

JABEE Criteria for Accrediting Engineering Education Programs Leading to Bachelor's Degree

Applicable in the years 2010 -

Approved by the JABEE Board of Directors

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**Criteria for Accrediting Engineering Education Programs
Leading to Bachelor's Degree
Applicable in the years 2010 -**

Preamble

These Criteria shall be stipulated to accredit programs of fundamental engineering education in higher educational institutions. A program seeking for accreditation shall satisfy all six criteria and supplementary criteria described below, and shall be required to demonstrate its conformity with evidence. The definition of engineer here implies individuals who commit to engineering profession in a broad sense including researchers.

Criterion 1: Learning Outcomes

- (1) For the purpose of fostering autonomous engineer, distinctive learning outcomes of the program shall be established covering the benchmark reference learning outcomes (a) to (h) below and shall be broadly disclosed. Also, the learning outcomes shall be made well-known to the students and faculty of the program:
 - (a) An ability of multidimensional thinking with knowledge from global perspective
 - (b) An ability of understanding of effects and impact of engineering on society and nature, and of engineers' social responsibilities (engineering ethics)
 - (c) Knowledge of and an ability to apply mathematics, natural sciences and information technology
 - (d) Knowledge of the related engineering disciplines, and an ability to apply it to solve problems
 - (e) An ability to design to respond to requirements of the society by using various sciences, technologies and information
 - (f) Communication skills including logical writing, presentation and debating in Japanese and fundamental communication skills on the international scene.
 - (g) An ability of independent and life-long learning
 - (h) An ability to manage and accomplish tasks systematically under given constraints.

- (2) The learning outcomes shall be established by taking account of tradition and resources of the program, fields of the graduates, and also shall take account of requirements of the society and demands of the students.

Criterion 2: Student Workload

- (1) The length of program shall be four-year full-time or equivalent. The graduates shall have obtained bachelor's degree with more than 124 credits.
- (2) The program shall contain more than 1,600 course hours in total to complete the program. The program total hours shall include more than 250 course hours in liberal arts, more than 250 course hours in mathematics, natural sciences, and information technology, and more than 900 course hours in the related engineering specialization.
- (3) The program shall encourage active learning of the students and shall commit to ensure sufficient self-learning hours for the students.

Criteria 3: Educational Process

3.1 Curriculum and Syllabus

- (1) The curriculum of the program shall be designed for the students to achieve the learning outcomes and shall be disclosed to the students and faculty of the program. The curriculum shall provide a set of courses, each of which shall be designed in clear relation to the learning outcomes of the program.
- (2) For each course of the program, the syllabus shall be prepared in accordance with the curriculum, be disclosed to the students and faculty of the program and be implemented as described. For each course, the syllabus shall clearly describe its position in the curriculum, its educational components and methods, its learning outcomes, and its evaluation methods and criteria. The course hour shall be specified either in its syllabus or in a related document.
- (3) The program shall let students regularly review the degree of achievement for each learning outcome to reflect it to their learning.

3.2 Educational Institution

- (1) The educational institution shall provide a sufficient number of faculty members able to realize the curriculum with applicable educational methods and to improve the educational result of the program, and shall provide the faculty with institutional support.
- (2) The educational institution shall have suitable communications network among faculty for close collaboration among courses set in the curriculum to obtain educational results. The activities of the suitable communications network shall be implemented.
- (3) The educational institution shall provide Faculty Development (FD) to increase the faculty's educational abilities and disclose them to the faculty of the program.
- (4) The educational institution shall institutionally evaluate faculty's educational activities

and shall disclose the evaluation methods to the faculty.

3.3 Process of Admission

- (1) The educational institution shall establish concrete student admission policies and procedures in order to admit students with proper knowledge and abilities to take course curriculum designed for the achievement of the learning outcomes of the program. The admission policies and procedures shall be disclosed. The students' admission shall be implemented in accordance with its policies and procedures.
- (2) In case the program consists of two tiers, the first of which is common to some number of programs, and the second of which is specific to the program, and the selective admission of students to the second tier takes place on their completion of the first tier, the educational institution shall establish concrete admission policies and procedures for this selective admission as well. The policies and procedures shall be disclosed to the students and faculty concerned with the program. The students' selective admission shall be implemented in accordance with its policies and procedures.
- (3) In case the educational institution admits student transfer into the program, the educational institution shall establish concrete policies and procedures of students' transfer. The policies and procedures shall be disclosed. The students' transfer shall be implemented in accordance with its policies and procedures.
- (4) In case the educational institution transfers students of the program to other programs, the educational institution shall establish concrete policies and procedures. The policies and procedures shall be disclosed to the students and faculty of the program. Students' leaving the program shall be implemented in accordance with its policies and procedures.

Criterion 4: Educational Environment and Student Support

4.1 Facilities

The educational institution shall be equipped with classrooms, laboratories, exercise rooms, library services, information related equipments, self-learning and rest facilities, cafeteria, etc. to achieve the learning outcomes of the program.

