# The Department of Bio-Mechatronic Engineering Course Catalog (Undergraduate)

| Code | Course | Type | Category | Credit | Description |
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| EBM2001 | Statics | Theoretical Study | Major | 3 | Deals with the state of rest of bodies under the action of forces. The study of statics is directed toward the quantitative description of forces that act on engineering structures in equilibrium. Including basic concepts of mechanics, Newton's laws, forces system and its vector analysis, moment and couple, equilibrium conditions, structures, distributed forces, friction, virtual work and area moment of inertia. |
| EBM2030 | Dynamics | Theoretical Study | Major | 3 | Deals with the motion of the bodies under the action of forces. Dynamics has two parts; kinematics, which is the study of motion without reference to the force which cause motion, and kinetics, which relates the action of forces on bodies to their resulting motion. Including basic concepts, kinematics and kinetics of particcles, plane kinematics and kinetics of rigid bodies, three dimensional dynamics of rigid bodies and mass moment of inertia. Introducing the fields of bio-mechatronics engineering study, this course intends to help students to establish the effective future study plan. |
| EBM2031 | Computer programming | Theoretical Study | Major | 2 | This course covers the theories and applications of programming, and the aim of the course is to develop talented professional software engineers. Students learn the basic programing technique from the concept, grammar, structures and algorithms of C language. Additionally, students develop their advanced programming skills by team project. |
| EBM2032 | Computer programming practice | Laboratory Course | Major | 1 | This course covers the theories and applications of programming, and the aim of the course is to develop talented professional software engineers. Students learn the basic programing technique from the concept, grammar, structures and algorithms of C language. Additionally, students develop their advanced programming skills by team project. |
| EBM2033 | Computer programming basics | Theoretical Study | Major | 3 | Numerical methods using computer programming are absolutely necessary when it is impossible to find the answers to the equations needed to solve various engineering problems analytically or arithmetically. A number of practical numerical analysis methods are discussed in order to achieve this, as well as methods for resolving engineering problems using the MATLAB programming language. |

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| EBM2034 | Embedded system design | Theoretical Study | Major | 3 | In this course, students learn theories and techniques for configuring microprocessor-based hardware and programming the software that operates it. The architecture and internal structure of the microprocessor is introduced, and the structure and operating principles of the memory system and various input/output devices are explained. Interrupt handling techniques, device drivers, run-time library, firmware, and real-time operation system programming techniques to effectively operate the configured hardware are explained. |
| EBM2035 | Biomechatronics Research Project | Theoretical Study | Major | 3 | Biomechatronics is an interdisciplinary converged scholarship that combines the words bio, machinery, electricity, and electronics. This course encourages students to plan and design tasks needed by society (or industry) by collaborating on projects in the Biomechatronics laboratory, conducting experiments, and writing reports, thereby improving students' creativity, practical skills, cooperative spirit, and leadership. The goal is to develop the ability to solve various pending issues of businesses/local governments. Classes are taught with the help of department professors and cover the broad topics of bio information and communications and intelligent mechatronics. |
| EBM2036 | Thermofluid mechanics | Theoretical Study | Major | 3 | The applied thermodynamic is a subject for students that major in bio-mechatronics, bio-medical engineering, mechanical engineering. The contents of this subject lead student to understand first and second laws of thermodynamics, reversible and irreversible processes, and introduction to basic thermodynamic cycles. In addition, through this course, thermodyanmic system applied in the various biomedical apparatus can be learned. |
| EBM2037 | Engineering Mathematics I | Theoretical Study | Major | 3 | By the end of this course, the students should be able to:<br>- Understand the basics of ordinary differential equations, linear algebra, and vector calculus.<br>- Develop skills and techniques of solving the mathematics of physics and engineering.<br>- Understand how to model physical systems.<br>- Apply the mathematical concepts to various engineering topics. |
| EBM2038 | Engineering Mathematics II | Theoretical Study | Major | 3 | This course starts with core concepts in the Fourier analysis, especially those useful in various engineering disciplines. Students learn Fourier Series, Sturm-Liouville Analysis, Fourier Integration, Fourier Transform, etc. Next, students study several applications of partial differential equations (PDEs) related to wave and heat transfer and their solution techniques. Finally, students study basic concepts in complex variables and complex calculus. |

