

## Second Laureate Applied Research

26<sup>th</sup> Khwarizmi International Award (KIA)



● **Project Title:** Design and Development of Hybrid Electric Bus

● **Executive Organization:** Vehicle, Fuel and Environment Research Institute of University of Tehran - Road and Railway Vehicles Research Group of Isfahan University of Technology  
-Tose'e, Khodro Kar Co.

● **Representative:** Dr. Mohsen Esfahanian

● **Collaborator Organizations:** - Automobile Parts Quality Improvement and Standardization Support Organization of Ministry of Industry, Mines and Trade - Iran Fuel Conservation Co.- Iran Khodro Industrial Group- Industrial Development and Renovation Organization- Technology Cooperation Office - Saba Battery Co.- Gita Battery Co.- Super Pipe Co.Safae Arshi, Ghader Shokrollahi, Arash Ahmadi, Mostafa Jafarzadeh.

● **Collaborators:** Vahid EsfahanianHassan -Nehzati Paghale -Alireza Jafari Reza-Kolaei-Seyed-Mojtaba Mirsoheil -Meisam Amiri Bavandpour- Yadollah Zakeri Hossain-Abadi- Masoud Masih -Tehrani -Hossain Sagha -Manouchehr Manteghi- Damoon Bazargan -Zeinab Pour -Bafarani- Kamran Mahoutchi -Saeed -Ali Safaei -Mohammad Javad Najafian - Ali Mahmoudian - Ramin Farnia -Ali Manteghi -Farhad Sangtarash -Mohammad Esmaeilzadeh- Masoud Besharat -Ahmad Javaheri -Mehdi Soufi -Hesam Akbarian -Parisa Amiri Bavandpour -Pooya Malekinejad Dezfouli -Mehdi Abolghasem -Sina Porsa -Ehsan Ghasemi -Mazdak Gorji -Hadi Rahemi -Ali Nabi Bidhendi -Amir Fazeli -Arash Akhgari.

### ● **Abstract:**

Hybrid technology has become the main solution for the reduction of fuel consumption and emission in vehicles in recent years. In this project, the series hybrid system is implemented on the O457 City bus. Two traction motors controlled by the drivers exclusively designed are the providers of the traction effort needed to operate the bus. The electric energy is produced either by the engine-generator set, or by the 168 lithium-polymer 3.7V40-Ah batteries. These batteries are packed in 12 boxes that are equipped by contactor, fuse, cooling system and Battery Management System (BMS). One of the main improvements this system provides is that the braking energy is also regenerated preventing the energy loss in conventional vehicles. The engine may be off in some parts of driving cycle, thus, the auxiliary motor has to drive all accessory loads such as compressors, alternator, etc. Due to deference in their working temperature, three sets of cooling systems for the engine, electric machines and the battery packs are provided in the hybrid electric bus.

In the electric energy distribution system, each device is protected by a contactor-fuse set. The Hybrid control system software consists of four subsystems implemented on micro-controllers of the drives, the main controller and BMS. Drive control software controls the drivers, and therefore the electric motors can provide suitable speed and torque. Switch management is performed by Vehicle Control Software (VCS) which turns off/on the battery and power contactors with respect to the vehicle switch position. DMMS software connects driver and traction motors and applies proper protections for motors and batteries. HCS software determines the operation conditions of the engine and the generator. For the traction motors and the generator drives, vector control algorithm is used. Communication of all components are done by CAN protocol.