4.2 Financial Resources

The educational institution shall commit to ensure necessary financial resources to maintain, improve, and operate facilities required for the achievement of the learning outcomes of the program.

4.3 Students Support

The educational institution shall provide institutional support for educational environment and for students learning, such as helping students better understand lectures, and enhancing student learning motivation, by taking account of demands of the students. The institutional support shall be disclosed to the students, faculty and staff of the program.

Criterion 5: Achievement of Learning Outcomes

- (1) The degree of achievement of the learning outcomes for each course shall be evaluated in accordance with the evaluation methods and criteria stipulated in the syllabus.
- (2) The program shall have evaluation methods for credits, which students have earned in other higher educational institution and the credit transfer shall be accepted in accordance with the stipulated evaluation methods. The program shall also have evaluation methods for the credits earned by the transferred students in the previous educational institution and the credit transfer shall be accepted in accordance with stipulated evaluation methods.
- (3) For each learning outcome of the program, holistic evaluation methods and criteria shall be stipulated to evaluate the degree of achievement of the learning outcomes, and the students shall be evaluated in accordance with them.
- (4) All the graduates of the program shall have achieved all the learning outcomes of the program.

Criterion 6: Educational Improvement

6.1 Self-review of Education

- (1) The program shall have a system for self-reviewing its educational activities in accordance with the criteria 1 to 5 based on the evaluation results of the degree of achievement of the learning outcomes, and shall disclose the self-reviewing system to the faculty of the program. The self-reviewing shall be implemented in accordance with its system.
- (2) The system shall include structure to take account of requirements of the society and demands of the students. The system itself shall have self-checking structure.
- (3) Record of the reviewing activities, such as minutes of meetings and committee reports shall be accessible to the faculty of the program.

6.2 Continuous Improvement

The program shall have a system to continuously improve its educational activities in

accordance with criteria 1 to 6 based on the self-reviewing results. The activities for continuous improvement shall be implemented in accordance with its system.

Supplementary Criteria: Program Criteria by Discipline

Program Criteria by Discipline stipulate supplementary items to accreditation criteria to apply to programs in each discipline. They mainly supplement Criterion on Learning Outcomes, such as 1 (1) (d), and Criterion on Faculty, such as 3.2 (1).

Program Criteria by Discipline
—Agricultural Engineering—

These Program Criteria by Discipline apply to the engineering educational programs for the discipline of Agricultural Engineering

1. Expected Knowledge and Abilities to be Acquired

Graduates are required to acquire the following knowledge and abilities at the time of completion of the program:

- (1) Applied mathematics, physics and either chemistry or biology as well as agriculture & environmental-related subjects as a common area of the discipline
- (2) Acquisition of principle areas of the following two Programs
 - (2-1) Irrigation, Drainage and Reclamation Engineering Program
Knowledge and abilities of either three areas of soil, water and foundation or three areas of soil, water and environment
 - (2-2) Agro-environmental Engineering Program
Knowledge and abilities of two out of four areas of agricultural meteorology & biological environment, biological production system & provisions system, information of agricultural & biological environment and agricultural machinery & agricultural work system
- (3) An ability to plan and execute experiment, to analyze and examine acquired data accurately, and to explain the results from engineering perspective in more than one principle area of the discipline
- (4) An ability to utilize knowledge and technologies applicable to the discipline, to research, to build and to solve issues
- (5) Fundamental ability to understand problems and issues in practice and to solve them appropriately.

2. Faculty

- (1) Faculty shall include either members who have qualification such as license of professional engineer or members who have ability to teach practice relating to educational components.

Program Criteria by Discipline
—Agricultural Science and Engineering—

These Program Criteria by Discipline apply to the engineering educational programs for the discipline of Agricultural Science and Engineering or specified areas such as, forestry function system, plant production system, animal production system, biochemical system, bio-economical system, and fishery system. Veterinary is, however, excluded.

1. Expected Knowledge and Abilities to be Acquired

Graduates are required to acquire the following knowledge and abilities at the time of completion of the program:

(1) Fundamental ability

Theoretical knowledge of biological science, bioenvironmental science, biological production science and biological resources science

(2) An ability to plan and execute experiment or surveys, to analyze and examine acquired data accurately and to explain the results

(3) An ability to utilize knowledge and technologies applicable to the discipline, to research, to build and to solve issues

(4) An ability to understand problems and issues in practice and to judge and solve them appropriately.

2. Faculty

(1) Faculty shall include either members who have qualification such as license of professional engineer or members who have ability to teach practice relating to educational components.

Supplementary remarks:

(1) Specific setting and its contents of the programs of agricultural science or its specified areas such as forestry function system, plant production system, animal production system, biochemical system, bio-economical system, and fishery system shall be provided by the related academic societies.

