its battery goes further on a charge. The converter between a low-voltage battery and a high-voltage motor drive must step up while motoring and step down while braking.

**Output:** A Simulink model of the paper's non-isolated high-gain bidirectional converter feeding a motor drive, run through motoring and regenerative braking under several driving conditions, with battery current, DC-link voltage and recovered energy.

**The base paper and the M.Tech extension**

*Base paper:* Performance Analysis of a High Gain Bidirectional DC-DC Converter Fed Drive for an Electric Vehicle With Battery Charging Capability During Braking, C. P. Ragasudha et al., IEEE Access, 2024
*Tools and M.Tech extension:* Tools: MATLAB/Simulink (the paper also used OPAL-RT software-in-the-loop).
**Simulation.** M.Tech extension: drive the model with the Modified Indian Driving Cycle (MIDC) speed profile, and tabulate energy recovered in braking, battery state of charge at the end of the cycle and converter

and THD at three coil offsets for fixed dual-phase-shift settings and for yours.

efficiency in boost and buck modes, for the paper's converter and a conventional bidirectional buck-boost converter of the same rating.

TOPIC IDEA · M.TECH · EV CHARGING

### Dual active bridge converter with virtual DC machine control for a steady DC microgrid bus

**Base paper: IEEE Access, 2024**

**Problem:** In a DC microgrid, such as rooftop solar and a battery feeding DC loads in a building, the bus voltage dips when a large load switches on, because power converters have none of the inertia of a rotating machine.

**Output:** A small-signal model of a dual active bridge with virtual DC machine (VDCM) control, Bode plots and step responses for each control parameter, and load-step simulations with three-parameter and four-parameter adaptive VDCM.

**The base paper and the M.Tech extension**

*Base paper:* **Research on Optimal Control of Dual Active Bridge DC-DC Converter Based on Four-Parameter Adaptive VDCM**, J. Song et al., IEEE Access, 2024
*Tools and M.Tech extension:* Tools: MATLAB/Simulink or PLECS.
**Simulation.**
M.Tech extension: the paper reports about 33% lower peak DC-bus fluctuation and about 25% shorter recovery than three-parameter adaptive VDCM. Add a load-current feedforward to the four-parameter controller, and tabulate peak voltage dip, recovery time and settling time for load steps of 25%, 50% and 100%, for fixed VDCM, the paper's adaptive VDCM and yours.

## Solar PV, MPPT and grid-tied inverters

These ideas suit students who want to work on rooftop and farm solar. Keep student hardware off the mains: test grid-tied control in simulation, and build hardware only for the DC side or for an isolated, low-voltage output.

TOPIC IDEA · M.TECH · SOLAR PV

### Fast global MPPT under partial shading with an improved water cycle algorithm

**Base paper: IEEE Open Journal of the Industrial Electronics Society, 2024**

**Problem:** On Indian rooftops, water tanks, parapets, trees and nearby buildings shade part of a solar array for some hours of the day. The P–V curve then has several peaks, and a simple perturb-and-observe tracker can stop at a local one.

**Output:** A simulated PV array under several shading patterns with the paper's SEPIC converter and improved water cycle MPPT, compared with perturb and observe and particle swarm optimisation on tracking efficiency, tracking time and the power lost when the load changes.

**The base paper and the M.Tech extension**

*Base paper:* A Fast MPPT Method Based on Improved Water Cycle Optimization Algorithm for Photovoltaic Systems Under Partial Shading Conditions and Load Variations, R. I. Jabbar et al., IEEE Open Journal of the Industrial Electronics Society, 2024
*Tools and M.Tech extension:* Tools: MATLAB/Simulink.
**Simulation + low-cost hardware:** a SEPIC run by an STM32 or TI C2000 board from a small panel with covers for shading, or from a PV emulator if your lab has one (the paper used a dSPACE controller). M.Tech extension: the paper reports 99.92%

TOPIC IDEA · M.TECH · SOLAR PV

### Reinforcement learning MPPT with soft actor-critic under partial shading

**Base paper: IEEE Open Access Journal of Power and Energy, 2025**

**Problem:** MPPT in a rooftop inverter must keep up with passing clouds and moving shade. Learning-based trackers promise to find the global peak without hand-tuned rules, but they have to be tested on conditions they were not trained on.

**Output:** The paper's PV array and boost converter written as a Markov decision process, with soft actor-critic (SAC), deep Q-network (DQN) and perturb-and-observe trackers compared on tracking accuracy under standard conditions, changing irradiance and partial shading.

**The base paper and the M.Tech extension**

*Base paper:* Soft Actor-Critic-Based MPPT Control of Solar PV Systems Under Partial Shading Conditions, S. E. Nwachukwu et al., IEEE Open Access Journal of Power and Energy, 2025
*Tools and M.Tech extension:* Tools: Python with PyTorch, Gymnasium and Stable-Baselines3, or MATLAB with the Reinforcement Learning Toolbox.
**Simulation.**
M.Tech extension: train with randomised shading patterns and panel parameters, then test on shading patterns the agent never saw, and tabulate tracking efficiency, time to reach the global

average tracking efficiency and 0.475 s tracking time. Restart the global search only when a shading change is detected, and tabulate tracking efficiency, tracking time, steady-state power oscillation and energy captured over a moving-shadow profile, for perturb and observe, the paper's method and yours.

peak and power oscillation for perturb and observe, DQN, the paper's SAC and your SAC.

