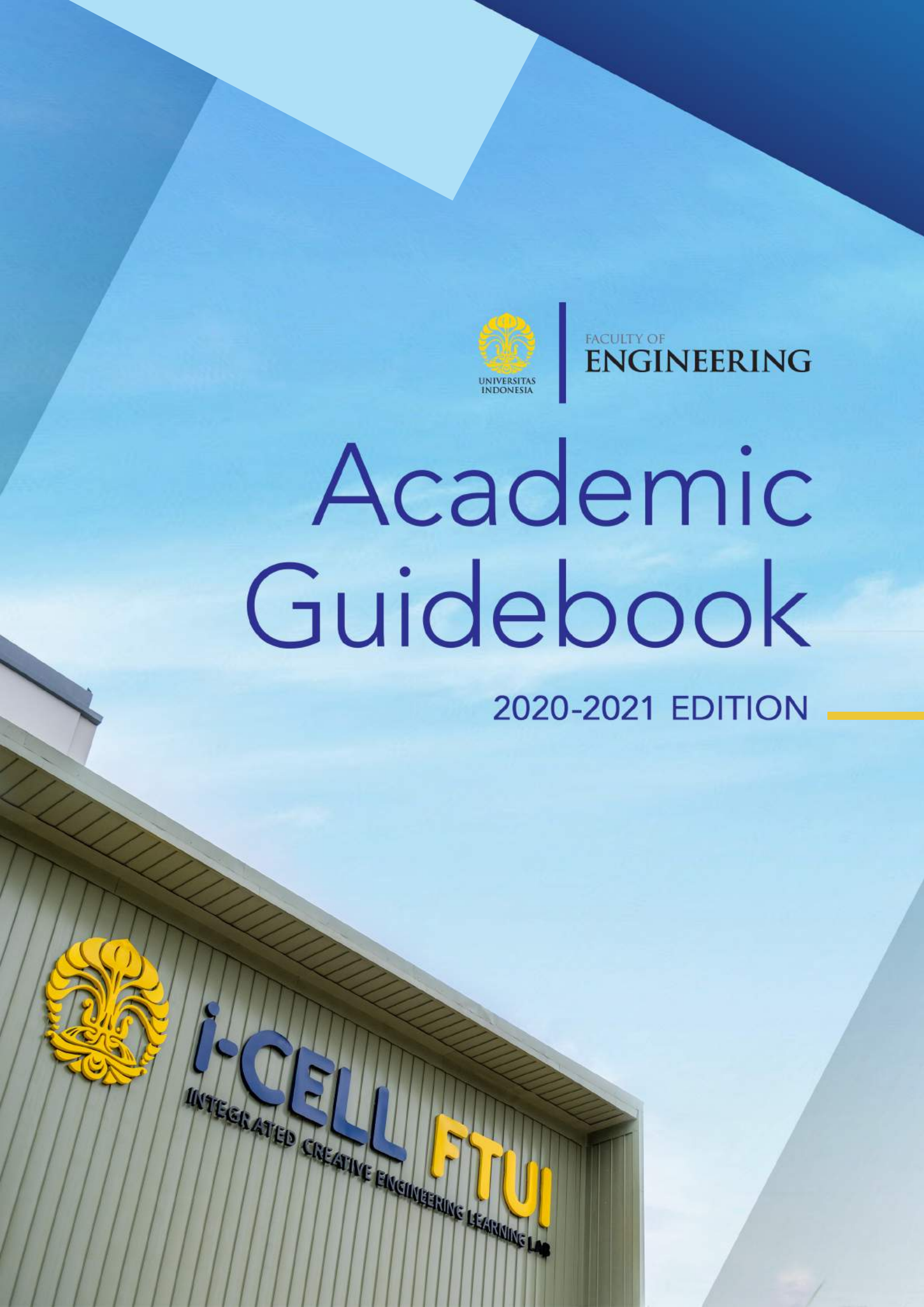
UNIVERSITAS INDONESIA

FACULTY OF
ENGINEERING

Academic Guidebook

2020-2021 EDITION



FACULTY OF ENGINEERING
UNIVERSITAS INDONESIA
ACADEMIC GUIDEBOOK
2020 - 2024

2020 - 2021 EDITION

ISBN 978-602-50431-3-0
19,5 X 26,4 cm
Cetakan I, November 2021
Penulis
Fakultas Teknik Universitas Indonesia

Desain Sampul dan Penata Letak
Fakultas Teknik Universitas Indonesia
Penerbit
Fakultas Teknik Universitas Indonesia
Email humas@eng.ui.ac.id
website http://eng.ui.ac.id