Program Criteria by Discipline
—Architecture and Building Engineering—

These Program Criteria by Discipline apply to the engineering educational programs for the discipline of Architecture and Building Engineering.

1. Expected Knowledge and Abilities to be Acquired

Specific learning outcomes ensuring knowledge and abilities of the discipline of Architecture as indicated in (1) below shall be established and disclosed. Also, a program, which has learning outcomes adjunct with knowledge and abilities of at least one specific discipline mentioned in (2) shall be established and disclosed.

Programs of Building Engineering can establish its own learning outcomes, applying requirements of the discipline of Architecture as mentioned above.

(1) Holistic knowledge and abilities of Architecture

Fundamental ability to understand Architecture as diverse elements such as arts, technology, culture, society, law, economics and in the context of transition in time such as history and life-cycle, to have wide knowledge of Architecture and to have holistic and systematic insight and ability to plan, design, manufacture, maintain architecture and living environment.

(2) High knowledge and abilities of the specific areas of architecture

High knowledge of the specific areas of architecture such as architecture planning, architecture design & plan, urban plan & design, residence, architecture environment, architecture equipment, architecture structure, architecture disaster prevention, architecture materials, architecture production, architecture operation & maintenance, architecture preservation & reproduction, or more developed knowledge of holistic knowledge referred to in (1) and ability to apply it to practice.

2. Faculty

(1) Faculty shall be composed with members who have ability to achieve sufficient learning outcomes as a whole in terms of principle, knowledge, technologies and practice.

Program Criteria by Discipline
—Biochemical, Biological and Biophysical Engineering—

These Program Criteria by Discipline apply to the engineering educational programs for the discipline of Biochemical, Biological and Biophysical Engineering.

1. Expected Knowledge and Abilities to be acquired

Graduates are expected to acquire the following knowledge and abilities at the time of completion of the program:

- (1) Fundamental knowledge of applied mathematics or ability to apply information processing technology applicable to biological engineering
- (2) Knowledge of more than two principle areas from biology, biological information, biochemical, cell engineering, bionics, biochemical engineering and environmental bioengineering or knowledge of combination of those areas, and ability to apply the knowledge to problem solving from engineering perspective namely:
 - (2-1) Knowledge and technologies of the discipline
 - (2-2) An ability to plan and execute experiment, to analyze and examine acquired data accurately and to explain the result
 - (2-3) An ability to utilize knowledge and technologies applicable to the discipline, to research, to build and to solve issues
 - (2-4) An ability to understand problems and issues in practice and to judge and solve them appropriately.

2. Faculty

- (1) Faculty shall include either members who have qualification such as license of professional engineer or members who have ability to teach practice relating to educational components.

Program Criteria by Discipline
—Chemical and Chemistry-Related Engineering—

These Program Criteria by Discipline apply to the engineering educational programs for the discipline of Chemical and Chemistry-related Engineering.

1. Expected Knowledge and Abilities to be acquired

Graduates are expected to acquire the following knowledge and abilities at the time of completion of the program:

- (1) An ability to utilize knowledge of industrial (applied) mathematics and engineering fundamentals including information-processing technology and to apply them for problem solving
- (2) An ability to utilize fundamental knowledge of stoichiometry including material and energy balance, thermodynamics including physicochemical equilibrium and knowledge of fundamental information in thermal, mass and momentum transfer phenomena and ability to apply them for problem solving
- (3) An ability to utilize fundamental knowledge and experimental skills of more than four areas of chemical and chemistry-related discipline namely: organic chemistry, inorganic chemistry, physical chemistry, analytical chemistry, high polymer chemistry, materials chemistry, electrochemistry, photochemistry, interface chemistry, pharmaceutical chemistry, biochemistry, environmental chemistry, energy chemistry, separation engineering, chemical reaction engineering and process system engineering ability to apply them for problem solving
- (4) Fundamental knowledge of at least one of the areas mentioned in (3) above, and ability to apply, design and manage for problems solving, taking account of influence on economic, safety, reliability and impacts on society and environment.

2. Faculty

- (1) Faculty shall include either members who have qualification such as license of professional engineer or members who have ability to teach practice relating to educational components.

Supplementary Remarks

- (1) "Chemical and Chemistry-related Engineering" discipline shall establish chemical engineering course and applied chemistry and shall also set quantitative guideline as mentioned in appendix.