TOPIC IDEA · M.TECH · SOLAR PV

### Cubic high-gain DC-DC converter for partially shaded grid-connected PV

**Base paper: IEEE Access, 2026**

**Problem:** A low-voltage PV string must be stepped up a long way to reach a grid inverter's DC link, and a plain boost converter then runs at extreme duty cycles, with high losses and device stress.

**Output:** A simulation of the paper's single-switch cubic-gain converter feeding a three-phase two-level inverter, with grid-current-based maximum power injection (no PV-side voltage or current sensors) and particle swarm search for the global peak, compared with a conventional boost converter under the same shading patterns.

**The base paper and the M.Tech extension**

*Base paper:* A Cubic High-Gain DC–DC Converter for Improved Maximum Power Extraction in Partially Shaded PV Systems, V. K. Raushan et al., IEEE Access, 2026
*Tools and M.Tech extension:* Tools: MATLAB/Simulink or PLECS.
**Simulation.**
M.Tech extension: replace the silicon switch and diodes with SiC parts in the loss model and raise the switching frequency to shrink the inductors, and tabulate efficiency from 20% to 100% load, inductor and capacitor values, and device voltage stress for the paper's design and yours.

TOPIC IDEA · M.TECH · SOLAR PV

### GaN five-level cascaded H-bridge inverter driven by a TI C2000 board

**Base paper: IEEE Access, 2023**

**Problem:** Home inverters and solar inverters can be made smaller and cooler with switches that switch faster and waste less energy. GaN transistors do this, but few students see how they behave in a multilevel inverter.

**Output:** Simulations of half-bridge, full-bridge and five-level cascaded H-bridge inverters with phase-shifted PWM, then GaN half-bridge evaluation boards switched by PWM from a TI C2000 microcontroller, as in the paper's hardware-in-the-loop setup.

**The base paper and the M.Tech extension**

*Base paper:* Hardware Evaluation for GaN-Based Single-Phase Five-Level Inverter, A. A. Hadi et al., IEEE Access, 2023
*Tools and M.Tech extension:* Tools: PLECS or MATLAB/Simulink, and TI Code Composer Studio.
**Simulation + low-cost hardware:**
a TI C2000 LaunchPad and GaN half-bridge evaluation boards, run at a low DC voltage. M.Tech extension: compare phase-shifted PWM with level-shifted (phase disposition) PWM on the same five-level inverter, and tabulate output voltage THD, switching frequency per device, estimated switching loss and the filter inductance each needs for the same current THD.

TOPIC IDEA · M.TECH · SOLAR PV

### 13-level reduced-switch multilevel inverter with switching angles found by black widow optimisation

**Base paper: IEEE Access, 2024**

**Problem:** A multilevel inverter gives a cleaner sine wave than a two-level one, but each extra level usually adds switches and gate drivers. A reduced-switch topology switched once per cycle at well-chosen angles keeps harmonics low with fewer parts and less switching loss.

**Output:** MATLAB code that finds the switching angles of the paper's 13-level reduced-switch inverter with black widow optimisation (BWO) to minimise THD and weighted THD, compared with two other bio-inspired algorithms, and a Simulink model of the inverter fed from one PV source through a multi-winding flyback converter.

**The base paper and the M.Tech extension**

*Base paper:* Lower Output Voltage Harmonics With Optimum Switching Angles of Single PV-Source Based Reduced Switch Multilevel Inverter Using BWO Algorithm, R. Mohanty et al., IEEE Access, 2024
*Tools and M.Tech extension:* Tools: MATLAB and Simulink.
**Simulation + low-cost hardware:** a single-phase, low-voltage version of the inverter, with gate signals from an STM32 or Arduino board reading a table of angles. M.Tech extension: in practice the flyback outputs are not exactly equal, so recompute the angles for the measured DC

TOPIC IDEA · M.TECH · SOLAR PV

### Lower switching loss in a single-phase rooftop PV inverter with modified hysteresis current control

**Base paper: IEEE Access, 2025**

**Problem:** Many rooftop solar systems on Indian homes feed the grid through a single-phase inverter. Hysteresis current control is simple, but it switches at a high, varying rate that wastes energy as switching loss.

**Output:** A Simulink model of a single-phase grid-connected rooftop PV system with conventional hysteresis current control, unipolar-toggle modulation and the paper's modified unipolar-toggle hysteresis current control (UTHCC), compared on switching frequency, switching loss and current THD.

**The base paper and the M.Tech extension**

*Base paper:* An Improved Current Control Scheme for Reduced Switching Frequency in a Rooftop Grid-Interfaced PV System, A. K. Dey et al., IEEE Access, 2025
*Tools and M.Tech extension:* Tools: MATLAB/Simulink (the paper also validated the scheme on an OPAL-RT 4510 real-time simulator and in hardware).
**Simulation.**
M.Tech extension: the paper reports up to 32% lower switching frequency in real-time and hardware tests, and 3.4% lower THD than unipolar-toggle modulation. Vary the hysteresis band with the grid voltage angle to hold the switching frequency nearly constant, and

angles for the measured DC voltages, and tabulate THD, weighted THD and fundamental voltage error with equal and with ±10% unequal DC sources, for the fixed angles and your recomputed ones.

frequency nearly constant, and tabulate average and peak switching frequency, switching loss and current THD at 25%, 50% and 100% power for hysteresis control, UTHCC and yours.