Undergraduate Program in Biomedical Engineering

Program Specification

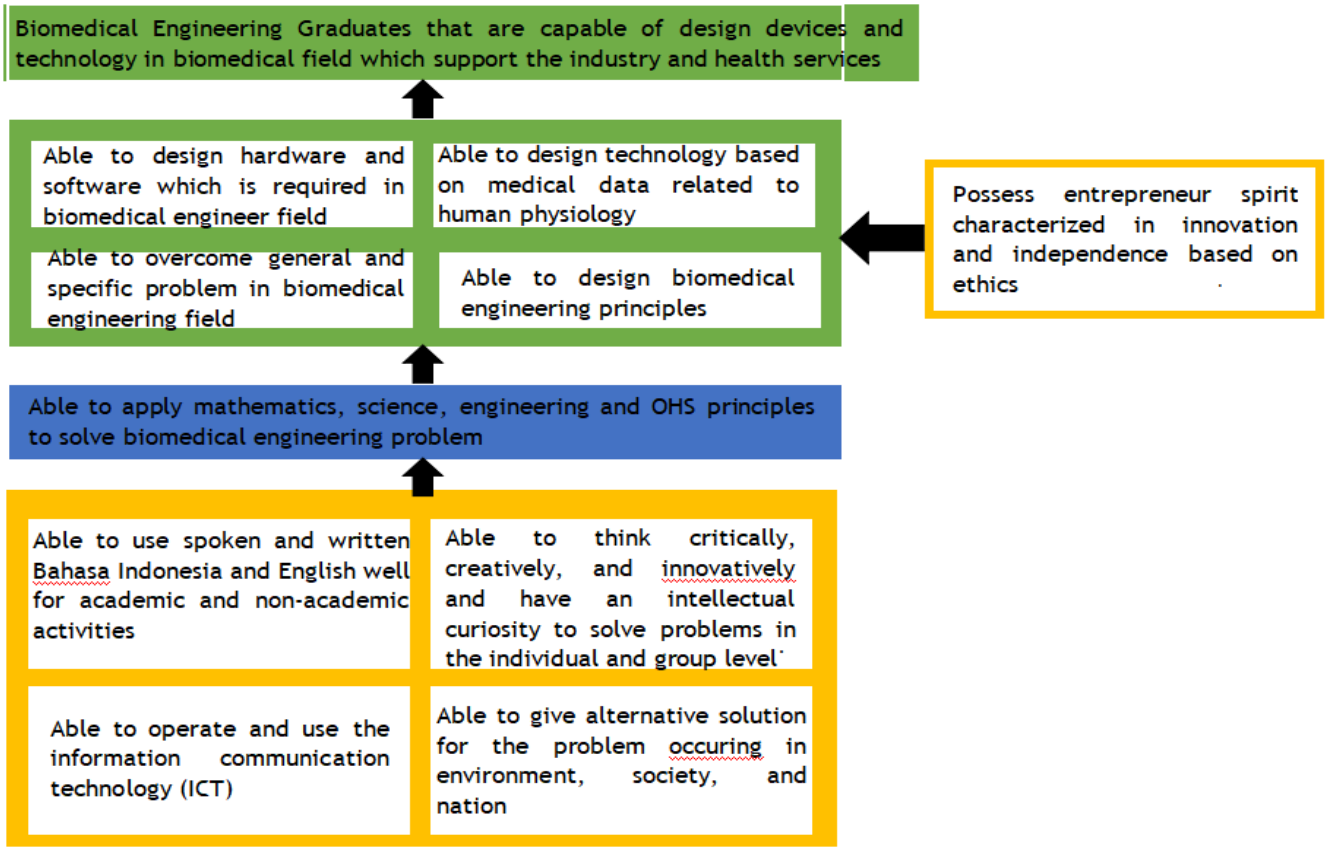
1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Programme Tittle**	Undergraduate Program in Biomedical Engineering	
4.	**Class**	Regular	
5.	**Final Award**	Sarjana Teknik (S.T)	
6 .	**Accreditation / Recognition**	Good accreditation by BAN PT	
7.	**Language(s) of Instruction**	Bahasa Indonesia	
8.	**Study Scheme (Full Time / Part Time)**	Full Time	
9.	**Entry Requirements**	High school / equivalent, AND pass the entrance exam.	
10.	**Study Duration**	Designed for 4 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	16
	Short (optional)	3	8
11.	**Graduate Profiles:** Biomedical Engineering Graduates that are capable of design devices and technology in biomedical field which support the industry and health services.		
12.	**Expected Learning Outcomes:** Biomedical Engineering Graduates are expected to have the following competence: 1. Able to design hardware and software which is required in biomedical engineer field. 2. Able to overcome general and specific problem in biomedical engineering field. 3. Able to design technology based on medical data related to human physiology. 4. Able to design biomedical engineering principles. 5. Able to apply mathematics, science, engineering and OHS principles to solve biomedical engineering problem. 6. Able to think critically, creatively, and innovatively and have an intellectual curiosity to solve problems in the individual and group level. 7. Possess entrepreneur spirit characterized in innovation and independence based on ethics. 8. Able to use spoken and written Bahasa Indonesia and English well for academic and non-academic activities. 9. Able to give alternative solution for the problem occurring in environment, society, and nation. 10. Able to operate and use the information communication technology (ICT).		
13.	**Classification of Subjects**		

No.	**Classification**	**Credit Hours (SKS)**	**Percentage**
i	**University General Subjects**	**9**	**6.25%**
ii	**Faculty Subjects**	**18**	**12.5%**
iii	**Expertise Subjects**	**84**	**58,3%**
iv	**Elective Subjects**	**25**	**17,36%**
v	**Special Subjects (KP, Seminar, and Undergraduate Thesis)**	**8**	**5.56%**
	Total	**144**	**100 %**
	Total Credit Hours to Graduate		**144 SKS**

Career Prospects

Graduates from Biomedical Engineering Study Program can work in various types of companies and health industries, information technology, education, government or regulator, and other industries related to health facilities, such as hospitals and health clinics.