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| EBM2039 | Mechanics of Solids | Theoretical Study | Major | 3 | Students will understand the physical behavior of the materials and bio-materials of the system elements and learn the basic theory and concept between force and deformation via modeling process. Basic theory and concept related to the internal stress of materials and bio-materials under external load, deformation, and fracture will be introduced through this course. Those basic theories and concepts will be applied to design the machine element and structure in biological production system. Finally, students will learn the ability of the engineering prediction on the physical effect and stability analysis related to the strength of materials for the given system. |
| EBM2040 | Electromagnetism(I) | Theoretical Study | Major | 3 | Learn the basics of electromagnetism, such as the concept of electromagnetic models, vector analysis, static electric fields, steady currents, and static magnetic fields. In addition, to understand the concept of electrostatic charge and electrostatic field, learn the concept of vector in space, the intensity of the electric field by electric charge and the emission of electric flux density, and learn about the meaning of electric potential energy and electrical characteristic constants of materials. |
| EBM2041 | Electromagnetism(II) | Theoretical Study | Major | 3 | Based on the concepts of electric and magnetic fields, this course deals with the elements of electrostatics including Coulomb's law, Gauss's law, Poisson's equation and Laplace's equation. Lastly, the basics of electromagnetism including Maxwell's Equation, Biot-Savart, and Ampere's law are covered, and the ability to analyze numerically is also developed by understanding the propagation of electromagnetic waves. |
| EBM2042 | Instrumentation Engineering of Micro/Nano scale | Theoretical Study | Major | 2 | Understand the concept of various micro/nano, learn about various micro/nano particles and structure fabrication process theory, and grasp the latest application technology. In addition, learn about techniques that can confirm the physical and chemical properties of micro/nanoparticles and structures, and learn and cultivate various measurement equipment (electrochemical, optical equipment, etc.) to which they are applied. |
| EBM2043 | Instrumentation Engineering Experiment of Micro/Nano scale | Laboratory Course | Major | 1 | Understand the concept of various micro/nano, learn about various micro/nano particles and structure fabrication process theory, and grasp the latest application technology. In addition, the characteristics of micro-nano materials are understood by directly producing and processing various micro-nano structures and directly analyzing them through various equipment. |
| EBM2044 | Advanced Biological Engineering | Theoretical Study | Major | 3 | Learn biotechnological information about dielectrics that produce enzymes and other cellular materials, organically relating the overall content of biotechnology. In addition, through the understanding of biochemistry and chemical engineering involved in intracellular biochemical reactions, students will learn application fields such as the production of high-loaded biological products such as proteins, intracellular substance transfer, and the separation process of biological products. |

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| EBM3003 | Sensor Engineering for Bio-System | Theoretical Study | Major | 3 | Measuring principles and components of sensors applied for bio-system are introduced. This course deals with the basic concepts and techniques to measure properties of plants and animals with bio-sensors. The course covers sensor materials, calibration, characteristics of output signals, sensor interface and characteristics of sensors. Sensors included are electrical sensor, electromagnetic sensor, piezoelectric sensor, optical sensor, acoustic sensor, and bio sensors. |
| EBM3007 | Biomechanics | Theoretical Study | Major | 3 | Principles of solid and fluid mechanics applied to analytical and experimental investigation of cardiovascular and skeletal system. |
| EBM3014 | Measurement and Instrumentation for Bio-System | Theoretical Study | Major | 2 | The course provides a study of operating principles and components of various measurement systems to design an accurate data acquisition system without error. The theory and practical application of measurement will be focused. The course investigates method of measurement, components of measuring system, data analysis, characteristics of input signals, measuring system response, characteristics of sensors, signal conditioning, operating characteristics of readout unit, and treatment of uncertainties. |
| EBM3015 | Laboratory of Measurement and Instrumentation for Bio-System | Laboratory Course | Major | 1 | The laboratory course provides a study of operating principles and operation of various measurement systems to sense the signals without error. Topics included are response of measurement system, analysis of measured data, signal processing form the sensor, and etc. Applied method to measure displacement, stress, force, rotational speed, torque, pressure, fluid flow, temperature, humidity, heat flux, light, acoustical will also be covered. |
| EBM3021 | Introduction of Biomaterial | Theoretical Study | Major | 3 | This course introduces undergraduate students to the use of artificial and natural materials in the human body. The concept of biocompatibility is developed, and includes the mechanical, electrochemical, immunological, and toxicological aspects of compatibility between materials and the body environment. Each student is required to complete and orally present a term project, half of which involves the design of an implant or prothesis which must function within the body. |
| EBM3032 | Biomechatronics Industrial training 1A | Field Education | Major | 2 | The class is opened during the regular semesters and managed as a Regular Clss-base. Students are strongly encouraged to achieve industrial experinence through the Program-base Industral training class. |
| EBM3033 | Biomechatronics Industrial training 1B | Field Education | Major | 2 | The class is opened during the regular semesters and managed as a Regular Clss-base. Students are strongly encouraged to achieve industrial experinence through the Program-base Industral training class. |
| EBM3034 | Biomechatronics Industrial training 2A | Field Education | Major | 3 | The class is opened during the regular semesters and managed as a Regular Clss-base. Students are strongly encouraged to achieve industrial experinence through the Program-base Industral training class. |