## Motor drives: PMSM, BLDC and SRM

Drive ideas can be tested on low-voltage motor-control kits, a TI C2000 or STM32 board with a small PMSM or BLDC motor, so the thesis can show measured speed and current waveforms as well as simulation.

TOPIC IDEA · M.TECH · MOTOR DRIVES

### Sensorless PMSM speed control with super-twisting sliding mode for an electric three-wheeler

**Base paper: IEEE Access, 2026**

**Problem:** Electric three-wheelers such as e-rickshaws carry changing passenger loads on uneven city roads, so the speed controller must hold speed through load changes without the chattering of ordinary sliding mode control, and ideally without a shaft sensor.

**Output:** A Simulink model of the PMSM, the three-wheeler's vehicle dynamics and an SVPWM inverter, with an extended state observer for sensorless speed, comparing super-twisting sliding mode control with PI, sliding mode, sliding mode with an exponential reaching law and fractional-order sliding mode control.

**The base paper and the M.Tech extension**

*Base paper:* Sensorless Speed Control of a PMSM Using Super-Twisting Sliding Mode Control for Three-Wheel Electric Vehicle Propulsion, H. Tadele et al., IEEE Access, 2026
*Tools and M.Tech extension:* Tools: MATLAB/Simulink.
**Simulation + low-cost hardware:** a low-voltage PMSM or BLDC motor on a TI C2000 or STM32 motor-control kit. M.Tech extension: the paper reports a settling time of 0.0619 s with 0.1507% overshoot at 100 rad/s. Add a load-torque observer with feedforward to the

TOPIC IDEA · M.TECH · MOTOR DRIVES

### Rotor position estimation for sensorless FOC of a PMSM with a super-twisting sliding mode observer

**Base paper: IEEE Access, 2025**

**Problem:** Fans, pumps and compressors with PMSM motors save cost and wiring by dropping the shaft position sensor, so the controller must estimate the rotor angle, and the chattering and filter delay of a basic sliding mode observer spoil the estimate.

**Output:** A Simulink model of a 0.75 kW surface-mounted PMSM under sensorless field-oriented control, with a conventional sliding mode observer and low-pass filter beside the paper's super-twisting observer with a modified phase-locked loop, compared on position and speed error during speed and load changes.

**The base paper and the M.Tech extension**

*Base paper:* Rotor Position Estimation for a Position-Sensorless FOC PMSM Drive—A Super-Twisting-Based Sliding Mode Observer Approach, J.-P. Chang et al., IEEE Access, 2025
*Tools and M.Tech extension:* Tools: MATLAB/Simulink.
**Simulation + low-cost hardware:** the paper reports simulation only, so running the observer on a TI C2000 or STM32 motor-control kit with a small PMSM adds measured results. M.Tech extension: add an I-f start-up that hands over to the observer

observer with feedforward to the speed loop, and tabulate settling time, overshoot, speed dip and recovery time after a sudden load step and on a slope, for PI, the paper's controller and yours.

that hands over to the observer above a set speed, and tabulate position error at low, medium and rated speed, the speed dip at handover and the share of successful starts under load, in simulation and on the kit.

TOPIC IDEA · M.TECH · MOTOR DRIVES

### Lower torque ripple in an open-end winding BLDC motor fed by two inverters

**Base paper: IEEE Access, 2024**

**Problem:** BLDC motors in e-scooters, fans and pumps produce torque ripple, felt as vibration and heard as noise. Feeding an open-end winding from two inverters gives more voltage vectors to reduce it.

**Output:** A simulation of the paper's dual-inverter open-end winding BLDC drive with peak current control and its two multilevel space-vector PWM schemes for low and high speed, in which only one inverter switches at a time, compared with conventional switching on torque ripple, switching loss and dv/dt.

**The base paper and the M.Tech extension**

*Base paper:* Multi-Level Voltage Space Vector Structure Based Control Strategy With Reduced Torque Ripple for Open-End Winding BLDC Motor Drives, U. Hari Krishna et al., IEEE Access, 2024
*Tools and M.Tech extension:* Tools: MATLAB/Simulink or PLECS.
**Simulation + low-cost hardware:** two three-phase inverter boards and a TI C2000 LaunchPad (the paper used a TMS320F28377S controller) with a small BLDC motor. M.Tech extension: replace the fixed vector selection with a finite-set model predictive controller that picks the vector giving the least torque error, and tabulate torque ripple, phase current THD and switching frequency

TOPIC IDEA · M.TECH · MOTOR DRIVES

### A simple four-phase switched reluctance motor drive for a ceiling fan

**Base paper: IEEE Access, 2023**

**Problem:** Ceiling fans run for long hours in Indian homes, so a cheaper, more efficient fan motor matters. A switched reluctance motor needs no magnets, but its current ripple and noise must be kept low for a fan.