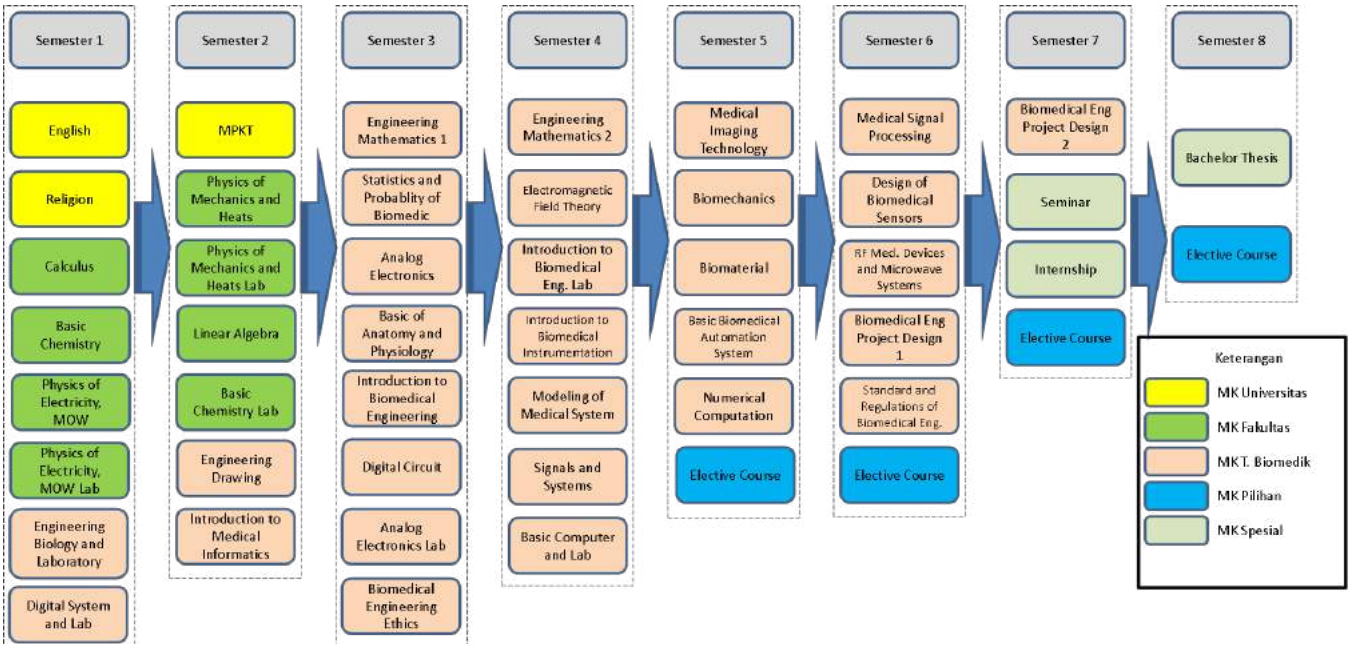
Learning Outcomes



Learning Outcomes

No	KKNI Level 6	General Competency	Output
1	Able to apply their expertise and use science, technology, and/ or art in their respective fields in solving problems and able to adapt to any situation faced	Able to design system, component, or process n biomedical engineering field Able to apply tecnique, skill and modern assist tools such as hardware and software required in biomedical engineering Able to design imaging technique for biomedical engineering	• Undergraduate Thesis • Paper • Publication, including a summary article of undergraduate thesis with journal format on UI repository. • Internship training report
2	Able to master theoretical concept in certain knowledge of a field in general and deep specialized theoretical concept in in said field and able to formulate problem-solving procedures	Able to design biomedical engineering principles Able to apply basic mathematics, chemistry, and physics to solve biomedical engineering problem	• Undergraduate Thesis • Paper • Publication, including a summary article of undergraduate thesis with journal format on UI repository. • Internship training report.
3	Able to make the correct decision based on information and data, and able to give instruction in choosing from a variety of solution alternatives both independently and in group.	Able to think critically, creatively, and innovatively and have an intellectual curiosity to solve problems in the individual and group level Able to give alternative solution for the problem occuring in environment, society, and nation	• Undergraduate Thesis • Paper • Publication, including a summary article of undergraduate thesis with journal format on UI repository. • Internship training report
4	Be responsible for their own work and can be given responsibility in achieving organization's output	Able to give alternative solution for the problem occuring in environment, society, and nation Possess entrepreneur spirit characterized in innovation and independence based on ethics	• Undergraduate Thesis • Paper • Publication, including a summary article of undergraduate thesis with journal format on UI repository. • Internship training report.

Flow Diagram of Subjects



Course Structure Undergraduate Program in Biomedical Engineering

Code	Subject	SKS
	1st Semester	
UIGE600003	English	2
UIGE600010-15	Religion	2
ENGE600003	Calculus	4
ENGE600003	Basic Chemistry	2
ENGE600007	Physics of Electricity, Magnetism, Optics, and Waves	3
ENGE600008	Physics of Electricity, Magnetism, Optics, and Waves Laboratory	1
ENBE601001	Engineering Biology and Laboratory	3
ENEE602005	Digital System and Laboratory	3
	Sub Total	**20**
	2nd Semester	
UIGE600001	Integrated Characteristic Building Subject	5
ENGE600005	Physics of Mechanics and Heats	3
ENGE600006	Physics of Mechanics and Heats Laboratory	1
ENGE600004	Linear Algebra	4
ENBE602002	Basic Chemistry Laboratory	1
ENBE602003	Engineering Drawing	3
ENBE602004	Introduction to Medical Informatics	3
	Sub Total	**20**
	3rd Semester	
ENBE603005	Engineering Mathematics 1	3
ENBE603006	Statistics and Probablity of Biomedical Engineering	3
ENBE603007	Analog Electronics	3
ENBE603008	Basic of Anatomy and Physiology	3
ENBE603009	Introduction to Biomedical Engineering	3
ENBE603010	Electric Circuit	3
ENBE603011	Analog Electronics Laboratory	1
ENBE603012	Biomedical Engineering Ethics	2
	Sub Total	**21**
	4th Semester	
ENBE604013	Engineering Mathematics 2	4
ENBE604014	Electromagnetics	3
ENBE604015	Introduction to Biomedical Engineering Laboratory	1
ENBE604016	Introduction to Biomedical Instrumentation	3
ENBE604017	Modeling of Medical System	3
ENEE604017	Signals and Systems	3
ENEE603014	Basic Computer and Laboratory	3
	Sub Total	**20**
	5th Semester	
ENBE605018	Medical Imaging Technology	3
ENBE605019	Biomechanics	3
ENBE605020	Biomaterial	3
ENBE605021	Basic to Biomedical Automation System	3
ENEE604020	Numerical Computation	2
	Elective Course	5
	Sub Total	**19**
	6th Semester	
ENBE606022	Medical Signal Processing	3
ENBE606023	Biomedical Sensor Design	3
ENBE606024	RF Medical Devices and Microwave Systems	3
ENBE606025	Biomedical Engineering Project Design 1	2
ENBE606026	Standard and Regulations of Biomedical Engineering	2
	Elective Course	8
	Sub Total	**21**
	7th Semester	
ENBE607027	Biomedical Engineering Project Design 2	3
ENBE607028	Seminar	2
ENBE607029	Internship	2
	Elective Course	6
	Sub Total	**13**
	th Semester	
ENBE608030	Bachelor Thesis	4
	Elective Course	6
	Sub Total	**10**
	Total	**144**

Electives Subjects for Biomedical Study Program

Code	Subject	SKS
ENBE605031	Medical Communication System	3
ENBE605032	Health, Safety & Environment for Hospital	2
ENBE607033	Biomedical Special Topic 1	3
ENBE607034	Immune Engineering	3
ENBE607035	Basic Thermodynamics	3
ENBE607036	Artificial Intelligent	3
ENBE606037	Biomedical Embedded System	4
ENBE606038	Biomedical Embedded System Laboratory	1
ENBE608039	Biomedical Special Topic 2	3

ENBE608040	Bioinformatics and Genomics	3
ENBE608041	Medical Therapy Technology	3

Elective subjects can also be taken across study programs, departments, and faculties. For students to take subjects from other faculty, they must follow Universitas Indonesia regulation and procedure.

Course Sylabus of University Subjects

INTEGRATED CHARACTER BUILDING

UIGE6000061/UIGE6100061
5 credits

Syllabus :

The Integrated Character Building is part of the Higher Education Personality Development Lecture which is held for students which contains elements of the internalization of basic life values, interaction/relationship skills, nationality and academic skills as the basis for student personality to carry out learning according to scientific disciplines.

MPKT is carried out in the form of a series of learning activities outside the formal class. activities carried out include participation in lectures/seminars, internships, field work practices, social work, sports and/or arts activities and other forms of activities that have the main goal of equipping students with soft skills and proven by portfolio documents. The form of this learning activity is different from the MPKT courses that have been carried out at the previous UI.