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| EBM3035 | Biomechatronics Industrial training 2B | Field Education | Major | 3 | The class is opened during the regular semesters and managed as a Regular Clss-base. Students are strongly encouraged to achieve industrial experinence through the Program-base Industral training class. |
| EBM3036 | Biomechatronics Industrial training 3A | Field Education | Major | 4 | The class is opened during the regular semesters and managed as a Regular Clss-base. Students are strongly encouraged to achieve industrial experinence through the Program-base Industral training class. |
| EBM3037 | Biomechatronics Industrial training 3B | Field Education | Major | 4 | The class is opened during the regular semesters and managed as a Regular Clss-base. Students are strongly encouraged to achieve industrial experinence through the Program-base Industral training class. |
| EBM3039 | Biomechatronics Industrial training 4B | Field Education | Major | 5 | The class is opened during the regular semesters and managed as a Regular Clss-base. Students are strongly encouraged to achieve industrial experinence through the Program-base Industral training class. |
| EBM3040 | Biomechatronics Industrial training 5A | Field Education | Major | 6 | The class is opened during the regular semesters and managed as a Regular Clss-base. Students are strongly encouraged to achieve industrial experinence through the Program-base Industral training class. |
| EBM3041 | Biomechatronics Industrial training 5B | Field Education | Major | 6 | The class is opened during the regular semesters and managed as a Regular Clss-base. Students are strongly encouraged to achieve industrial experinence through the Program-base Industral training class. |
| EBM3055 | Thesis Research | Independent Research | Major | 3 | Research for the proparation of B.S thesis. |
| EBM3066 | Design of Bio-System | Theoretical Study | Major | 2 | The bio-system is a subject for students that major in bio-mechatronics, bio-medical engineering. Why our blood vessel is similar like a garden hose. Why are seashells strong even though they are made of chalk? How can our opaque white tendons be made of the same material as our transparent corneas? Additionally, this course may learn about biomedical scaffolds for tissue engineering and biomimetic materials, which can be derived from Nature. |
| EBM3067 | Experimental design of Bio-System | Laboratory Course | Major | 1 | The design of bio-system is a subject for students that major in bio-mechatronics, bio-medical engineering. Why our blood vessel is similar like a garden hose. Why are seashells strong even though they are made of chalk? How can our opaque white tendons be made of the same material as our transparent corneas? Additionally, this experimental course may learn about biomedical scaffolds for tissue engineering and biomimetic materials, which can be derived from Nature. |

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| EBM3074 | Cardiovascular Biomechanics | Theoretical Study | Major | 3 | Cardiovascular Biomechanics provides an introduction to the application of computer simulation to solve fundamental problems in biomechanics and other related biomedical engineering. Computational modeling of musculoskeletal mechanics, hard and soft tissue modeling, computational modeling of cell, tissue, and organ biomechanics are introduced. Limitations of computational strategies as a predictive tool and the need for rigorous verification and validation of computational techniques are discussed.<br>Course Topics:<br>1. Computational modeling<br>2. Material modeling<br>3. Viscoelasticity<br>4. Solid and fluid mechanics in biologic system<br>5. Computational models of musculoskeletal mechanics<br>6. Hard and soft tissue modeling<br>7. Computational models of cell, tissue, and organ biomechanics |
| EBM3079 | Bioengineering | Theoretical Study | Major | 2 | This course provides basic knowledge of cell biology,general chemistry, and biomanufactruing processes,which are basic knowledge in the field of bioengineering. By learning the chemical composition of cells,which are the basic units of living organisms,and the structure and biological function of each organ of human tissues,the students can understand the basic concept of biology and characteristics of human tissues,and also establish the basis for biomedical researches. In addition,students can establish a vision as a biomedical scientist by grasping the current status of biotechnology,and they can understand the development trends of the overall biomedical engineering fields including stem cell researchers and tissue engineering.<br>Therefore,this course is based on theoretical explanation. In this course,teaching subjects are divided into (1) cell culture,(2) biomaterials,(3) biomanufacturing,and (4) analysis and evaluation techniques of the biomaterials.<br>1. In the “Cell Culture” section,students learn theories on various cell culture methods. 2. In the “Biomaterials” section,various biomaterials,such as synthetic and natural polymers and ceramics are examined. 3. In the “Biomanufacruring methods” section,students can understand the basic principles of recent biomanufacturing techniques,3D bioprinter and electrospinning processes. 4. In the “Analysis and Evaluation” section,they will learn how to evaluate cellular activities,cell viability and cell proliferation. |