**Output:** A simulation of the paper's four-phase switched reluctance motor (SRM) with an asymmetric bridge converter and Hall-sensor commutation, with no speed or current loop, showing phase currents, current ripple and torque ripple at fan speeds.

**The base paper and the M.Tech extension**

*Base paper:* A Simple Four-Phase Switched Reluctance Motor Drive for Ceiling Fan Applications, P. Kumar et al., IEEE Access, 2023
*Tools and M.Tech extension:* Tools: MATLAB/Simulink, with the motor's flux-linkage data from the free FEMM finite element tool or from measurements.
**Simulation + low-cost hardware:** an asymmetric bridge switched by an Arduino or STM32 board reading the Hall sensors, if your lab has a low-voltage SRM. M.Tech extension: tune the turn-on and turn-off angles for each fan speed setting, for example with a genetic algorithm, and tabulate input power, current ripple and torque ripple at each speed setting for the paper's fixed angles

current THD and switching frequency at 10%, 50% and 100% of rated speed, for six-step control on one inverter, the paper's scheme and yours.

setting for the paper's fixed angles and your tuned ones.

TOPIC IDEA · M.TECH · MOTOR DRIVES

### Fast simulation model for MPPT design in a PMSM solar water pump under partial shading

**Base paper: IEEE Access, 2025**

**Problem:** Solar water pumps irrigate farms across India, and shade from trees or poles cuts the water they lift. Testing MPPT on a full switching model of the inverter and motor is slow, which limits how many designs a student can try.

**Output:** The paper's analytically derived equivalent model of the inverter and PMSM pump, checked against a full switching model under uniform and partially shaded irradiance, then used to design the MPPT controller and to study how its convergence time affects overshoot and settling time.

**The base paper and the M.Tech extension**

*Base paper:* **Stability Assessment of PMSM-Based Solar Water Pumping System in Partially Shaded Conditions Using an Analytical Equivalent Model**, D. Shetty et al., IEEE Access, 2025
*Tools and M.Tech extension:* Tools: MATLAB/Simulink.
**Simulation.**
M.Tech extension: add a global MPPT, such as particle swarm, to the same model and run a full shaded day, and tabulate shaft power and energy, settling time and overshoot for perturb and observe and for your global tracker, with the simulation time of the equivalent model and of the full switching model

the full switching model.

## Power systems, protection and smart grid

These are simulation and data projects, so they suit students without a power electronics lab. Generate fault, stability and relay data on IEEE test systems in MATLAB/Simulink or PSCAD, and train the learning models in Python.

TOPIC IDEA · M.TECH · POWER SYSTEMS

### Electricity theft detection from monthly meter readings with machine learning

**Base paper: IEEE Access, 2025**

**Problem:** Theft and meter tampering add to the losses Indian discoms report. Where consumers still have conventional meters read once a month, inspection teams need a short, ranked list of premises to visit.

**Output:** Decision tree, naive Bayes, random forest, k-NN, logistic regression and a deep neural network trained on monthly consumption, with the paper's layered filtering through three-theft, two-theft and one-theft models to produce a ranked inspection list.

**The base paper and the M.Tech extension**

*Base paper:* Electricity Theft Detection Using Machine Learning in Traditional Meter Postpaid Residential Customers: A Case Study on State Electricity Company (PLN) Indonesia, A. P. Taruna et al., IEEE Access, 2025
*Tools and M.Tech extension:* Tools: Python with pandas and scikit-learn.
**Simulation.**
The paper used private data from Indonesia's state utility PLN and reports accuracy 0.89 and recall 0.98 for random forest with k-NN, so use the public SGCC electricity theft dataset of daily readings. M.Tech extension: sum the daily readings into monthly bills to mimic a conventional meter, and tabulate precision, recall, F1, AUC and the hit

TOPIC IDEA · M.TECH · POWER SYSTEMS

### Short-term load forecasting for a distribution system with a GA-enhanced LSTM

**Base paper: IEEE Access, 2024**

**Problem:** Discoms schedule power a day ahead, so a poor forecast for the evening peak means costly last-minute purchases or load shedding.

**Output:** The paper's LSTM whose inputs are combined by an efficient parallel genetic algorithm (EPGA), using wind, humidity, temperature, season, load history and holiday peaks, compared with a plain LSTM on RMSE and MAPE.

**The base paper and the M.Tech extension**

*Base paper:* Short-Term Load Forecasting for Electrical Power Distribution Systems Using Enhanced Deep Neural Networks, S. Tsegaye et al., IEEE Access, 2024
*Tools and M.Tech extension:* Tools: Python with TensorFlow or PyTorch, and a genetic algorithm library such as DEAP.
**Simulation.**
The paper used Ethiopian Electric Utility data for Jimma town and reports an RMSE about 7.5% better than the LSTM alone; use a public hourly load series with weather data, or demand data from your state load despatch centre (SLDC) if it publishes it. M.Tech extension: weight errors at the evening peak more heavily in the training loss, and tabulate overall MAPE, peak-hour MAPE and RMSE for a plain LSTM, the EPGA-LSTM and yours

precision, recall, F1, AUC and the hit rate in the top 5% of the ranked list for monthly and for daily data, to show how much a smart meter's finer readings help.