The material provided at MPKT aims to form a human thinking pattern with values and morals to create a human personality by having critical, logical, creative, innovative thinking, and having intellectual curiosity and an entrepreneurial spirit. The material provided includes 9 UI values, national, state and citizen values based on Pancasila. Solving problems in science, technology, health, and humans as natural managers by using reasoning and utilizing Information and Communication Technology (ICT) to achieve the final objectives of this module.

Lecture activities are carried out using an online student-centered learning (SCL) approach which can use the following methods: experiential learning (EL), collaborative learning (CL), problem-based learning (PBL), question-based learning, and project based learning. The use of these various methods is carried out through group discussion activities, independent assignment exercises, presentations, writing papers in Indonesian and interactive discussions in online discussion forums. The language of instruction in this lecture is Indonesian.

Graduate Learning Outcomes :

- CPL 1: Able to use spoken and written language in Indonesian and English both for academic and non-academic activities (C3, A5)
- CPL 2: Have integrity and are able to think critically, creatively, and innovatively and have intellectual curiosity to solve problems at the individual and group level (C4, A3)
- CPL 3: Able to provide alternative solutions to various problems that arise in the community, nation, and country (C4, A2)
- CPL 4: Able to take advantage of information communication technology (C3)
- CPL 5: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)

Course Learning Outcomes :

- CPMK 1: After completing this course, students are able to apply self-regulated learning characteristically in studying critically, logically, creatively, innovatively through analysis of societal problems, nation, state, and Pancasila ideology based on self-understanding as individuals and members. the community by using good and correct Indonesian and the latest information and communication technology (C4, A4)
- CPMK 2: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)
- CPMK 3: After completing this course, students are able to apply self-regulated learning characteristically in pursuing integrated and comprehensive knowledge through analysis of science problems, technology based on the role of nature manager by using good and correct Indonesian and information technology and current communications. (C4, A4)
- CPMK 4: After completing this course, students are able to plan creative activities to solve problems in society and the world of work/industry by showing creativity, critical thinking, collaborative self-discipline using good and correct Indonesian as well as the latest information and communication technology (C5, A5)

Prerequisite : -

ACADEMIC WRITING

UIGE610002
2 credits
The Objectives :

To activate students, English so that they will be able to communicate effectively in English;

To enable students to develop the learning strategies and study skills needed to finish their study successfully and o continue learning on their own after taking the MPK program (to develop independent learners)

Main Competencies :

- Listen to, understand and take notes of key information in academic lectures of between 5-10 minutes length;
- Improve their listening skills through various listening materials and procedures;
- Speak confidently, ask questions in and contribute to small group discussions;
- Use different reading strategies needed to the effective readers;
- Improve their reading skills through extensive reading material;
- Develop skills in connecting ideas using appropriate transitions and conjunctions;
- Work as part of a group to prepare and deliver a 25-minute presentation on an academic topic using appropriate organization, language and visual aids;
- Write a summary of a short academic article;
- Write an expository paragraph;
- Write a short essay.

Learning Method : Active learning, Contextual language learning, small group discussion.

Prerequisite :

1. Students Learning Orientation/Orientasi Belajar Mahasiswa (OBM)

ENGLISH

UIGE600003
2 credits
Learning Objectives :

After attending this subject, students are expected to capable of use English to support the study in university and improve language learning independently.

Syllabus :

Study Skills : (Becoming an active learner, Vocabulary Building: word formation and using the dictionary Listening strategies Extensive reading) Grammar: (Revision of Basic grammar Types of sentences Adjective clauses, Adverb clauses Noun clauses, Reduced clauses) Reading: (Reading skills: skimming, scanning, main idea, supporting ideas, Note-taking Reading popular science arti-cle, Reading an academic text) Listening: (Listening to short conversations, Listening to a lecture and notetaking, Listening to a news broadcast, Listening to a short story) Speaking: (Participating in discussions and meetings, Giving a presentation) Writing: (Writing a summary of a short article Describing graphs and tables, Writing an academic paragraph, Writing a basic academic essay (5 paragraphs).

ISLAMIC STUDIES

UIGE6000010/UIGE610005
2 credits
General Instructional Objectives :

The cultivation of students who have concern for social, na-tional and countrys issues based on Islamic values which is applied in the development of science through intellectual skills.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve :

1. Analyze the problem based on the Islamic values they adopted;
2. Analyze the problem by implementing active learning stages;
3. Discuss and express their thoughts and ideas by using proper and correct Indonesian language in discussion and academic writing.

Syllabus :

Islam history: the meaning of Islam, the characteristic of Islam, the sources of Islamic teachings, Muhammad SAW as prophet and history figure, introduction of Islam in Indonesia, the teaching essence of Islam: the basic principle of Islam teachings, the unity of Allah, worship prac-tice in live, eschatology and work ethics, human's basic rights and obligation, social structure in Islam: sakinah mawaddah and ramhah family, the social implication of family life, Mosque and the development of Islam, zakat and the economic empowerment of the people, Islam society, Science: reason and revelation in Islam, Islam's motivation in development of science, science characteristics, source of knowledge, IDI (each Faculty and Department/Study Program).

CATHOLIC STUDIES

UIGE6000011/UIGE610006
2 credits
General Instructional Objectives :

To help deliver students as intellectual capital in implementing lifelong learning process to become scientists with mature personality who uphold humanity and life.

Be scholars who believe in God according to the teachings of Jesus Christ by continuing to be responsible of his faith in life in church and society.

Syllabus :

Almighty God and the God teachings; Man, Morals, science technology and art; harmony between religions; Society, Culture, Politics, Law: the substance of theses studies will be addressed by integrating the four dimensions of the teachings of the Catholic faith: the personal dimension, the dimension of Jesus Christ, the dimension of the Church, and Community dimension. Dimensions are implemented in the following themes: People, Religion, Jesus Christ, the Church, and Faith in the society.

CHRISTIAN STUDIES

UIGE6000012/UIGE610007
2 credits
General Instructional Objectives :

Cultivating students with comprehensive Christian knowledge and teaching in the midst of the struggle and the fight of the nation while also discussing the student's participation in line with the study to help improve and build our country.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve:

1. Analyze the problem based on the Christian values
2. Analyze the problem by implementing active learning stages
3. Discuss the problem by using proper and correct Indonesian language

Syllabus :

History (Historical terms): Status of the Bible, the existence of God and Morality, Christ the Savior, the Holy Spirit as existence reformer and outlook on the world: Faith and Knowledge of Science, Church and service, Ecclesiology, Spiritual and enforcement of Christian Human Rights and the world of ethics: Christian Ethics, Christian and worship, Christianity and politics, Christian love and social reality: Christian Organizations, Students and Service, Christian and expectations.

