

Dept. of Security Enhanced Smart Air Mobility

The department of security enhanced smart air mobility is established to lead the highest level of education services in the field of urban air mobility solution including drone delivery system, drone taxi, flying car as well as urban air-traffic management. With the strong support from government, the urban air mobility is believed to pioneer the future of new industries which have never been experience before. In cooperation with domestic and international air industries and in alliance with automotive industries, the department has organized two special majors such as an urban air mobility major and a security enhanced smart mobility major in order to educate highly profession engineers in those fields.

☐ 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.

- **Mobility Noise 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.

- **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.

- **Special Topics in UAM 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.

- **UAM Transportation System Planning(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 Mobility Electric System(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.

- **Smart Mobility Energy Management System (3)**

In this class, students will learn about the principles of energy management systems (EMS) for smart mobility such as electric vehicles, electric ships, and air mobility to improve energy efficiency of electric power generation and electric propulsion systems. This class will cover the operation algorithm of the EMS for smart mobility using the efficiency curve of electric power drives considering loading conditions and energy storing techniques. Students will also learn how to apply various optimization techniques to improve the performance of EMS of smart mobility.

- **Autonomous and Collaborative Transportation 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.

- **Special Topics in Security of Mobility Infrastructure (3)**

This course deals with the secured interfaces of Air Traffic Management control System between Urban Air Mobility Platform and Ground Control Systems,

- **Mathematics and Optimization in Artificial Intelligence(3)**

This course covers the mathematics fundamental to recent deep learning and AI methodologies, including linear algebra and non-linear optimization. Details on topics such as fundamental vector spaces of a matrix, eigen analysis, low-rank constraints, positive definiteness of a matrix, and singular value decomposition, as well as details of gradient descent, Newton's method, and convex optimization will be included.

- **Special Topics in Security of Smart Mobility(3)**

This course involves collision avoidance technologies of smart mobility for security and safety.

- **Project Based Prelim(PBP) (3)**

In advance taking a "Project Based Learning" course, This preliminary course will be covered " Research Methods", "Research Planning and Programming", "Data Analysis Methods", " Writing Method for Research Paper" etc

- **Project Based Learning(3)**

Students acquire self-directed knowledge and skills by discovering practical research topics related to given smart mobility and solving and exploring problems by themselves through cooperation

- **Project Based Research(3)**

Based on the self-directed learning ability cultivated through the Project Based Research, This research is conducted to cultivate empathy, insight, creativity, and application ability to solve new mobility research tasks

- **Team Teaching & Research(3)**

This class organizes a research team for each subsystem that consist of the mobility system, Students conduct their research for each team, and cultivate the research ability of each team by sharing and synthesizing the results.

- **Independent Study(3)**

In order to cultivate individual research ability, students independently carry out the each individual research on mobility-related topics. And then write and present their research results as papers

- **Unmanned Air Mobility Design(3)**

Based on the requirement of capability of unmanned air mobility, students carry out design process of air mobility configuration according to the system engineering procedure.

- **Flight Control and Guide(3)**

This course introduces the equation of motion of the unmanned air vehicle to maintain the stability and maneuverability, and students learn the theory of automatic control that performs th stability of unmanned air mobility

- **Special Topics in Unmanned Air Mobility UX(3)**

The theory of interface operation of human-machine system for friendly and safe operation of unmanned aerial mobility and situation recognition techniques are studied.

- **Air Mobility Network(3)**

Fundamentals techniques for air mobility network are studied.

- **Machine Learning and Deep Learning(3)**

Machine Learning is concerned with computer programs that automatically improve their performance through experience (e.g., programs that learn to recognize human faces, recommend music and movies, and drive autonomous robots). This course covers the core concepts, theory, algorithms and applications of machine learning. We cover supervised learning topics such as classification (Naive Bayes, Logistic regression, Support Vector Machines, neural networks, k-NN, decision trees, boosting) and regression (linear, nonlinear, kernel, nonparametric), as well as unsupervised learning (density estimation, clustering, PCA, dimensionality reduction).

- **Computer Vision(3)**

This course covers established theories along with more recent developments of computer vision. Particularly, the foundation and characteristics of cameras and images, determining and matching feature points, reconstructing 3-D structure, estimating and tracking motion, image classification, scene parsing and semantic segmentation will be included. Deep learning and machine learning methodologies that are critical for computer vision will also be described. Students will also gain practical skills by actually implementing specific methods through programming.

- **Advanced Aero Dynamics(3)**

The theory of advanced aerodynamics will be applied to the air mobility configurations. Especially, Computational Fluid Dynamics methods are introduced to calculate the aerodynamic forces and moments around the air mobility.

- **Flight Dynamics(3)**

This class is primarily concerned with the provision of good flying and handling quality in the new Air mobility. Flight dynamics is about the relatively short term motions of an air mobility in response to a control input or an external disturbance based on the motion of equations. Therefore, flying and handling qualities are described qualitatively.

- **Special Topics in Mobility Solution(3)**

The aim of this module is to propose user centred mobility design solution. The qualitative design research methodology such as in-depth user interview, observation along with key principle of service design are explored to generate rich design insight and design outcome.

- **Mobility Design Studio(3)**

It is a studio class that discusses design of ground mobility, infrastructure, etc. with unmanned aerial vehicles at the center and combines practical design processes to produce design results.

- **Special Topics in Design(3)**

The aim of this module is to provide wide perception about the history of mobility and design, studying evolution of transport, current social issue and context along with paradigm shifts in mobility industry.

- **Mobility Inclusive Design(3)**

The value of inclusive designs lies in understanding various issues of user including their circumstance, physical issues and demands. Hence, inclusive design approach including in-depth user experience analysis and co-production design workshops are explored to propose inclusive design led mobility design.

- **Ultra Low Latency Smart Mobility Communication(3)**

Fundamentals techniques for ultra low latency smart mobility communication are studied.

- **Special Topisc in Smart Mobility Infrastructrue(3)**

Students learn about the airspace system, the air route system, the air traffic system, the airport and vertiport system, and the flight control system that support smart mobility.

- **Smart Mobility Information System(3)**

Students learn about information systems such as geographic information, environmental information, weather information, flight information, safety information, and control information that support smart mobility.

- **Special Topics in Smart Mobility(3)**

Students learn about the concept of operation of smart mobility, the smart mobility ecosystem, core technology elements, and technology development prospects.

- **Database Structure and Algorithm for Autonomous and Collaborative Transportation(3)**

Fundamentals techniques for database structure and algorithm for autonomous and collaborative transportation are studied.

- **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.

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