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| EBM3080 | Experimental Bioengineering | Laboratory Course | Major | 1 | This course provides basic experimental knowledge of cell biology,general chemistry,and biomanufactruing processes,which are basic knowledge in the field of bioengineering. By learning the chemical composition of cells,which are the basic units of living organisms,and the structure and biological function of each organ of human tissues,the students can understand the basic concept of biology and characteristics of human tissues,and also establish the basis for biomedical researches. In addition,students can establish a vision as a biomedical scientist by grasping the current status of biotechnology,and they can understand the development trends of the overall biomedical engineering fields including stem cell researchers and tissue engineering. Therefore,this course is based on experimental subjects.In this course,teaching subjects are divided into (1) cell culture,(2) biomaterials,(3) biomanufacturing,and (4) analysis and evaluation techniques of the biomaterials.1. In the "Cell Culture" section,students learn experimental on various cell culture methods.2. In the "Biomaterials" section,various biomaterials, such as synthetic and natural polymers and ceramics are examined.3. In the "Biomanufacruring methods" section,students can understand the basic principles of recent biomanufacturing techniques,3D bioprinter and electrospinning processes.4. In the "Analysis and Evaluation" section,they will learn how to evaluate cellular activities,cell viability and cell proliferation. |
| EBM3085 | Big data engineering | Theoretical Study | Major | 3 | The purpose of this class is to introduce students to methodologies to search and process structured and unstructured big data in the biological and medical fields. Students learn systems, interpretation techniques, and algorithms necessary for analyzing bio-big data such as medical images and biological signals. Detailed contents of the class are followed as: Knowledge-based intelligent system, Rule-based expert system, Fuzzy expert system, Artificial neural network system, Deep learning technique. |
| EBM3086 | Knematics | Theoretical Study | Major | 3 | Deals with the relative motion of machine parts, and the forces acting on the parts of a machine and the motion resulting from these forces ; Fundamental concepts, properties of motion, relative motion, methods of motion transmission, linkages, cams, gears, instant centers, velocities and acceleration in mechanism, velocity and acceleration graphs, static and dynamic forces in machines. |
| EBM3087 | Signal and system | Theoretical Study | Major | 3 | This course begins with learning the elements used in electronic systems, and learns about elements and electrical stability required when designing or manufacturing electronic devices. Introduce the newest signal analysis technologies, such as artificial neural networks, fuzzy theory, and genetic algorithms, and learn about various algorithms that can be used to extract useful information from medical signals, such as electrocardiograms and brain waves. |

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| EBM3088 | CAD | Theoretical Study | Major | 2 | The aim of this course is to introduce students to computer-aided engineering design and analysis methods. Lessons are taught through lectures and exercises. Design procedures are taught using CATIA, whereas analytical techniques are taught using ADAMS. |
| EBM3089 | CAD practice | Laboratory Course | Major | 1 | As a first step for the computer simulation based analysis, 3D object modeling will be practiced in this course. 3D CAD programing skill as a basic quality that should have as an engineer, it has been applied to various industrial sites, and recognized as a fundamental skill in the research field. In this course, creation and analysis of solid features, parts assemblies, cartography and analysis, and model management will be treated. |
| EBM3090 | Automatic Control | Theoretical Study | Major | 3 | This subject's contents help students understand the analysis principle and system composition of various types of automatic control systems. Furthermore, after studying feedback system, control loop, and a controller, students will study the composition and modeling method of control system, and apply automatic control theory to human body system and various bio-systems. Students will learn how to control the system with an input value to achieve the desired result value in the process. |
| EBM3091 | Biomanufacturing technology | Theoretical Study | Major | 3 | The applied heat transfer is a subject for students that major in bio-mechatronics, bio-medical engineering, mechanical engineering. The bio-microfabrication is the application of micro-fabrication methods to build tools for exploring the mysteries of biological systems. This course will cover the basics of biology and the principles and practice of micro-fabrication techniques with a focus on applications in biomedical and biological research. A team design project that stresses interdisciplinary communication and problem solving will be one of the course requirements. |
| EBM3092 | Fluid Power | Theoretical Study | Major | 3 | This is a study that understands and applies basic theories related to fluid mechanics, and learns the characteristics and application fields of hydraulic and pneumatic circuits and systems. Finally, the goal is to design a hydraulic/pneumatic system using hydraulic/pneumatic elements, and in detail, pressure energy is supplied using a hydraulic pump to a working fluid having an appropriate viscosity with lubricity, and the working fluid is supplied to pipes, various valves, and their accessories. It is a study of a series of mechanical elements and their combinations that work by controlled hydraulic power, such as guiding to an actuator (motor or cylinder) through a control device including a control device. |