- (2) A program wishing to apply for the examination under “Chemical and Chemistry-related Engineering” discipline shall refer to the quantitative guideline applicable to each course.
- (3) Educational components (1) to (4) mentioned above in 1., “Expected Knowledge and Abilities to be acquired” imply the necessity that each program shall be organized into four hierarchical structure: (1) engineering fundamentals, (2) chemical engineering fundamentals, (3) fundamentals of the discipline, and (4) profession on the basis of fundamental knowledge of mathematics, natural sciences and technologies mentioned in criteria applied to all disciplines. The educational components are the components of education but do not stipulate the name of the subjects. Therefore, it is legitimate right for a program to name the title of the subjects according to own judgment. It is also allowed that one subject may be divided into educational components (1) to (4).
- (4) Possible subjects of “engineering fundamentals” mentioned in (1) in “educational components” could be, in addition to industrial (applied) mathematics and information processing technology, material measurement, electrical engineering, materials chemistry or material mechanics, fluid dynamics, environmental engineering, safety engineering, kansei engineering, intellectual property right, and engineering economics. The name of the subject here is only an example and does not stipulate the name of the subject for the program.
- (5) Fundamental knowledge referred to in educational component (4) could include, in addition to classroom lectures, undergraduate research or knowledge acquired by participating seminar sessions.
- (6) An ability to apply, design and manage for problem solving, taking account of influence on economic, safety, reliability and impacts on society and environment in educational component (4) could be acquired through undergraduate research or seminars.
- (7) “Design ability” mentioned in educational components (4) does not necessary mean only designing equipment but also includes ability to holistically design for problem solving.

Appendix Quantitative Guideline

Educational Components	Chemical Engineering Course	Applied Chemistry Course
(1)	120 hours	80 hours
(2)	60 hours	60 hours
(3)	120 hours With more than 60 hours chemical engineering contents such as separation engineering, chemical reaction engineering, and process system engineering	160 hours
(4)	80 hours	80 hours
Total Credit hours	380 hours	380 hours

Reference: JABEE Committee of Chemical and Chemistry-related Disciplines:
<http://www.chemistry.or.jp/gaku/jabee/>

Program Criteria by Discipline
—Civil Engineering—

These Program Criteria by Discipline apply to the engineering educational programs for the discipline of Civil Engineering.

1. Expected Knowledge and Abilities to be Acquired

Graduates are expected to acquire the following knowledge and abilities at the time of completion of the program:

- (1) Applied mathematics
- (2) Fundamentals of natural sciences (at least one from physics, chemistry, biology and geometry)
- (3) At least three out of principle areas of civil engineering discipline: civil engineering material & construction management/ structural engineering & earthquake engineering & maintenance management engineering/ geotechnique/ hydraulic engineering/ civil engineering planning & traffic engineering and civil environmental system
- (4) An ability to plan and execute experiment, to analyze result accurately, and to examine from engineering perspective and to explain at least in more than one discipline out of principle areas of the civil engineering discipline
- (5) Gain self-learning custom, creativity and ability to solve problems through exercises of at least one of principle areas of the discipline
- (6) An ability to utilize knowledge and technologies applicable to the discipline to research, to build and to solve issues by comprehensively utilizing knowledge and technologies applicable to the discipline based on taking classes that integrate subjects in the discipline of engineering profession
- (7) Fundamental ability to understand problems and issues that engineers experience during engineering practice in the discipline of civil engineering-related profession and to solve them appropriately.

2. Faculty

- (1) Faculty shall include either members who have qualification such as license of professional engineer or engineer accredited by the Japan Society of Civil Engineers, or members who have qualification to teach subjects through experience in engineering practice.

Supplementary remarks

- (1) Guide to program criteria by discipline: civil engineering and civil-related engineering
These program criteria by discipline are intended to be the educational contents applicable to the most of civil engineering-related departments. Namely, “CIVIL” and “CONSTRUCTION” defined by ABET2008-2009 criteria are included.
 - (1-1) Applied mathematics mentioned in 1 (1) above indicates applicable contents required in the discipline of civil engineering and civil-related disciplines based on the mathematics mentioned in JABEE criteria 1(c). The contents shall be determined by the educational institution in accordance with learning outcomes of the program.
 - (1-2) As regards 1 (2), the educational institution in accordance with learning outcomes of the program selects one compulsory subject from physics chemistry, biology or geology.
 - (1-3) For easy understanding of the principle areas of civil engineering discipline referred to in 1 (3), “Principle area of the discipline and list of Keywords” is attached below. The attached list is provided to better understand the category of the principle areas of civil engineering discipline. This list is not, however, exclusive. It does not mean to exclude educational contents which are not listed in the attachment. Educational institution could add or delete some contents listed in the attachment depending on their learning outcomes. The list shall be revised if necessary.
 - (1-4) 1(4) means experiment and laboratory work, etc.
 - (1-5) 1(5) means exercise, etc.
 - (1-6) 1(6) means undergraduate research, etc.
 - (1-7) 1(7) could be acquired through internship, special lectures given by professional engineers, on-site visits and normal lectures, etc.
 - (1-8) Part-time and visiting positions could be included in faculty.
 - (1-9) Young faculty members, in particular, shall have teaching experience during their post-graduate time to undergraduate students.

