Dept. of Secured Smart Electric Vehicle

As an effort to address technical demands and issues from rapidly changing future societies and to lead the creatively integrated technical industries, Department of Secured Smart Electric Vehicle has been established since September 2013, to educate topic oriented engineers. More specifically, the department targets to cultivate engineers with thorough understanding of IT security and smart electric vehicle with the grant of BK21 plus for the education of target-oriented engineers from the government. As of March 2017, 11 full time professors are leading the department to educate 8 Ph.D. and 28 M.S. students to become the specialist in the field of secured smart electric vehicles. With the strong relationship with Hyundai-Kia Motors, Hyundai Mobis and many other tier 1 and tier 2 companies, many research topics related to security enhances electric vehicle systems are pursued in the department. 3 out of 11 full-time faculties are specializing in the automotive engineering and the rest are specializing in the electronic and in the computer engineering. Furthermore, some members of the faculty have successfully implemented the integrated solution of a battery swappable smart electric bus and with this experience from the industrial applications, it is strongly believed that the department has a full capacity of educating graduate students with industry oriented solution approach.

☐ Courses

❑ Core Courses

· Power System Control (3)

Characteristics of power system will be introduced and the related fundamentals will also be provided. Furthermore, various operation and management strategy for the power system control including economic load dispatch, unit commitment, state estimation, voltage control, frequency control and stability analysis and more.

· Control and Applications of Electric Machines (3)

Fundamentals and applications of electric machines are discussed. Initially, theory of electric energy conversion is introduced to understand the function of transformers and electric machines. Secondly, most popular electric machines such as AC synchronous motor and induction motor will be studied in detail and finally the control algorithms for the rpm and torque of the machine utilizing power inverters with PWM control with axis transformation system.

· Understanding of Information Security (3)

Basic concept of information security will be discussed and the advanced theory will also be introduced. Symmetric key algorithm, hash function, MAC technique, Public key system, digital signature, key management techniques will be discussed.

· Understanding of the Principles of Electric Vehicles (3)

Fundamentals of the electric vehicle structures and core components are explained in

this course. Prior to the discussion of secured smart electric vehicles, solid understanding of the electric vehicle will be achieved.

· **Electric Vehicle Control Engineering (3)**

Based on the fundamentals of control theory, system analysis of the electric vehicle will be discussed and the control algorithm for the analyzed electric vehicle will be detailed.

· **Knowledge of some kind of Communication (3)**

Fundamentals of M2M and IoT will be introduced to understand the core concepts and furthermore. new trends for the M2M, IoT will be discussed.

· **Vehicle Sound and Vibration (3)**

In this class, noise and vibration sources of vehicle are found out and various kinds of control methods are treat to decrease their levels through the objective and subjective evaluation. In addition, sound design and vibration reduction technique considering human perceptual feelings are studied.

· **Smart Electric Vehicle System (3)**

Advanced functionality in the smart electric vehicle systems and the core components are discussed in the lecture. Further applications and future of the smart electric vehicles are also detailed.

· **Charging System for Smart Electric Vehicle (3)**

Battery charging systems, battery exchange system, battery management system and communication protocols for the smart charging architectures are introduced and detailed.

· **Security System for Smart Electric Vehicle (3)**

Enhanced security systems for the internal and external communications of the smart electric vehicle will be introduced. Various possibilities will be further discussed in the lecture.

· **Information System for Smart Electric Vehicle (3)**

Information exchange systems for smart electric vehicles such as vehicle to vehicle connection, vehicle to infrastructure networks are introduced and discussed to evaluate the pros and cons of various information sharing technologies.

· **Secured Smart Electric Vehicle System (3)**

In order to prevent hacking of the vehicle control systems, various security system has to be implemented in the secured smart electric vehicle systems. Especially for the system which directly controls the brake system, electric machines, higher security level is required. In this course, various ideas and techniques will be discussed to achieve the higher security levels for the smart electric vehicle operation.

· **Charging Infrastructure for Secured Smart Electric Vehicle (3)**

In this course, charging facility, communication system, central operation of the facility management including fee collection methods for the electricity used for the smart electric vehicle charging will be generally discussed. Future technologies for the advanced charging infrastructures will also be introduced.

· **Information Security System for Secured Smart Electric Vehicle (3)**

Specialized security enhancement for the smart electric vehicles will be discussed and the related security encoding algorithms will be introduced and trained.

· **Linear Control System (3)**

In order to understand the linear system modeled based on the state-space model of modern control theory, stability of the model, pseudo controllability, pseudo observability will be introduced and discussed. Based this understanding, optimum control and observational design will be studied through examples of successful applications.

