# Elective Course Description (1. Fall Semester)

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| Subject (English) | Electricity and Magnetism A | Semester | Fall | Day/Slot | |
| 科目名 (日本語) | 電磁気学 A | | | | |
| Course Code | | Course Numbering | TEI-ELM303 | Period | Oct. – Feb. |
| Instructors (Post) | Professor Taiichi Otsuji, Professor Takumi Fujiwara | | | Campus | |
| | | | | Building | |
| Faculty | Department of Electrical, Information and Physics Engineering | Credits | 2 | Class Room | |

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| Class subject | Electricity and Magnetism |

**Object and summary of class**

Electricity and Magnetism (EM) is a branch of physics and one of the fundamental and key studies in the engineering. This course object is to study the fundamental idea and theory of the static characteristics of EM. Two professors will give the lectures weekly. The students will practice solving basic EM problems after each lecture.

The basis of EM is the knowledge of electrons in free space and substances. Electrons behave as charge-carrier particles and waves with characteristic kinetic energy and wave numbers. The fundamental physical properties of solids depend upon the static distributions and dynamic motions of electrons, which is governed by well-known Coulomb's law in electro-statics, Ampere's Law in magneto-statics, and Faraday's law in electro-magnetic dynamics. This course covers the electro-statics and magneto-statics, which will be followed by the consecutive course Electricity and Magnetism B. The motions of electrons such as velocity and angular momentum are described with vectors. Therefore, the vector analysis is indispensable to understand the EM, which will be studied first as the fundamental Mathematical basis.

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| Keywords | Vector analysis, Electro-statics, Electric field, Electric potential, Magneto-statics. |

**Goal of study**

For the first step, students are requested to obtain perfect knowledge of the laws and principles of EM, and practical skills for solving basic EM problems by choosing pertinent laws and principles of EM.

**Contents and progress schedule of class**

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| 1: Introduction and outline | (Prof. T. Fujiwara) |
| 2: Vector Analysis | |
| 2.1: Vector Algebra | |
| 2.2: Differential Calculus | (Prof. T. Fujiwara) |
| 2.3: Integral Calculus -1 | (Prof. T. Fujiwara) |
| 2.4: Integral Calculus -2 | (Prof. T. Fujiwara) |
| 2.5: Curvilinear Coordinates | (Prof. T. Fujiwara) |
| 3: Electro-Statics | (Prof. T. Otsuji) |
| 3.1: The Electric Field | |
| 3.2: Divergence and Curl of Electrostatic Field | |
| 3.3: Electric Potential | (Prof. T. Otsuji) |
| 3.4: Work and Energy in Electrostatics | |
| 3.5: Conductors and Capacitors | (Prof. T. Otsuji) |
| 4: Special Techniques | (Prof. T. Otsuji) |
| 4.1: Laplace's Equation | |
| 4.2: The Method of Images | (Prof. T. Otsuji) |
| 4.3: Separation of Variables | (Prof. T. Otsuji) |
| 5: Magneto-Statics | (Prof. T. Fujiwara) |
| 5.1: The Biot-Savart Law | |
| 5.2: Applications of Ampere's Law | (Prof. T. Fujiwara) |
| 6: Final Exam. | |

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| Preparation | Nothing special |
| Record and evaluation method | The course grades are basically determined by class participation, homework and the midterm and final examinations. |
| Textbook and references | No textbook, but print+handout will be served by each professor.<br>Reference: Introduction to Electrodynamics, written by David J. Griffiths, Prentice Hall, NJ, USA, 1999. |
| Self study | Home works in case of incompletion of the practices within the time slot of the lecture. |
| In addition | (None) |