DESIGN OF ELECTRIC VEHICLE SYSTEMS

A course under Global Initiative of Academic Networks (GIAN)

Overview

The increased competences of future engineers will boost the electrification of transport means used in India. The potential of electrification is huge: electrification can improve the air quality and produce new business opportunities in India. With sufficient competences, Indian engineers can develop own products for local companies. The products for electro-mobility exits, but are not limited to electrical vehicle design, manufacturing, charging, and infrastructure. Various opportunities exist also in services related to electro-mobility, such as search engines for charging stations, vehicle-to-vehicle communication, and other service related smart phone and mobility. Significant opportunities exist, particularly in lightweight vehicles such as three wheeler auto-rickshaw and two-wheelers.

Electrical vehicles are booming in Western Countries, California and Norway being the early adaptors for the electrification of transport. Countries with large cities and high population density have started to consider electrical vehicles as a solution for air quality problems in their major cities. China has been a forerunner in electrifying two-wheelers used in large cities. Similarly, it is likely Indian vehicles will electrify in near future. Electrification of electric vehicles will have profound impact in the smart cities planned in India.

The course will deal with electrical vehicle design including the design of the vehicle components, system level design and optimization as well as the infrastructure design. The course is given by internationally known academics that both have about 20-year experience on mechanical engineering, electro-mechanics and power electronics. The hosting faculty, Professor Kalita at the IIT Guwahati, has worked on rotor dynamics, electro-mechanics, electrical machines. He has worked for University of Nottingham and Converteam Ltd, in the UK. The visiting faculty, Professor Tammi at the Aalto University Finland, has worked on rotor dynamics, electrical vehicles, and energy efficiency of electro-mechanical power transmission systems in electrical busses and ships. He has earlier worked at the Technical Research Centre of Finland and North Carolina State University. The host and the visiting faculty have collaborated in multiple projects in the area of electro-mechanics and have now focused on electrical vehicle research together.

Course Objectives:

- Understand the electrical vehicle functions and will be able to recognize various components required for different electrical vehicles.
- Be able to choose components for a given electrical vehicle design and dimension them according to the specification.
- Be able to integrate electrical vehicle components into a system and design for necessary controls.
- Understand the requirement for the infrastructure, including various charging and power distribution solutions, required for electrical vehicles.
- Be competent to evaluate an electrical vehicle design and infrastructure, design using simulation tools.
- Be able to use software simulation tools for vehicle modeling.

The course would cover the following topics:

Basics of Electric Vehicles, Electrical vehicles and their impact on CO_2 and other exhaust emissions. Infrastructure required for electrical vehicles including charging, maintenance and repair.
Review of existing design of Electric Vehicles, Electrical vehicle design, performance, operation, and charging. Hybrid vehicle principles: serial, parallel, electrical, hydraulic.
Basics of electric motors, induction motors, synchronous motors, torque production characteristics, Electrical motor topologies and operations principles: radial, axial and transversal flux motors. Torque production and characteristics of induction, permanent magnet and reluctance motors.
Variable frequency supply, electrical converters, switching and control. The embedded design of the converters.
The most common battery chemistries. The principles of the fuel cell operation. The energy storage system integrations and safety aspects.
Requirements for charging and fueling infrastructure.
Specification of the electrical vehicle in concordance with driving cycle and range requirements. Building up a simplified computational model of the powertrain.
Electrical vehicle design and design evaluation using the computational model. Performance assessment.
Basics of vehicle dynamics. The impact of electrical powertrain on vehicle dynamics.
The opportunities provided by electrical power train. Summary and feedback.
Electrical vehicle as a part of transport system, smart mobility, smart cities.
Refinement of the electrical vehicle powertrain model for the design power transmission efficiency assessment.
Driving cycle estimation, electrical vehicle energy usage.
Efficiency assessment based on the powertrain model and driving cycle estimation.
System level design for electrical vehicles in a transport system. Route planning, charging infrastructure.
Charging infrastructure and hydrogen (or methane) distribution for fuel cell vehicles.
State-of-the-art-review, case: charging stations, electrical vehicles, and electrical busses in Helsinki and Oslo.
Projections for the future, how electro-mobility will develop, what is role of smart cities, future mobility services.
Summary and feedback

Duration	November 29, 2016 to December 10, 2016
You Should Attend If…	You are Executives, engineers and researchers from manufacturing, service and government organizations including R&D laboratories. Students at all levels (BTech/MSc/MTech/PhD) or Faculty from reputed academic institutions and technical institutions. Number of participants for the course will be limited to 50
Fees	The participation fees for registering the course is as follows: **Student Participants: INR 1,000/- (refundable)** **Participants from abroad: US $500** **Industry/ Research Organizations: INR 30,000/-** **Academic Institutions: INR 10,000/-** The above fees include all instructional materials, computer use for tutorials and assignments (if any), laboratory equipment usage charges, 24 hr free internet facility. The participants will be provided with accommodation on payment basis in hostels (details will be available later in the webpage).

The Faculty

Dr. Kari Tammi is Associate Professor, (Design of Mechatronic Machines) at Aalto University. His area of interest is in the field of mechatronics, electrical machines, hybrid energy systems, dynamic phenomena in machineries, and their control.

Dr. Karuna Kalita is Associate Professor(Department of Mechanical Engineering) at Indian Institute of Technology Guwahati(IITG). . His area of interest is in the field of Rotordynamics, Coupled Dynamics of Electro-Mechanical Systems, Vibration.

Course Co-ordinator

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