Indian Institute of Technology, Kanpur

Department of Sustainable Energy Engineering

Proposal for a New Course

1. **Course Number:** SEE6xx
2. **Course Title:** Power Electronics for Electric Vehicles
3. **Per Week Lectures:** 3_(L), Tutorial: _(T), Laboratory: _(P), Additional Hours[0-2]: ___(A)
4. **Duration of Course:** Full Semester
5. **Proposing Department:** SEE

   Other Departments/IDPs which may be interested: EE

   Other faculty members interested in teaching: Dr. Suvendu Samanta
6. **Proposing Instructor**: Amarendra Edpuganti
7. **Course Description:**

Electric vehicles (EVs) are gradually replacing the conventional vehicles due to climate concerns, shortage of oil resources, and energy security. Power electronics plays an important role in EVs for charging battery from grid and/or renewables, power train, and powering the auxiliary loads. The aim of this course is to give students a deeper understanding of the state-of-the-art power converters used in electric vehicles in terms of operation, analysis, component design, and closed-loop control. Also, the course will cover some of the promising power converters for EVs from the ongoing research.

This course consists of four modules starting with the basics of EVs and the role of power electronics for EVs. The second module focuses on analysis, design, and control of power converters for on-board chargers. The third module focuses on different types of front-end converters including solid state transformers, and high power dc-dc converters for off-board charging. Also, this module covers analysis and design of conventional and multiport converters for renewables assisted EV charging and partial power processing converters for EV fast charging. The last module covers the design and control of dc-dc converters for interfacing the battery and control of dc-ac inverters for induction motor, brushless dc motor, and permanent magnet synchronous motor for EVs.

8. **Learning Objective:** At the end of this course, a student should be able to-

   - Understand the role of power electronics in EVs.
   - Analyze, design, and control of different types of power converters for EV charging, motor control, and dc-dc converters for interfacing the battery.
   - Study and analyze the upcoming or promising converters for EVs

9. **Contents:**

S. No	Broad Title	Topics	No. of Lectures
1	Introduction	Basics of EVs, and role of power electronics in EVs	3

2	On-board EV Chargers	CCM and DCM based power factor correction converters, dual active bridge converter, and integrated on-board chargers.	14
2	Off-board EV Chargers	Front-end converters, solid-state transformers, multilevel converters, conventional and multiport converters for renewables assisted EV charging, and partial power processing converters	14
3	Power Train	Dc-dc converters for interfacing battery, control of dc motors, control of induction motors, permanent magnet synchronous motors, and brushless dc motors.	11
		Total lectures	42

10. Pre-requisites: EE360 (Power electronics) or EE660 (Basics of power electronic converters) or consent of instructor (only for EE/SEE students)

11. Textbooks:

1. "Fundamentals of Power Electronics", Robert W. Erickson and Dragan Maksimovic, Springer, Third Edition 2020.
2. K. T. Chau - Electric Vehicle Machines and Drives: Design, Analysis and Application. Wiley-IEEE Press (2015).
3. Iqbal Husain, ELECTRIC and HYBRID VEHICLES, Design Fundamentals, CRC Press, 2021.
4. “Power Converters for Electric Vehicles”, L. Ashok Kumar and S. Albert Alexander, CRC Press, 2020.

Dated: 6/9/2024 Proposer: Amarendra Edpuganti

DPGC Convener : _____

The course is approved / not approved

Chairman, SPGC

Dated:_____