Principle areas of the discipline and list of Keywords

Principle areas of the discipline	Keywords
Civil engineering material & construction & build management	concrete, steel, bituminous material, composite material/new material, Lumber, construction, maintain/management, construction project planning/designing, construction management etc.
Structural engineering & Earthquake engineering & Maintenance management engineering	applied mechanics, structural engineering, steel structure, concrete structure, composite structure, wind engineering, earthquake engineering, earthquake-proof construction, maintenance management engineering etc.
Geotechnique	soil mechanics, foundation engineering, rock engineering, civil engineering geology, ground behavior, ground and construction, ground disaster prevention, geo-environmental engineering etc.
Hydraulic engineering	hydraulics, environmental hydraulics, hydrology, river engineering, water-resource engineering, coastal engineering, harbor engineering, ocean engineering etc.
Civil engineering planning & Traffic engineering	civil engineering planning, regional urban planning, land planning, disaster prevention planning & environmental planning, traffic engineering, railway engineering, survey/remote sensing, landscape & design, history of civil engineering, etc.
Civil environmental system	environmental planning & management, environmental system, environmental conservation, drainage system, wastage, soil & water environment, atmospheric circulation & noise and vibration, environmental ecology, etc.

Reference Japan Society of Civil Engineers: <http://www.jsce.or.jp/opcet/jabee/>

Program Criteria by Discipline
—Communication, Computer, Software,
and similarly named Engineering—

These Program Criteria by Discipline apply to the engineering educational programs for the Discipline of Communication, Computer, Software, and similarly named Engineering in general or specific disciplines such as, computer science (CS), Computer Engineering (CE), Software Engineering, Information Systems (IS) or other similar disciplines.

1. Expected Knowledge and Abilities to be Acquired

Graduates are expected to acquire the following knowledge and abilities at the time of completion of the program:

- (1) Fundamental knowledge and its application skills from theory to problem analysis and design for the following studies
 - (1-1) Algorithm and data structure
 - (1-2) Composition and architecture of computer system
 - (1-3) Information network
 - (1-4) Software design
 - (1-5) Various concepts of programming language
- (2) An ability of programming
- (3) Knowledge of mathematics, including discrete mathematics, probability and statistics and its application skills
- (4) Specific knowledge and its application skills applicable to the educational program.

2. Faculty

- (1) Faculty shall include sufficient number of full-time members, who have experience in providing information processing system made to be used by the third party in premise and have ability to educate students with system development projects.

Supplementary Remarks

- (1) Examination of programs under Communication, Computer, Software, and similarly named Engineering shall be implemented in cooperation with the Information Processing Society of Japan, the Institute of Electronics, Information and Communication Engineers and the Institute of Electrical Engineers of Japan.
- (2) In this discipline of Communication, Computer, Software, and similarly named Engineering and related disciplines such as, CS, CE, SE, IS or other similar

disciplines, it is the responsibility of a program provider to set educational components of the program and learning outcomes.

Reference:

Information Processing Society of Japan: <http://www.ieice.org/jpn/jabee/sinsakijun.html>
The Institute of Electronics, Information and Communication Engineers: <http://jabee.ipsj.or.jp>
The Institute of Electrical Engineers of Japan: http://www.iee.or.jp/eng_edu/

Program Criteria by Discipline
— Electrical, Electronic and Similarly named Engineering —

These Program Criteria by Discipline apply to the engineering educational programs for the discipline of Electrical, Electronic and similarly named Engineering in general or specific disciplines (Electrical and electronics engineering, information communication engineering, electronics, measurement control system engineering or other similar disciplines).

1. Expected Knowledge and Abilities to be Acquired

- (1) Educational components provided by the program shall be as such giving the width and depth of the engineering discipline defined by its name of the program
- (2) Graduates are expected to acquire the following knowledge and abilities at the time of completion of the program:
 - (2-1) Theoretical knowledge of fundamental mathematical principle and of principle in physics which are required in order to meet learning outcomes of the program (fundamental academic ability in the discipline)
 - (2-2) An ability to plan and execute experiment to be complied with learning outcomes of the program, to analyze data accurately, and to examine from engineering perspective and to explain the results (planning and execution ability of the experiment)
 - (2-3) An ability to utilize knowledge and technologies applicable to the discipline to research, to build and to solve issues (ability to solve given issues in the discipline of engineering profession)
 - (2-4) An ability to understand problem and issues on engineering practice that engineers experience in the discipline of the program (ability to set issues in engineering profession).

2. Faculty

- (1) Faculty shall include members who have ability to teach engineering practice relating to projects in the discipline indicated in the program.

Supplementary remarks

- (1) Examination of programs under this filed shall be implemented by the Institute of Electronics, Information and Communication Engineers or the Institute of Electrical Engineers of Japan.
- (2) Establishment and disclosure of the specific learning outcomes and program contents

of generalized or specified discipline for Electrical, Electronic and similarly named Engineering such as, information and communication engineering, electrical and electronic engineering, electronics, measurement control system engineering, or other similar disciplines, shall be provided by the program provider.