EPGA-LSTM and yours.

TOPIC IDEA · M.TECH · POWER SYSTEMS

### Transmission line fault detection and classification with a CNN on voltage and current waveforms

**Base paper: IEEE Access, 2025**

**Problem:** A transmission line fault must be detected and its type identified within cycles so that the right breaker trips, and in a large interconnected grid like India's, a slow or wrong decision can spread an outage.

**Output:** A Simulink model of the IEEE 9-bus system that generates post-fault voltage and current time series, with fault type, location and resistance varied, and a CNN trained to detect and classify the faults.

**The base paper and the M.Tech extension**

*Base paper:* Time Series-Based Fault Detection and Classification in IEEE 9-Bus Transmission Lines Using Deep Learning, S. Jiriwibhakorn et al., IEEE Access, 2025

*Tools and M.Tech extension:* Tools: MATLAB/Simulink or PSCAD for the fault data, and Python with PyTorch or the MATLAB Deep Learning Toolbox for the CNN.

**Simulation.**

M.Tech extension: the paper reports an MSE of zero for detection on its simulated data, so test robustness: add measurement noise and current transformer saturation, and test on the IEEE 14-bus system without retraining. Tabulate accuracy for each fault type at each noise level, on the 9-bus and the 14-bus system.

TOPIC IDEA · M.TECH · POWER SYSTEMS

### Transient stability assessment from PMU data with deep transfer learning

**Base paper: IEEE Access, 2023**

**Problem:** After a large disturbance, grid operators need to know within moments whether the generators will stay in step. Phasor measurement units (PMUs) supply fast data, and a learning model must never call an unstable case stable.

**Output:** Training data from time-domain simulations of the IEEE 39-bus and 118-bus systems, PMU state variables turned into feature maps of disturbance severity, and ImageNet-pretrained CNNs fine-tuned with some layers frozen, compared by confusion matrix and under noise.

**The base paper and the M.Tech extension**

*Base paper:* Transient Stability Assessment Using Deep Transfer Learning, J. Kim et al., IEEE Access, 2023

*Tools and M.Tech extension:* Tools: MATLAB/Simulink for the simulations, and Python with PyTorch or the MATLAB Deep Learning Toolbox for the networks.

**Simulation.**

M.Tech extension: shorten the post-fault observation window and drop some PMU channels, and tabulate accuracy and the rate of unstable cases called stable at each window length, for the paper's best network and a lighter one such as MobileNetV2.

TOPIC IDEA · M.TECH · POWER SYSTEMS

### Adaptive overcurrent relay coordination for distribution networks that change topology

**Base paper: IEEE Access, 2025**

**Problem:** When a feeder is reconfigured or rooftop solar is added, fault currents change, and relay settings chosen for one topology can trip the wrong breaker or trip too slowly.

**Output:** Network topologies grouped by K-means and particle swarm optimisation, with the number of clusters checked by the elbow and silhouette methods, then cuckoo search to set the time multiplier settings for each cluster, with standard and non-standard relay characteristics compared on operating time and coordination time interval.

**The base paper and the M.Tech extension**

*Base paper:* Adaptive Clustering and Optimization With Hardware-in-the-Loop Validation for Enhanced Overcurrent Relay Protection in Power Distribution Networks, A. Elhaffar et al., IEEE Access, 2025
*Tools and M.Tech extension:* Tools: MATLAB for the clustering and optimisation, with fault currents from ETAP (as in the paper), PSCAD or a MATLAB short-circuit model.
**Simulation.**
The paper adds hardware-in-the-loop tests. M.Tech extension: add rooftop solar inverters at several buses of the test feeder, which

TOPIC IDEA · M.TECH · POWER SYSTEMS

### Grid-forming inverter for a hybrid wind-solar plant on a weak grid

**Base paper: IEEE Open Journal of Power Electronics, 2024**

**Problem:** Wind and solar plants built far from load centres can connect through long lines to a weak grid, where inverters that only follow the grid voltage can become unstable.

**Output:** A simulation of the paper's hybrid generator, a permanent magnet wind generator with a voltage-source rectifier and a PV array sharing the DC side of a grid-forming inverter, with its small-signal model, compared with grid-following control on a very weak grid, and tested through faults.

**The base paper and the M.Tech extension**

*Base paper:* Grid-Forming Voltage-Source Inverter for Hybrid Wind-Solar Systems Interfacing Weak Grids, A. Radwan et al., IEEE Open Journal of Power Electronics, 2024
*Tools and M.Tech extension:* Tools: MATLAB/Simulink or PSCAD.
**Simulation.**
The paper adds real-time simulation tests. M.Tech extension: add a battery on the DC side for short-term frequency support, and tabulate the lowest short-circuit ratio with stable operation, the frequency nadir and the DC-link voltage swing after a load step and a fault, for grid-following control, the paper's grid-forming control and yours.

buses of the test feeder, which changes the fault currents, and tabulate total relay operating time and coordination violations for fixed settings, the paper's clustered settings and settings re-optimised for each solar level.

TOPIC IDEA · M.TECH · POWER SYSTEMS

## Microgrid energy management with deep reinforcement learning that accounts for battery wear

**Base paper: IEEE Access, 2026**

**Problem:** A campus, hospital or factory with rooftop solar and a battery saves money only if the battery charges and discharges at the right hours under a time-of-day tariff, without wearing the battery out early.