HINDU STUDIES

UIGE6000013/UIGE610008
2 credits

Syllabus :

Hindu religion, Hindu history), Source and scope of Hinduism (the Veda as the source of Hindu religion teachings, the scope of the teachings in Hindu religion), The concept of the God (Brahman) according to the Veda, the Path to Brahman (Catur Marga Yoga, Mantra and Japa), Human Nature (The purpose of human life, Human's duties, obligations, and responsibilities both individually or collectively), Ethics and morality (Principles teaching, self-control), in-depth understanding of the scripture (deep understanding of the Bhagawadgita, deep understanding of the Sarasamuschaya), The Role of Hinduism in science, technology, and art (Hinduism benefits in science

and technology in accordance with each department, benefit / the role of Hinduism in the arts), Cohesion and community's prosperity /independence (Benefits of unity in the religious plurality, independent community (kerthajagathita) as a common goal, Tri Pitakarana), Culture as an expression of Hindu religious practice, Contribution to the Hindu religion teachings in the political life of nation and country, laws and the enforcement of justice, Awareness of and obeying the Rita / Dharma.

BUDDHIST STUDIES
UIGE6000014/UIGE610009
2 credits

Syllabus :

Almighty God and the God Study (Faith and piety, Divine Philosophy/Theology), Human (Human Nature, Human Dignity, Human Responsibility), Moral (Implementation of Faith and Piety in everyday life), Science, Technology and Art (Faith, Science and Charity as a unity, the Obligation to study and practice what you are taught, Responsibility for nature and environment), harmony between religion (religion is a blessing for all mankind, the essence of the religious plurality and togetherness), community (the role of religious society in creating a prosperous independent society, the responsibility of religious society in the realization of human rights and democracy), Culture (the responsibility of religious society in the realization of critical thinking (academic), work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDY
UIGE6000015/UIGE610010
2 credits

Syllabus of Faculty Subjects

CALCULUS 1
ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, basic engineering, and engineering specialization to be used in solving complex engineering problems.

Syllabus :
Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite: None

Textbooks:

Main reference:
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

CALCULUS 2
ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus: :
Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Textbooks:
1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Calculus Thirteenth Edition Volume 2, Erlangga, 2019.

CALCULUS
ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

Students are able to use the basic concepts of calculus involving functions of one to three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, Derivatives, Derived Applications, Indeterminate Integral, Integral Applications, Infinite Row, and Series. Derivatives with many variables, Duplicate Integral (2 and 3), Duplicate Integral Application.

Prerequisite: None

Textbooks:

Main :
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison – Wesley Pearson, 2009.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 SKS
Course Learning Outcomes:
Students are able to calculate linear system problems to solve engineering problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Linear Systems and matrix equations, Determinants, Euclid vector spaces, Common vector spaces, eigenvalues and eigenvectors, inner product spaces, Diagonalization and General Linear Transformation.

Prerequisite: None

Textbooks:
1. Elementary Linear Algebra, Howard Anton & Chris Rorres, 11th edition, 2014
2. Gilbert Strang, Introduction to linear algebra 3rd edition Wellesley Cambridge Press, 2003

MECHANICAL AND HEAT PHYSICS

ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them to understand natural phenomena and human engineering, including their applications.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy, and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torque, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Prerequisite: none

Textbooks:
1. Halliday, Resnick, and Walker, Principles of Physics 10th Edition, Wiley, 2014.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS

ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves, Light Properties and Propagation, Optical Geometry.

Prerequisite: none

Textbooks :
1. Halliday, Resnick, and Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

BASIC CHEMISTRY

ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:
Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:
Able to apply mathematics, science, and basic engineering to be used in solving complex engineering problems.

Syllabus:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Prerequisite: none

Textbooks :
1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc., New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

ENGINEERING ECONOMY

ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

Students are able to analyze the economic and financial feasibility of making economic practice decisions.

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic considerations, in individual and group, as well as in project management.

Syllabus:

Introduction to Engineering Economics, Time Value of Money, Combining Factors, Interest Rates, Money Worth Analysis, Rate of Return Analysis, Effects of Inflation, Benefit Cost & Break-Even Point Analysis, Sensitivity Analysis, Depreciation, Tax Analysis, Cost Estimation & Allocation, Capital Budgeting & Replacement Analysis.

Prerequisite:
1. Civil Engineering : -
2. Environmental Engineering : -
3. Naval Engineering : -
4. Industrial Engineering : must pass the introductory Economic course and have completed 38 credits

5. Chemical Engineering : -
6. Bioprocess Engineering : -

Textbooks:
1. Blank, Leland and Tarquin, Anthony. 2018. Engineering Economy 8th Ed. McGraw Hill.
2. Park, Chan S. 2016. Contemporary Engineering Economics 6th Ed. Pearson. Upper Saddle River.
3. White, Case and Pratt. 2012. Principles of Engineering Economic Analysis 6th ed. John Wiley and Sons.

STATISTICS AND PROBABILISTICS

ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

Students are able to handle quantitative data/information starting from the descriptive stage (collection, organization, and presentation) to the inductive stage, which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Graduate Learning Outcomes:
1. Apply descriptive statistics and probability theory to data processing and serving
2. Apply probability distribution to data processing and serving
3. Apply the principles of sampling and estimation for decision making
4. Apply hypothesis test samples for decision making

Syllabus:

Introduction to Statistics for Engineering Studies, Probability Theory, Dasar Basic concepts and definitions, Distribution Probability, Sampling, Estimation, Hypothesis testing, Hypothesis test 1 sample at an average value, Regression

Prerequisite: none

Textbooks :
1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

HSE PROTECTION

ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

Upon completion of this subject students are expected to be able to carried out hazard identification, and characterization, to propose appropriate methods for risk reduction and mitigation, and to design safety management system. The student is also expected to improve their awareness on industrial safety and health, and understanding on safety regulation framework and standards as well as environmental program.

Graduate Learning Outcomes:
1. Students are expected to understand safety, health and environmental aspect as an integral part of fundamental principal in engineering code of ethics.
2. Students are expected to be able to carry out process of risk assessments by considering risk factors in the impact of hazards on people, facilities, and the surrounding community and environemt.
3. Students are expected to understand the regulatory framework and standard related to the stages of life cycle of machine, building structure, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

Introduction to SHE Regulation and Standards, SHE Perception (Risk and Environment), Identification, Assessment and Management, Construction, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :
1. Charles A. Wentz, Safety, Health and Environmental Protection, McGraw Hill, 1998.
2. Asfahl, C.R., Rieske, D. W., Sixth Edition Industrial Safety and Health Management, Pearson Education, Inc., 2010.
3. United Kingdom - Health and Safety Executive, http://www.hse.gov.uk/
4. National laws and regulations related to the K3 Management System and the Environment.
5. Related Journal (http://www.journals.elsevier.com/safety-science/) etc, related standards and publications.