Reference: Institute of Electrical Engineers of Japan http://www.iee.or.jp/eng_edu/

Reference: Institute of Electronics, Information and Communication Engineers
<http://www.ieice.org/jpn/jabee/sinsakijun.html>

Program Criteria by Discipline
—Engineering Physics and Applied Physics—

These Program Criteria by Discipline apply to the engineering educational programs for the discipline of Engineering Physics and Applied Physics.

1. Expected Knowledge and Abilities to be Acquired

Graduates are expected to acquire the following knowledge and abilities at the time of completion of the program:

(1) Fundamental ability

(1-1) Fundamental knowledge and skills of mathematics (calculus, linear algebras, vector analysis, physical mathematics), physics (dynamics, electromagnetic, thermal physics, quantum physics), basic experiment and information technology

(1-2) Fundamental ability to understand issues by utilizing (1-1) above, to solve precisely, to show appropriately, and to communicate its contents accurately

(2) An ability applicable to the discipline

At least one of the principle areas of the discipline (physics & applied physics in general, physicality & materials, physical information measurement, electronics & element) of Engineering Physics and Applied Physics

(2-1) Systematically acquired knowledge and technologies of the discipline required to achieve learning outcomes of the program in each discipline

(2-2) An ability to utilize knowledge and technologies mentioned in (2-1) to research and to solve issues precisely

(2-3) An ability to understand issues on engineering practice that engineers experience during engineering practice in this discipline and to solve precisely, to present appropriately and to communicate properly.

2. Faculty

(1) Faculty shall be composed with members who have ability to teach educational components applicable to the discipline that is expected to be achieved as educational outcomes of the program.

Reference: The Japan Society of Applied Physics <http://www.jsap.or.jp/activities/education/jabee/index.html>

Program Criteria by Discipline
—Environmental Engineering—

These Program Criteria by Discipline apply to the engineering educational programs for the discipline of Environmental Engineering.

1. Expected Knowledge and Abilities to be Acquired

Graduates are expected to acquire the following knowledge, abilities, and technologies at the time of completion of the program:

- (1) Fundamental ability to understand and appropriately address with fundamental principle of environmental management, conservation, improvement, renovation and decreasing negative environmental impact
- (2) An ability to observe, acknowledge and analyze phenomena relating to environment.
- (3) Knowledge and abilities of applied (industrial) mathematics and at least two subjects from natural sciences mainly focusing on physics, chemistry, biology and geology
- (4) One of the following areas applicable to environment or fundamentals of integrated area of those areas
 - (4-1) Area relating to urban environment and environmental system (1*)
 - (4-2) Area relating to infrastructure and its environment (1*)
 - (4-3) Area relating to residency and living environment (1*)
 - (4-4) Area relating to environment of materials and energy (2*)
 - (4-5) Area relating to environment other than above (3*)
- (5) An ability to plan and execute surveys or experiment, to analyze and examine acquired data accurately, and to explain the result in more than one area out of areas relating to the environmental engineering mentioned in (4) above
- (6) An ability to integrate knowledge and technologies applicable to the discipline indicated by the program, acknowledge environmental issues and to set its issues and to solve based on applicable process.

2. Faculty

- (1) Faculty shall be composed with members who have ability to teach educational components relating to the discipline that is expected to be achieved as learning outcomes of the program.

1* : Refer Japan Society of Civil Engineering < <http://www.jsce.or.jp/opcet/jabee/> >
regarding supplementary remarks of discipline number 1~ 3

- 2* : Refer JABEE committee of Chemical and Chemistry-related Disciplines
< <http://www.csj.jp/gaku/jabee/index.html> > regarding supplementary remarks of
disciplines number 4
- 3* : Currently undecided

Program Criteria by Discipline
— Forest Engineering —

These Program Criteria by Discipline apply to the engineering educational programs for the discipline of Forest Engineering.

1. Expected Knowledge and Abilities to be Acquired

Graduates are expected to acquire the following knowledge and abilities at the time of completion of the program:

- (1) Knowledge of one of general fundamentals related to forest and natural environment and of the discipline of engineering such as forestry, forest engineering, natural environment, forest product, or of combination of these areas as well as ability to utilize them for problem solving. Additionally, example of general fundamentals and discipline of engineering are explained in the supplementary remarks
- (2) An ability to plan and execute experiment or surveys, to analyze and examine acquired data accurately and to explain the result
- (3) An ability to utilize knowledge and technologies applicable to the discipline to search, to build and to solve issues
- (4) An ability to understand problems and issues in practice and to judge and solve them appropriately.

2. Faculty

- (1) Faculty shall include either who have qualification such as license of professional engineer or who have ability to teach practice relating to educational components.