**Output:** A soft actor-critic energy management agent for a grid-connected microgrid with PV, a microturbine and a battery modelled with nonlinear losses and cycle degradation, compared with other controllers under time-of-use and real-time pricing.

### The base paper and the M.Tech extension

*Base paper:* Deep Reinforcement Learning-Based Energy Management of a Microgrid With Nonlinear Battery Losses and Degradation, H. Jang et al., IEEE Access, 2026

*Tools and M.Tech extension:* Tools: Python with Gymnasium and Stable-Baselines3.

**Simulation.**

M.Tech extension: set the model up with your state's commercial time-of-day tariff and a year of campus load and PV data, then add a day-ahead PV forecast to the agent's inputs, and tabulate total cost, battery throughput and peak grid import for a rule-based controller, the paper's agent and yours

the paper's agent and yours.

## Batteries and BMS: SOC, SOH and balancing

Public cell test data, such as NASA's and CALCE's, cover the estimation work. For hardware, a small pack of cells with an STM32 or Arduino board logging voltage, current and temperature is enough. Never charge lithium cells without a protection circuit.

TOPIC IDEA · M.TECH · BMS

### State-of-charge estimation with an extended Kalman filter whose battery parameters change with SOC

**Base paper: IEEE Access, 2023**

**Problem:** An EV or e-scooter shows its remaining range from the BMS's state-of-charge estimate, and a Kalman filter with fixed battery parameters drifts as the cell's resistance and capacitance change with charge and with temperature, which in India runs from cold winter mornings to hot summer afternoons.

**Output:** An equivalent-circuit cell model with parameters extracted at different SOC levels, C-rates and temperatures, and the paper's EKF that updates the parameters by SOC section, compared with a conventional EKF on RMSE and maximum error.

**The base paper and the M.Tech extension**

*Base paper:* State-of-Charge Estimation Method for Lithium-Ion Batteries Using Extended Kalman Filter With Adaptive Battery Parameters, J. Yun et al., IEEE Access, 2023
*Tools and M.Tech extension:* Tools: MATLAB/Simulink, with public cell test data at several temperatures, such as CALCE's.
**Simulation + low-cost hardware:** the filter running on an STM32 board fed with logged or live voltage, current and temperature. M.Tech extension: the paper extracted parameters at 0, 25 and 45 °C and

TOPIC IDEA · M.TECH · BMS

### SOC, SOH and state-of-power estimation combining an LSTM with an extended Kalman filter

**Base paper: IEEE Access, 2025**

**Problem:** A BMS for a hot country must estimate charge, health and available power over a wide temperature range. A neural network needs data covering every condition, and a Kalman filter is only as good as its battery model.

**Output:** An LSTM model and time-series analysis combined with an extended Kalman filter to estimate state of charge, state of health and state of power at 0, 25 and 45 °C, compared with the LSTM alone and the EKF alone.

**The base paper and the M.Tech extension**

*Base paper:* Estimation of Essential Battery State Parameters for Battery Management Systems (BMS) in Electric Vehicles Using Long Short Term Memory (LSTM) and Time Series Analysis Combined With Extended Kalman Filter, N. Sradha et al., IEEE Access, 2025
*Tools and M.Tech extension:* Tools: Python with TensorFlow or PyTorch and FilterPy, or MATLAB.
**Simulation.**
The abstract does not name the data, so read the paper's data section; public NASA or CALCE cell data can stand in. M.Tech extension: replace the LSTM with a GRU or a small temporal CNN that would fit on a BMS microcontroller, and tabulate SOC and SOH error at each

parameters at 0, 25 and 45 °C and reports up to 49.37% lower RMSE than a conventional EKF. Make the parameters depend on temperature as well as SOC, and tabulate RMSE and maximum SOC error at each temperature and two C-rates for the conventional EKF, the paper's EKF and yours, with run time per step on the STM32.

SOC and SOH error at each temperature, model size and inference time for the paper's LSTM with EKF and yours.

TOPIC IDEA · M.TECH · BMS

### Battery state-of-health estimation: a fair benchmark of five machine learning regressors

**Base paper: IEEE Access, 2026**

**Problem:** Reusing EV batteries for solar storage, and valuing a used EV, both depend on knowing a battery's state of health, and a complex model that looks good on one random split can fail on a new cell.

**Output:** Linear regression, decision tree, SVR, random forest and XGBoost trained on six per-cycle inputs from NASA's B0005 and B0006 cells and a synthetic set, and tested with random, leave-one-battery-out and chronological splits.

− The base paper and the M.Tech extension

*Base paper:* Comparative Benchmarking of Five Machine Learning Regressors for Lithium-Ion Battery State of Health Estimation: Temporal and Cross Cell Robustness Evaluation, A. Singh et al., IEEE Access, 2026

*Tools and M.Tech extension:* Tools: Python with scikit-learn and XGBoost, and NASA's public battery ageing data.