Course Syllabus of Biomedical Engineering

ENGINEERING BIOLOGY AND LABORATORY

ENBE601001
3 CREDITS
Learning Outcomes:

After completing this course, students will be able to analyze comprehensive knowledge from engineering biology to biomedical engineering and health sciences (C4).

Topics:

Molecules of cell, structure and function of protein, metabolism in cell, changes in cell: constituent of life molecule design, biochemistry and genetic revolution, DNA, biochemistry linkages with biodiversity, protein synthesis from nucleate acid to amino acid sequence, RNA polymerase to ribosome for protein synthesis, the difference between prokaryotic and eukaryotic; catalyst reaction to cell: protease, nucleoside monophosphate kinases; mechanical chemistry on cell: how protein motors convert chemical energy into mechanical work.

Prerequisites: None

Textbook:
1. Alberts, 2003, Molecular Biology of the cell.
2. Lodish, 2004, Molecular cell biology.

BASIC DIGITAL SYSTEM AND LABORATORY

ENEE602005
3 CREDITS
Learning Outcomes:

This lecture aims to enable students to apply various levels of design and implementation of digital systems using simple logic gates, logic function components, to simple memory units. This lecture covers several practicums in the design, implementation, and verification of digital logic series.

Topics:

Introduction to logic gates AND, OR and NOT; Combinational, Multiplexer and Decoder logic circuit: Full Adder, binary memory unit: SR latch, D and JK flip-flops, sequential circuit: Ripple Counter, Register and Counter: Universal Shift register, Ring counter and BCD counter, design and simulation.

Prerequisites: None

Textbook:
1. M. Morris Mano, "Digital Design," 4th Edition (International Edition), Prentice-Hall, 2007.
2. Robert Dueck, "Digital Design with CPLD Applications and VHDL," Delmar Cengage Learning; Second Edition, 2004, ISBN-10: 1401840302, ISBN-13: 978-1401840303.
3. M.M. Mano andC.R. Kime," Logic and Computer Design Fundamentals," Third Edition (International Edition), Prentice-Hall, 2004.

BASIC CHEMISTRY LABORATORY

ENBE602002
1 CREDIT
Topics:

Physical and chemical properties; Separation and purification of the substance; Identification of alkali metal ions, alkaline earth, ammonium, sulfate, iodid, bromide and nitrate; acid-base titration; metal and acid reaction; Water crystals

ENGINEERING DRAWING

ENBE602003
3 CREDITS
Learning Outcomes:
Students are able to change geometry component by drawing according to the drawing standard of International Standard Organization (ISO). Students understand the drawing theory and procedures based on ISO standard. Students have the ability to read, interpret and moving 2D/3D geometry images from components or construction. Students are able to draw orthogonal projection based on ISO standard. Students are able to draw orthogonal projection based on ISO standard and bale to model the drawing using mathematical calculation.

Topics:

Function and benefit of engineering drawing; SAP; measurement and evaluation; Introduction to drawing tools; understanding basic geometry, paper format, drawing rules, line, plane, line configuration, basic shape geometry; geometric visualization, isometric and unsymmetrical projection, function and type of lines, geometric configuration shape, orthogonal projection, projection standard, viewing concept, width of view principle, advance orthogonal projection, the concept of circumpolar regions, the concept of special areas, cutting concept, wide display and refraction.

Prerequisites: None

Textbook:
1. ISO 1101, Technical Drawings, International Organization for Standardization.
2. A.W. Boundy, Engineering Drawing, McGraw-Hill Book Company.
3. Colin Simmons & Dennis Maguire, Manual of Engineering Drawing, Edward Arnold.
4. Warren J. Luzadder, Fundamentals of Engineering Drawing, Prentice- Hall, Inc.
5. Giesecke-Mithcell-Spencer-Hill-Dygdon-Novak, Technical Drawing, Prentice Hall Inc.

INTRODUCTION TO MEDICAL INFORMATICS

ENBE602004
3 CREDITS
Learning Outcomes:

After this course, students are expected to:
1. Able to understand the basic concept of information technology for application in the medical field.
2. Able to implement information basic method by combining basic knowledge of programming to acquire, organize, combine, and analyze health data sources.

Topics:

Introduction to Medical Informatics, Controlled Medical Terminology, The Electronic Health Record (EHR), Health Information Systems in Clinical Settings, Health Information Systems in Public Health, Informatics Issues in Virtual Healthcare, Telemedicine, and Expert Systems, Medical Informatics and Clinical Decision Making, Future Technologies, Fundamental Algorithms & Methods of Medical Informatics, Medical Data Resources: Acquisition, Processing, and Classification.

Prerequisites: None

Textbook:
1. Biomedical Informatics: Computer Applications in Health Care and Biomedicine (Health Informatics) 4th ed. 2014 Edition.
2. Method in Medical Informatics: Fundamentals of Healthcare Programming in Perl, Python, and Ruby, Jules Berman, CRC Press 2010.

ENGINEERING MATHEMATICS 1

ENEE603005
3 CREDITS
Learning Outcomes:

After completing this course, students are expected to have the ability to use matrix, Singular Value Decomposition (SVD), complex function on electric circuit, implement Cauchy Riemann method on Laplace and Poisson equation, use Cauchy integral method on Cartesius coordinate and polar.

Topics:

Number and complex function, polar form, De Moivre theory, dot multiplication and cross limit complex function, derivative, del, gradient, divergence, curl in complex function, analytical and harmonic function, Cauchy-Riemann equation, Laplace and Poisson, complex integral, Cauchy integral and residue integration, real integrals using complex function, vector on two dimension and three dimension space, vector operation, dot and cross product, matrix operation, Eigen value problem, canonical reduction, SVD.

Prerequisites: Calculus.

Textbook:
1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, Wiley Publisher 2006
2. Glyn James, "Advanced Modern Engineering Mathematics", 2nd Edition, Prentice Hall Publisher 1999

BIOMEDICAL STATISTIC AND PROBABILITY

ENBE603006
3 CREDITS
Learning Outcomes:

Students have ability to analyze probability and stochastic concept; to use probability and stochastic concept to solve engineering problem in general and biomedical engineering problem specifically.

Topics:

Probability concept, random variables and probability distribution, mathematic expectancy, probability distribution function, probability transformation, stochastic process, random walk, spectrum, mean square estimation, entropy, Markov process, central limit theorem.