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| EBM3093 | Biofluidic mechanics | Theoretical Study | Major | 3 | In this class, not only blood circulation in the human body based on fluid dynamics, which is an important mechanical subject of mechanical engineering, but also how it can be applied to air flow through the lungs, joint lubrication, intraocular fluid flow, and blood movement within the kidney are explained. In particular, the specific lectures on various blood diseases will be given through the physiological interpretation of the human heart that regulates blood flow. In addition, this class supports the logic of the relevance and importance of current research related to biofluid and covers medical treatment of various diseases caused by poor biofluidic systems including blood flow. |
| EBM3094 | Introduction to Biodesign | Theoretical Study | Major | 3 | By the end of this course, the students should be able to do the following:<br>- Develop and exercise skills to apply engineering knowledge to problems that are ill-defined and open ended.<br>- Develop skills and techniques of locating and evaluating information.<br>- Develop an appreciation of the design process. This includes the ability of recognizing, and defining engineering problems, creating conceptual solutions, and evaluation of alternatives.<br>- Develop skills for professional communication including both formally and informal written and oral presentation.<br>- Develop skills for documenting your work, including proposal writing and patenting. |
| EBM3095 | VR Programming | Theoretical Study | Major | 2 | This course is designed for students who major in biomechatronic engineering and biomedical engineering and have basic knowledge of coding. The purpose of this course is to cultivate practical talents suitable for Industry 4.0 through learning that combines biomechatronics with virtual reality (VR). In this course, students learn basic knowledge of Python programming necessary for preprocessing various image data, and learn the basics of Blender and Unity 3D, open source programs for VR implementation. In addition, it aims to cultivate the core capabilities of the future industrial era by implementing creative contents on a VR platform using preprocessed image data through a team project. |
| EBM3096 | Experimental VR Programming | Laboratory Course | Major | 1 | This course is designed for students who major in biomechatronic engineering and biomedical engineering and have basic knowledge of coding. The purpose of this course is to cultivate practical talents suitable for Industry 4.0 through learning that combines biomechatronics with virtual reality (VR). In this course, students learn basic knowledge of Python programming necessary for preprocessing various image data, and learn the basics of Blender and Unity 3D, open source programs for VR implementation. In addition, it aims to cultivate the core capabilities of the future industrial era by implementing creative contents on a VR platform using preprocessed image data through a team project. |

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| EBM3097 | Mechatronics Control | Theoretical Study | Major | 2 | The purpose of this course is to teach integrated mechatronic control engineering theory and computer programming and to cultivate excellent biomechatronics engineers. Students learn robotic kinematics analysis, dynamics theory, robot control path planning, feedback control and simulation methods for articulated robot manipulators. Students learn robot control simulation techniques using V-REP software and robot control programming using Arduino. |
| EBM3098 | Experimental Mechatronics Control | Laboratory Course | Major | 1 | The purpose of this course is to teach integrated mechatronic control engineering theory and computer programming and to cultivate excellent biomechatronics engineers. Students learn robotic kinematics analysis, dynamics theory, robot control path planning, feedback control and simulation methods for articulated robot manipulators. Students learn robot control simulation techniques using V-REP software and robot control programming using Arduino. |
| EBM3099 | Engineering Circuit Analysis | Theoretical Study | Major | 3 | Clearly understand the basic concepts and analysis methods of electric circuits required to study electrical and electronic fields. Starting with basic concepts such as voltage, current, and Ohm's law, students learn the components of electric circuits and circuit analysis techniques. Furthermore, learn and apply circuits with more complex elements such as capacitors and inductors. Finally, circuits with DC sources and circuits with sinusoidal sources are analyzed, and topics of energy storage devices, operational amplifiers, and analysis methods are covered. |