**Simulation.**

M.Tech extension: the paper finds plain linear regression the most robust, with $R^2$ of about 0.991 to 0.993 in the leave-one-battery-out test. Add features from the incremental capacity (dQ/dV) curve, and tabulate MAE, RMSE and $R^2$ under leave-one-battery-out and chronological splits for the paper's

TOPIC IDEA · M.TECH · BMS

### Active cell balancing: comparing equaliser topologies and Si, SiC and GaN switches

**Base paper: IEEE Access, 2025**

**Problem:** Cells in a series pack drift apart in charge, and the weakest cell then limits the whole pack. Passive balancing burns the extra charge as heat, which a pack in an Indian summer can do without; active balancing moves it between cells.

**Output:** Simulations of the paper's three active equalisers (a hierarchical buck-boost on SOC difference, a bidirectional flyback using the mean and spread of SOC, and a fuzzy-controlled buck-boost), with Si, SiC and GaN MOSFETs compared on balancing speed, power loss and stability.

− The base paper and the M.Tech extension

*Base paper:* Comparative Analysis of Battery Equalization Strategies: Evaluating the Impact of Semiconductor Devices (Si, SiC, GaN) on Balancing Speed and Efficiency, Y. Wang et al., IEEE Access, 2025

*Tools and M.Tech extension:* Tools: MATLAB/Simulink or PLECS.

**Simulation + low-cost hardware:** a four-cell buck-boost equaliser driven by an STM32 board, with cell voltages read by a battery monitoring IC. M.Tech extension: add cell temperature as a third fuzzy input, so that hot cells are balanced more gently, and tabulate time to balance, energy lost in balancing

chronological splits for the paper's six inputs and your added features, on the NASA cells and on a second public set such as CALCE's.

balance, energy lost in balancing, final SOC spread and peak cell temperature for the paper's fuzzy buck-boost and yours.

TOPIC IDEA · M.TECH · BMS

### Early detection of internal short circuits in a lithium-ion pack from temperature anomalies

**Base paper: IEEE Access, 2024**

**Problem:** An internal short circuit in one cell can heat a pack towards thermal runaway, and EV and e-scooter packs in India often work in high ambient temperatures, so the BMS must tell a developing fault from a hot day.

**Output:** A simulated 3 kWh pack of 18650 cells with faults injected at temperatures from –20 °C to +60 °C, and the paper's level-shift anomaly detector compared with isolation forest and elliptic envelope on detection accuracy and detection time.

**The base paper and the M.Tech extension**

*Base paper:* Integrating Level Shift Anomaly Detection for Fault Diagnosis of Battery Management System for Lithium-Ion Batteries, D. Hethu Avinash et al., IEEE Access, 2024

*Tools and M.Tech extension:* Tools: MATLAB/Simulink for the pack and the faults, and Python with scikit-learn for the detectors.

**Simulation.**

M.Tech extension: the paper reports 97% accuracy from temperature data. Add cell voltage and current as inputs, and tabulate accuracy, false alarms over normal drive cycles and time from fault start to alarm for the paper's temperature-only detector and your multi-signal one, at 25 °C

and your multi-signal one, at 25 °C and at 45 °C ambient.

KEY POINTS

- **28 M.Tech EEE and power electronics ideas,** each built on an open-access IEEE paper from 2023 to 2026 and checked against its DOI record.
- **Five groups:** converters and EV charging (5), solar PV and inverters (6), motor drives (5), power systems and smart grid (7), and batteries and BMS (5).
- **All free to read:** 25 papers are in IEEE Access, and one each in the IEEE Open Journal of Power Electronics, the IEEE Open Journal of the Industrial Electronics Society and the IEEE Open Access Journal of Power and Energy.
- **Every card is marked** Simulation or Simulation + low-cost hardware, with the tools named.
- **Every card names one measured change** and the table that compares it with the base paper.

### Choosing an M.Tech EEE project?

Send your specialisation, the software and kits your lab has, and your Stage-I date. The consultation is free.

Message before 7 pm for a reply today.

Free consultation →

WhatsApp

# What results must an M.Tech EEE thesis show?

Whatever the topic, an EEE thesis needs three things: the base paper reproduced, your change measured on the same model or prototype, and the numbers side by side. Plan these results in Stage-I, so that every Stage-II run collects them.

### Results an M.Tech EEE or power electronics thesis should show, and how to get them

| RESULT | WHAT TO SHOW | HOW |
|---|---|---|
| **Efficiency curve** | Efficiency against output power from light load to full load, for the base design and yours on one plot | In simulation, from device loss models (conduction and switching); on hardware, from measured input and output power at each load step |
| **THD and harmonics** | Current or voltage THD and the harmonic spectrum, with the standard you compare against named, such as IEC 61000-3-2 in the on-board charger paper above | An FFT over whole line cycles in Simulink or PLECS; on hardware, a power analyser or the oscilloscope's FFT |
| **Settling time and dynamics** | Settling time, overshoot and steady-state error after a step in reference, load or irradiance | The same step applied to the base controller and to yours, with the settling band (2% or 5%) stated |
| **Waveforms** | Gate signals, switch voltage, inductor current, output voltage, phase currents, speed and torque | Labelled oscilloscope captures or simulation plots, with axes and units, on the same time scale for both designs |
| **Ripple and stress** | Inductor current ripple, output voltage ripple, and device voltage and current stress | Peak-to-peak and peak values read from steady-state waveforms |
| **Accuracy (learning and estimation ideas)** | RMSE, MAE or MAPE for estimates and forecasts; precision, recall, F1 and a confusion matrix for classifiers | A held-out test set split by day, cell, feeder or fault location where the data allow, not only a random shuffle |
| **Comparison with the base paper** | Your result beside the base paper's method on the same model, data or board | One row per metric, with columns for the paper's reported figure, your reproduction and your extension |

Compare like with like. Reproduce the base paper's method in your own model or on your own board, and compare your change with that, not with figures the paper got on different hardware.