Prerequisites: None

Textbook:
1. Guojun Lu, "Communication and Computing for Distributed Multimedia Systems", John Wiley and Sons
2. Luis Correia, "Mobile Broadband Multimedia Networks', Elsevier, UK, 2006

ELECTRONIC ANALOG

ENBE603007
3 CREDITS
Learning Outcomes:

After finishing this course, students are expected to:

1. be able to explain, characterize diode, FET, JFET, MOSFET, VMOS, CMOS, and MESFET;
2. able to analyze BJT application sequence: small-signal model and large-signal for electronic circuit and able to analyze FET application circuit.
3. Able to design analog electronics networks.

Topics:

Diode basic principles, transistor circuit, FET, JFET, MOSFET, VMOS, CMOS, MESFET, BJT common source circuit, common base, common emitter, and common collector, BJT applications, small signal and large signal BJT model; current and voltage amplifier; MOSFET depletion and enhancement type, FET application.

Prerequisites: -

Text Books

Boylestad R, Nashhelsky L, "Electronic Devices and Circuit Theory" 9th Edition Prentice Hall, New Jersey, USA, 2006

BASIC ANATOMY AND PHYSIOLOGY

ENBE603008
3 CREDITS
Learning Outcomes:

After finishing this course, students are expected to have the ability to analyze the human body structure and the physiological function of the human body.

Topics:

The understanding of the human anatomy, Cytology and Histology, Osteology, Arthrology, Myology, Digestive System, Respiratory System, Blood Circulatory System, Muscle System, Bone System, Hormone System, Urine System, Nerve System, Reproduction System, Body Immunity System, Skin System.

Prerequisites: None

Textbook:
1. Marieb EN and Hoen K. Human. Anatomy & Physiology. 10th ed.Elsevier Inc. 2015
2. Tortora GJ et al. Principles of Anatomy & Physiology : 1st Asia-Pacific Ed. John Wiley & Sons Australia Ltd.2015
3. Martini FH, Nath JL, Bartholomew E. Fundamentals of Anatomy & Physiology, 10th Edition. 2015
4. Sherwood L. Human Physiology, From Cells to System. 7th ed. Brook/Cole. 2016

INTRODUCTION TO BIOMEDICAL TECHNOLOGY

ENBE603009
3 CREDITS
Learning Outcomes:

After finishing this course, students are expected to have the following abilities:

1. explain the concept of engineering system application to solve human biology problems (C2).
2. explain the concept of devices for monitoring human physiology signals (C2).
3. apply the basic principles of engineering to the biomedical field (C3).

Topics:

Basics of biomedical engineering, biomaterials, biomechanics, Medical Instrumentation, Imaging, Biosensors, Bioinformatics, Bioelectric Phenomena.

Prerequisites: None

Textbook:
1. The Biomedical Engineering Handbook, J.D. Bronzino & D.R. Peterson, 4th Ed., CRC Press, 2015.
2. Standard Handbook of Biomedical Engineering and Design, M. Kutz, McGraw-Hill, 2003.
3. The biomedical Engineering Handbook, Biomedical Signals, Imaging and Informatics. J.D. Bronzino & D.R. Peterson,CRC Press, 2014
4. Wang, Biomedical Sensors and Measurements, 2011
5. Ibrahim, K. S., G. Gurusubramanian, Zothansanga, R. P. Yadav, N. S. Kumar, S. K. Pandian, P. Borah, S. Mohan, Bioinformatics – A Student's Companion, Springer 2017

ELECTRICAL CIRCUIT

ENBE603010
3 CREDITS
Learning Outcomes:

After finishing this course, students are expected to be able to use star and delta circuit, calculate current phase, conductor, three-phase electric power system, electric circuit complex frequency, and use Laplace and Fourier transformation and its invers on electric circuit.

Topics:

Balanced three-phase sequence, complex frequency, magnetic clutched circuit; Laplace transformation, Laplace transformation circuit, frequency selection, active filter sequence, two polar sequence, Fourier series review, circuit with Fourier transformation, resistive circuit, dependent sources and opamp, analysis method, energy saving element, order 1 circuit, order 2 circuit, sources and fasor sinusoidal, analysis the AC steady-state, AC steady-state power condition.

Prerequisites: None

Textbook:
1. James W. Nilsson, Susan A. Riedel, "Electric Circuits", 6th Edition, Prentice Hall International, Inc., 2000 (Chapter 11-18)
2. David E. Johnson, Johnny R. Johnson, JohnL. Hilburry, Peter D. Scott, "Electric Circuit Analysis", 3rd Edition, Prentice Hall International, Inc., 1997 (Chapter 10-17)

ELECTRONIC ANALOG LABORATORY

ENBE603011-MB
1 CREDIT
Learning Outcomes:

After finishing this course, students are expected to able to

design one stage, two stages, and multi stages of amplifier sequence and multi vibrator, oscillator, and op amp circuit.

Topics:

The defining experiment of device characteristic, diode circuit, amplifier one stage, compound transistor stages, multi vibrator circuit, oscillator circuit, op amp circuit.

Prerequisites: Electrical Circuit

Textbook:

Electrical Circuit Laboratory Module

ETHICS OF BIOMEDICAL TECHNOLOGY

ENBE603012
2 CREDITS
Learning Outcomes:

1. Able to explain the ethic and ethical code in medical field both in the international level and in Indonesia.
2. Able to explore the ethics problem in medical field.

Topics:

The procedures and ethics that must be followed while planning to conduct experiment on subject of animal and human; the ethical dilemma in biomedical engineering research and the importance of considering all sides of the problems; the health technology impact for the society; several equality concept for gender, culture, and ethic.

Prerequisites: None

Textbook:

1. Ethics, Research Methods and Standards in Biomedical Engineering, Monique Frize, Publisher: Morgan & Claypool, 2011.
2. Ethics and Community in the Health Care Professions, Michael Parker, Publisher: Routledge, 1999.

ENGINEERING MATHEMATICS 2

ENBE604013
4 CREDITS
Learning Outcomes:

After finishing this course, students are expected to implement the Green theory, Gauss and Stoke divergence for line and surface integral to determine series convergence to convert function towards Taylor series, MacLaurin and Fourier, and use function linearization, use Laplace, Fourier, and Z transformation.

Topics:

The use and operation of vector, Derivative, del, gradient, divergence and curl from vector, line, surface integral, Gauss divergence, Stoke and Green theory, the use in electromagnetic field, definition of order, series, type of series, series test, ratio test, integral test, comparison test, root test, Raabe test, Gauss test, Taylor and MacLaurin series, Fourier series in complex form, Laplace, Fourier, and Z transformation.

