# ***EE673 – Power Systems and Power Electronics Laboratory***
# ***Spring Semester, 2025***

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**PowerPulse:** Designing a 60W AC-DC Converter for Mobile Charging

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## Problem Statement:

Design and develop a high-efficiency digitally controlled AC-DC converter that provides a regulated 12V DC output at 60W, specifically for mobile charging applications. The converter should accept an input voltage range of 85V-270V (RMS) AC and ensure stable operation with features such as voltage regulation. The design should prioritize compactness, cost-effectiveness, and reliability.

Students must choose one of the following flyback converter topologies for their design:

- Conventional Flyback Converter
- Quasi-Resonant Flyback Converter
- Active-Clamped Flyback Converter

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## Design Specifications:

- Input Voltage: 85V-270V (RMS) AC
- Output Voltage: 12 VDC (regulated)
- Output Power: 60W
- Output Current: 5A
- Performance Criteria:
    - Output Voltage Ripple, Load Voltage Regulation(specified over the load range 10% to 100% of full load), Line Voltage Regulation will be measured to compare designs of different groups.

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**Marks distribution:** Weightage: 35% (midterm review for 50%- final submission 50%)

## Design Requirements:

1. Efficiency: Minimize energy loss during AC to DC conversion for high efficiency.
2. Regulation: Ensure stable 12V output across varying input voltages and loads.
3. Temperature: Operate reliably within specified temperature range with proper thermal management.
4. EMI: Minimize EMI emissions and manage parasitics to avoid interference.
5. PCB Size & Power Density: Design should be compact with high power density for 60W output.
6. Cost: Stay within ₹5000 budget for components; additional costs are borne by the team.

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**Logistics:**

1. **Timeline:**
    - Stage 1 Evaluation: 12 March
        - Deliverables: Schematic design, 3D PCB design, and BOM.
    - Final Submission: After the end-of-semester examination.
2. **Budget:**
    - Total Budget: ₹5000 per team for component procurement.
    - Any costs beyond ₹5000 must be borne by the students.
    - Submit your BOM to the course coordinator for approval.
3. **Lab Access:**
    - Lab hours: Every Wednesday, thursday and Friday, 2:00 p.m. - 7:00 p.m.
    - Each group will be assigned a Teaching Assistant (TA) for guidance throughout the project.
    - If you feel that you require more time to spend in the lab other than the lab hours, please inform the RAs beforehand.
4. **Component Procurement:**
    - Components should be requested through the course coordinator by submitting the BOM.
    - The BOM should include 2-3 times the required components to ensure there's a margin for any potential delays or unforeseen issues.
5. **PCB Fabrication:**
    - PCBs can be fabricated either through the college PCB lab or from external sources (within the ₹5000 budget).
    - Submit Gerber files to the PCB lab for fabrication.
6. **Safety and Equipment:**
    - Follow all lab safety protocols (e.g., wear shoes in the lab).
    - Ensure that the power supply is turned on only after the TA/RA checks the circuit.
7. **Microcontroller Usage:**
    - Microcontrollers will be provided for use in the design and will not count toward the PCB size metric.
    - Return microcontrollers at the end of the lab sessions in good condition.

**General instructions:**

- Each group should stick to one table as per their group number during the entire project duration.

- Machines lab have some components like switches, heat sinks, some passives like resistors and capacitors (both smd and through-hole) which can be issued from the lab.

- Each group will be provided with a toolkit box at the beginning of the project and a locker will be provided for each group where the toolkit needs to be kept after the lab session. Once the project is finished, the toolkit box must be returned to the lab authority. If anything in the toolkit box is found to be damaged/missing, then the corresponding group has to take responsibility to fix/replace it; otherwise, no marks will be allotted for the project.

- If MCU is damaged, the students will have to arrange for their own replacement. This will also take 10 days to come, so be careful while using MCU.

- You are allowed to use the resources of the Electrical Machines Lab only. Do not bring any equipment from the other labs without permission of the professor/instructor for this lab.

- When the students are in the lab, no power testing, access to scopes, power supplies, etc. should be given without the supervision of an RA/TA.

**Some useful resources:**

**i)** https://youtu.be/-efYc_h28Kw?feature=shared

**ii)** https://youtu.be/pjkghX6uOoA?feature=shared

**iii)** https://youtu.be/XTURnO6MYck?feature=shared

**iv)** https://youtu.be/3_s7yAOuPaw?feature=shared

**v)** https://youtu.be/udptHumklqU?feature=shared

**vi)** PMP7453 reference design | TI.com

**vii)** https://acrobat.adobe.com/id/urn:aaid:sc:AP:fb9c5a32-ee52-40ad-b6f7-0f8d15c6dbe5

**viii)** https://acrobat.adobe.com/id/urn:aaid:sc:AP:c5ab2fb6-d60f-4bf0-99d5-484c33cac2f6

**ix)** https://acrobat.adobe.com/id/urn:aaid:sc:AP:33b7633d-8a93-4cad-8e40-bafa7e3a089f

**x)**https://acrobat.adobe.com/id/urn:aaid:sc:AP:58f0a10e-5409-4fd5-85de-4e504ad0142e

**xi)** https://acrobat.adobe.com/id/urn:aaid:sc:AP:bbb0481c-a465-45ca-acde-43b2d1efa352

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Good luck with your design project!

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