Supplementary remarks

- (1) General fundamentals of forest and forest-related disciplines are knowledge and abilities to be acquired commonly among disciplines for forest ecosystem, forest environment, conservation of natural environment, sustainable production and utilization of forest resources.
- (2) Program should have more than 90 educational learning hours relating to general fundamentals.
- (3) Program is allowed to make discipline of engineering profession distinctive according to the learning outcomes. Examples of discipline of engineering profession are as follows:

(3-1) Discipline of Forestry

Knowledge and abilities applicable to breeding technology including measurement of forest resources, growth prediction of the forest, forest planning and management, forestation, growing and protecting forest, and DNA manipulation based on the understanding of forest ecosystem

(3-2) Discipline of Forest Engineering

Engineering knowledge and abilities required for forest management or logging and transportation for lumber production, designing forest road and its relating facilities, national land conservation such as sand erosion control, soil conservation, and management of water resources

(3-3) Discipline of Natural Environment

Knowledge and abilities applicable to conservation of forest ecosystem and wild organism in forest ecosystem, planning and management of green space and green plant of Natural Park or park in the urban area and green plant of city itself

(3-4) Discipline of Forest Product

Knowledge and abilities applicable to function, physicality, and components of lumber and wood materials, utilization of its characteristics to the life and residential space, and knowledge and abilities applicable to the physical and chemical processing and manufacturing for the usage of wood materials, functioning and utilization of forest and other products, and positive effect of usage of wood materials to the earth environment.

- (4) Educational components as indicated here are only examples and shall not stipulate name of the subject. Therefore, program has right to determine the name of the subject according to their distinctive character.

Program Criteria by Discipline
— Industrial Engineering and Management —

These Program Criteria by Discipline apply to the engineering educational programs for the discipline of Industrial Engineering and Management.

1. Expected Knowledge and Abilities to be Acquired

Graduates are expected to acquire the following knowledge and technologies at the time of completion of the program:

- (1) Knowledge of management principle and of procedure and its application ability
- (2) Mathematical analytic ability
- (3) An ability to utilize and apply information technology
- (4) Fundamental knowledge of engineering, economics, management and other related disciplines.

2. Faculty

- (1) Faculty shall include members who have ability to teach practice applicable to the discipline of industrial engineering and management and other related disciplines.

Supplementary remarks

- (1) Followings are additional explanations to help understanding the program criteria by discipline: (1) to (4) of 1, expected Knowledge and Abilities to be acquired:
 - (1-1) Scope of management covers in wider perspective, organizations and comprehensive system between human being and information. Therefore, program shall not be restricted, if the appropriate scope of the management concept is clearly indicated and if its curriculum is made to acquire methods, knowledge and utilizing ability applicable to its concept
It is desirable that the program is made to be able to acquire not only technology-oriented subjects specified in scope but also interdisciplinary perspective by the methodology
 - (1-2) These mentioned above include ability to plan systematic data collection and to analyze data taking account of probability variation and ability to find most optimal result modeling actual problems to mathematical formula
 - (1-3) As regards the ability to utilize and apply information technology such as calculator, there may be various levels of technologies such as, programming, system designing, and networking technology

- (1-4) Fundamental knowledge applicable to the industrial engineering and management discipline such as technologies applicable to the engineering discipline, interdisciplinary technologies and social science falls into this category.

Program Criteria by Discipline
—Materials and Metallurgical Engineering—

These Program Criteria by Discipline apply to the engineering educational programs for the discipline of Materials and Metallurgical Engineering. The discipline for Materials and Metallurgical Engineering here includes metallic materials, inorganic materials including ceramics and glasses etc., organic materials including polymers, plastics etc., combined materials and semiconductor materials. The discipline includes the areas of manufacturing, converting, and application of wide range of each material.

1. Expected Knowledge and Abilities to be Acquired

Graduates are expected to acquire the following knowledge and abilities at the time of completion of the program:

- (1) Understanding fundamentals of material structure and characteristics
- (2) Understanding fundamentals of process of materials
- (3) Understanding fundamentals of function, design and utilization of materials
- (4) An ability to plan and implement experiment and to analyze data.

Educational components (1), (2), (3) shall contain more than 100 hours each and more than 400 hours in total and more than 200 hours of learning and educational hours regarding (4).

2. Faculty

- (1) Faculty shall be composed with members who have ability to teach educational components relating to the discipline that is expected to be achieved as learning outcomes of the program.

Reference: Iron and Steel Institute of Japan <http://www.isij.or.jp/lkusei/jabee.htm>

Program Criteria by Discipline
—Mechanical Engineering—

These Program Criteria by Discipline apply to the engineering educational programs for the discipline of Mechanical Engineering.

1. Expected Knowledge and Abilities to be Acquired

Graduates are required to acquire the following knowledge and abilities at the time of completion of the program:

- (1) An ability to apply mathematics such as linear algebra and calculus and fundamental knowledge of probability and statistics as well as fundamental knowledge of physics for the natural sciences
- (2) Knowledge of discipline that each program considers as important out of fundamental disciplines of Mechanical Engineering such as, materials and structure, movement and vibration, energy and flow, information measurement and control, design manufacture and management, and ability to apply it to solve problems
- (3) An ability to plan and execute experiment and projects, to analyze its result, and to observe from engineering perspective.