Write the thesis in your university's format; our M.Tech thesis format guide sets out the chapters. For the reproduction step, including what to do when your numbers do not match the paper's, read how to implement a base paper.

## How does an M.Tech EEE project run from Stage-I to Stage-II?

Many universities split the M.Tech project into two stages, each with a report and a review; check your own university's regulations for the exact split. For an EEE or

power electronics project, the work usually falls like this.

### Stage-I: literature, base paper and reproduction

1. **Literature and the base paper.** Read the recent papers on one problem, choose the base paper, and write down the gap your change will address. Our guide on how to select a base paper covers the checks.
2. **Reproduction in simulation.** Rebuild the paper's circuit, controller or model in MATLAB/Simulink, PLECS, PSIM, PSCAD or Python, and put your waveforms and numbers beside the paper's.
3. **Design of the extension.** Fix the one change, the test conditions and the table you will fill in Stage-II. If you will build hardware, order the boards and parts now.
4. **Stage-I report and review.** Literature, gap, the reproduced baseline and the plan. Our base paper presentation guide covers the slides.

### Stage-II: extension, results, thesis and paper

1. **Extension.** Add your change to the model, and build the low-voltage prototype if your project has one.
2. **Results.** Run the base method and your change under the same conditions, and fill the comparison table.
3. **Thesis.** Write it in your university's format, with the efficiency curves, waveforms and tables from the section above.
4. **Paper.** If your course asks for one, write the result as a conference or journal paper. See our IEEE paper format guide.

## How can we help with an M.Tech EEE or power electronics project?

We check the base paper first: whether it can be reproduced with the tools your lab has, whether it needs hardware, and whether the extension fits your time. Then we reproduce it, plan one measured extension with you, build and test it in simulation

or on a low-voltage prototype, and support the Stage-I and Stage-II reports, the thesis and, if you need one, a paper and viva preparation.

See how an ECE or EEE project runs, track by track, on our M.Tech projects for ECE page. For the M.Tech service across branches, with the thesis and the paper, see M.Tech projects. More M.Tech lists built on verified IEEE base papers: M.Tech VLSI projects, M.Tech projects on embedded systems and IoT and M.Tech projects in machine learning.

We build, guide, help with the writing and explain every result. The thesis you submit must follow your university's rules and cite the base paper.

# Frequently asked questions

### Which is the best M.Tech project for EEE?

There is no single best one. A good M.Tech EEE project rebuilds a recent IEEE paper in MATLAB/Simulink or a similar tool, then makes one change you measure against it, such as higher efficiency, lower THD or faster settling. Each of the 28 cards on this page names such a change. Our guide to selecting a base paper covers the checks.

### Can I do an M.Tech power electronics project only in simulation?

Often yes, but ask your guide first, because expectations differ between universities. Power system studies are normally done in simulation. For converters and drives, a small low-voltage prototype on a TI C2000, STM32 or Arduino board adds measured waveforms and an efficiency curve, which makes the thesis stronger.

### Which software is used for M.Tech EEE projects: MATLAB, PLECS, PSIM or PSCAD?

MATLAB/Simulink covers converters, drives and control, and many of the papers on this page use it. PLECS and PSIM are built for fast simulation of switching circuits, PSCAD for electromagnetic transients in power systems, and Python for machine

learning on load, fault and battery data. Use what your lab has a licence for, and name the version in your thesis.

### What are good M.Tech power system project topics?

Topics with public data or standard IEEE test systems work best: fault detection and classification, transient stability assessment, load forecasting, relay coordination with rooftop solar, grid-forming inverters, microgrid energy management and electricity theft detection. Each has a card in the power systems group above. For more papers, see the IEEE base papers for ECE.

### What should the M.Tech extension be in a power electronics project?

One change you can measure against the base paper on the same model or prototype: a new control loop, a different modulation, SiC or GaN switches, a new MPPT rule or a test under new conditions. Put both in one table with efficiency, THD, ripple or settling time. Our base paper implementation guide shows how to reproduce the paper first.

### Can The Ultimate Project World help with an M.Tech EEE project?

Yes. Send the DOI of your base paper, the software and kits your lab has, and your stage review dates in the free consultation. We tell you which parts we can take on, such as the simulation, a low-voltage prototype, the thesis, an IEEE-format paper and viva preparation. Our M.Tech projects service explains how it runs.

RELATED SERVICES

# From a topic to a project you can present

### M.Tech projects

A base paper, one measured extension, a paper and the thesis.

### IEEE projects

Start from a published base paper and extend it.

### Research papers

A paper in IEEE, Springer or journal format, and a journal shortlist.