· **Embedded Linux System Programming (3)**

Several considerations on implementation of embedded system based on Linux operation system are discussed. Programming techniques for embedded systems using Linux system calls are studied.

· **ECU Design (3)**

Fundamentals of ECU(Electronic Control Unit) design and ECU Hardware/Software design techniques are studied.

· **Advanced Topics on Transportation Infrastructure (3)**

This subject will demonstrate the development trends of transportation infrastructure; and discuss modernization of transportation and technical factors that should be considered when planning transportation infrastructure.

· **Transportation Planning for Smart Electric Vehicle (3)**

Transportation planning and applied research in related technologies regarding provision of safe and efficient driving environment for smart electric vehicle.

· **Vehicle Network System (3)**

Vehicle network system is a automobile-IT convergence technology, which wireless communication network combined with vehicle. The vehicle network technology provides vehicle safety and diagnostics, telematics, ITS and other services. This course goes to training for vehicle communication network technology. Details educational contents is as follows: One is a In-Vehicle Network technologies including LIN(Local Interconnect Network), CAN(Controller Area Network), FlexRay. And the other is Vehicle-to-Vehicle Network and Vehicle-to-Infrastructure Network(V2I) technologies based on Wireless Access In Vehicle Environments(WAVE), Dedicated Short-Range Communications(DSRC), Wireless Personal Area Network(WPAN), and so on. Additionally, study networking technologies for autonomous driving based on the previously learned vehicle network technologies.

· **Signal Measurement and Analysis (3)**

This class studied how to measure and analyze acoustic and vibrational signals. To this end, the followings are treated: acoustic and vibrational sensors, FFT, transfer function, filters, sound identification techniques.

· **Understanding of Automotive Electronic Systems (3)**

This course involves understanding of characteristics and basic operation of analog

passive/active elements, digital logic circuits and microcontrollers. It is also an introductory course on instrumentation, control, and diagnosis of drive systems, chassis systems, and body systems in vehicles.

· **Understanding of Battery Management Circuit for Smart Electric Vehicle (3)**

Understand the basic structure and operation of a battery management system. Also, core analog/digital circuits for the battery management system such as DC-DC converters or active battery balancing circuits are introduced.

· **Understanding of Intelligent Transport System (3)**

Develop an understanding of ITS which applies advanced technologies in electricity, control and communication to modes and systems of transport in order to enhance the efficiency and safety of transportation operation.

· **Future Prospects Transportation System based on ICT (3)**

With the prospect of a mega-trend and transportation system in the future, design a transport system of electric cars based on ICT applications.

· **Research Ethics & Thesis Study (3)**

Research ethics will be discussed for the M.S. and Ph.D. students with the typical examples occurring in the research and development environment. Furthermore, internationally acknowledged rules and regulations will be discussed and the purpose and the importance of observing the regulations will be studied with renown examples and cases.

☐ **Faculty Members**

Oh, Ha Ryoung
Seoul National Univ., B.S.
KAIST, M.S.
KAIST, Ph.D.
Computer Engineering
hroh@kookmin.ac.kr

Ahn, Hyun Sik
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ., Ph.D.
Control Engineering
ahs@kookmin.ac.kr

Hong, Sung Soo
Seoul National Univ., B.S.
KAIST, M.S.
KAIST, Ph.D.
Power Electronics
hongss@kookmin.ac.kr

Park, Jun Seok
Kookmin Univ., B.S.
Kookmin Univ., M.S.
Kookmin Univ., Ph.D.
RF/Microwave Circuit Design
jspark@kookmin.ac.kr

Choi, Woong Chul
Seoul National Univ., B.S.
The Ohio State Univ., M.S.
The Ohio State Univ., Ph.D.
Mechanical Engineering
danchoi@kookmin.ac.kr

Choi, Sun Woong
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ., Ph.D.
Computer Network
schoi@kookmin.ac.kr

Kang, Yeon Sik
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Univ. of California Berkeley, Ph.D.
Mechanical Engineering
ykang@kookmin.ac.kr

Kim, Ji Hye
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Univ. of California Irvine, Ph.D.
Security and Privacy, Applied Cryptography
jihyek@kookmin.ac.kr

Chae, Hyung Il
Seoul National Univ., B.S.
University of Michigan., M.S.
University of Michigan., Ph.D.
RF/Analog Integrated Circuit Design
hichae@kookmin.ac.kr

Shin, Sung Hwan
KAIST, BS.
KAIST, M.S.
KAIST, Ph.D.
Acoustics (Noise&Vibration Control)
soulshin@kookmin.ac.kr

Chang, Hyuk Jun
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Imperial College London., Ph.D.
Control Theory and Applications
hchang@kookmin.ac.kr