2. Faculty

- (1) Faculty (including part time staff) shall include either who have qualification such as license of professional engineer or who have ability to teach practice relating to educational components.

Supplementary remarks

- (1) Example of keywords to link contents in each fundamental discipline as mentioned 1(2) above and quantitative guideline shall be as follows. Keywords indicated here are only examples to help contents of the discipline understandable and do not necessary exclude contents from the discipline that are not indicated here.

Fundamental Discipline	Example of keywords to link contents	Quantitative guideline
Materials and Structures	<ul style="list-style-type: none"> -Pull force, compress force, shear stress and strain -Elasticity and plasticity -Strength of materials and allowable stress -Structure and organization of materials 	<p>More than three disciplines and in total of 210 learning hours^(*1) from fundamental disciplines as mentioned in the first left column which are considered as important for the program</p>
Motion and Oscillation	<ul style="list-style-type: none"> -Static mechanics -Laws of motion -Free oscillation -Forced oscillation 	
Energy and Flow	<ul style="list-style-type: none"> -State quantity and state change -Mass and conservation of momentum -Law of conservation of energy (first law of thermodynamics and Bernoulli's principle) -2nd principle of thermal dynamics -Thermal migration 	
Information and Measurement & Control	<ul style="list-style-type: none"> -Fundamentals of calculator Utilization -Measurement foundational theory and fundamental method of quantitative measurement -Transfer function, feedback control state equation, and feedback control function 	
Design and Manufacturing & Management	<ul style="list-style-type: none"> -Design methods -Graphics and Rules -Processing Methods -Manufacturing & Management 	

(*1): If all graduates are confirmed to have completed the program by taking subjects that meets program requirement, there is no need that all students to take the same subjects as compulsory subjects.

- (2) Requirement as mentioned above 1(3) primary indicates experiment which enables students to systematically acquire methods of experiment and device operation as well as project focusing subject (undergraduate research etc.) which make students address with either unsolved or creative issues. Approximately, more than 300 hours are required.

Reference: The Japan Society of Mechanical Engineers <http://www.jsme.or.jp/jabee/>

Program Criteria by Discipline
— Multi- and/or Trans-disciplinary Engineering and
New-disciplinary Engineering —

These Program Criteria by Discipline apply to the engineering educational programs for the discipline of Multi- and/or Trans-disciplinary Engineering and New-disciplinary Engineering.

1. Expected Knowledge and Abilities to be Acquired

Graduates are required to acquire the following knowledge and abilities at the time of completion of the program:

(1) Knowledge and Abilities of fundamental engineering

Knowledge and abilities of at least one subject from each cluster subject in total of more than six subjects are expected to be acquired. The five cluster subjects of fundamental engineering contents are namely, (i) design & system, (ii) information & logic, (iii) material & biology, (iv) dynamic and (v) socio-technical

(2) Knowledge and Abilities applicable to the discipline

(2-1) Knowledge and ability of engineering discipline (Contents of the specific discipline of Multi- and/or Trans-disciplinary Engineering and New-disciplinary Engineering shall be stipulated by the higher educational institution applying for program examination)

(2-2) An ability to plan and execute experiment by utilizing fundamental knowledge and technologies of several disciplines of engineering, to analyze and examine data accurately from engineering perspective and to explain the result

(2-3) An ability to integrate fundamental knowledge and technologies applicable to the discipline, to research issues, to build and to solve with creativity

(2-4) Fundamental ability to understand problems and issues appropriately that engineers experience during engineering practice and to solve them appropriately.

2. Faculty

(1) Faculty shall include either who have qualification such as license of professional engineer or who have ability to teach practice relating to educational components.

Program Criteria by Discipline
— Resources and Geological Engineering —

These Program Criteria by Discipline apply to the engineering educational programs for the discipline of Resources and Geological Engineering.

1. Expected Knowledge and Abilities to be Acquired

Graduates are expected to acquire the following abilities and technologies at the time of completion of the program:

- (1) Knowledge and ability of at least one area of the principle areas (development and disaster prevention of geosphere, resource development and manufacturing, and resource circulation and environment) or integrated knowledge and ability of the above
 - (1-1) Knowledge and skills of the discipline
 - (1-2) An ability to plan and execute experiment and surveys, to analyze acquired data, and to explain the result
 - (1-3) An ability to integrate (1-1) and (1-2) to research and solve issues
 - (1-4) Fundamental ability to understand problems and issues appropriately that engineers experience during engineering practice and to solve them appropriately.

2. Faculty

- (1) Faculty shall include either who have qualification such as license of professional engineer or who have ability to teach practice relating to educational components.

Reference: The Mining and Materials Processing Institute of Japan <http://www.mmij.or.jp/jabee/>