Prerequisites: Calculus

Textbook:

1. Erwin Kreyszig, "Advanced Engineering Mathematics"9th Edition, Wiley Publisher 2006
2. Glyn James, "Advanced Modern Engineering Mathematics", 2nd Edition, Prentice Hall Publisher 1999

ELECTROMAGNETIC FIELD THEORY

ENBE604014
3 CREDITS
Learning Outcomes:

After finishing this course, students are expected to able to apply the Maxwell Law 1, 2, 3, and 4. Students can interpret physical concept in biomedical engineering field.

Topics:

Static Electricity, Magnetic Field, Maxwell Equation, Electromagnetic Wave, Wave Propagation, Wave Characteristic on Different medium, Wave Transmission, Matching Impedance, Radiation.

Prerequisites: Calculus, Engineering Mathematics

Textbook:

1. Stuart M. Wentworth, "Fundamentals of Electromagnetics with Engineering Applications,"John Wiley, 2005.
2. William H. Hayt and John A. Buck, "Engineering Electromagnetics," McGraw-Hill Companies: 6th Ed. 2001..

INTRODUCTION TO BIOMEDICAL TECHNOLOGY LABORATORY

ENBE604015
1 CREDIT
Learning Outcomes:

After completing this course, students are able to:

1. Conducting experiments on instrumentation related to biomedical engineering (C3)
2. Conducting experiments on software related to biomedical engineering (C3)
3. Conducting experiments related to biosensor (C3).

Topics:

Tensimeter untuk tekanan darah, EKG, USG, Ventilator, Karakterisasi Material, Database bioinformatika, immunologi virtual lab, dan Biosensor.

Prerequisites: Introduction to Biomedical Technology

Textbook:

Biomedical Engineering Laboratory Module

INTRODUCTION TO BIOMEDICAL INSTRUMENTATION

ENBE604016
3 CREDITS
Learning Outcomes:

After finishing this course, students are expected to have the following abilities:

1. Menganalisis sistem pengukuran biomedis
2. Menganalisis beragam jenis pengukuran sistem kardiovaskular, sistem respirasi, dan sistem saraf.
3. Menganalisis faktor-faktor keselamatan pasien yang harus diperhatikan dalam pengukuran

Topics:

Introduction to biomedical instrumentation; basic transducer principle (active and passive transducer, transducer for biomedical application; source of bioelectric potentials; electrodes; the cardiovascular system; cardiovascular measurement; measurement in respiratory system; noninvasive diagnostic instrumentation; measurement in nervous system; sensory and behavioral measurements; electrical safety of medical equipment; role of laser in healthcare.

Prerequisites: None

Textbook:

1. Andrew G. Webb - Principles of Biomedical Instrumentation-Cambridge University Press (2018)
2. Biomedical Instrumentation and Measurement, Leslie Cromwell, Fred J. Weibel and Erich A. Pleiffer, Prentice

Hall, New Jersey.
3. Handbook of Biomedical Instrumentation, RS Khanpur, Tata McGraw-Hill Education, 2003.

MODELING OF MEDICAL SYSTEM

ENBE604017
3 CREDITS
Learning Outcomes:

After completing this course, students are able to analyze a system model for certain physiological cases (C4).

Topics:

Physiological complexity, physiological process modeling, systems modeling, data modeling, parametric modeling, parametric model estimation, bioelectric phenomena, introduction to MATLAB Simulink and SymBiology, and simulation case studies.

Prerequisites: Basic Anatomy and Physiology

Textbook:
1. Cobelli C and Carson ER, Introduction to Modeling in Physiology and Medicine. 1st ed. A volume in Biomedical Engineering. 2008
2. Enderle, J. D., Bioelectric Phenomena, Elsevier 2012
3. https://www.mathworks.com/support/learn-with-matlab-tutorials.html

SIGNAL AND SYSTEM

ENEE604017
3 CREDITS
Learning Outcomes:

After completing the lecture, students are expected to be able to analyze the results of the process and signal transformation into Fourier, Laplace and Hilbert functions, be able to design simple filters, sample signals into discrete (Z transform), be able to design IRR and FIR filters on continuous systems.

Topics:

Fourier transformation and its characteristics, Discrete Time Fourier Transformations and its characteristics, continuous time system, Laplace transformation and its characteristics. System function, windows, filter design. Hilbert transformation. Discreet time signals, sampling, reconstruction theory, Z-transformation and its characteristics. System function, discreet simulation of continuous system, windows, IIR and FIR filter design.

Prerequisites: None

Textbook:
1. Simon Haykin and Barry Van Veen, "Signals and System", 2nd Edition John Wiley & Sons Publisher, 2003
2. Alan V. Oppenheim, Ronald W. Schafer, and John R. Buck, "Discrete-Time Signal Processing", Prentice Hall; 2nd Edition, 1998

BASIC COMPUTER AND LABORATORY

ENEE603014
3 CREDITS
Learning Outcomes:

After completing this course, students are expected to:

1. Explain the hardware and software of a computer system.
2. Design a simple algorithm in the form of pseudocode and implement the algorithm into a programming language.

Topics:

Introduction to computer system, Introduction to computer hardware, Introduction to computer software, algorithm, pseudo code, Introduction to programming language C, programming process on programming language C, structured program for programming language C.

Prerequisites: None

Textbook:
1. A. Evans, K. Martin, and M. A. Poatsy, "Technology in Action (TiA)," 2nd Edition, Prentice-Hall, 2006.
2. G. B. Shelly and M. E. Vermaat, "Discovering Computers 2011: Living in a Digital World," Course Technology, Cengage Learning, 2011.
3. Deitel & Deitel, "C How to Program," 5th Edition, Pearson Education, 2007.

MEDICAL IMAGING TECHNOLOGY

ENBE605018
3 CREDITS
Learning Outcomes:

After this course, students are expected to:
1. Able to design medical imaging techniques for applications in the health sector (C6)
2. Able to recommend medical image processing techniques for applications in the health sector (C5)

Topics:

Introduction to Medical Imaging Technologies (X-Ray and CT, MRI, Ultrasound, PET and SPECT, Electrical Impedance Tomography), Image formation and Reconstruction (Acquisition, Digitization, Image Reconstruction Methods), Image Enhancement (Fundamentals of enhancement techniques, Image enhancement with linear, nonlinear, fixed, adaptive, and pixel-based methods), Image Segmentation and Analysis (Fundamentals of Medical Image Segmentation, Image preprocessing and acquisition artifacts, Thresholding, Edge-based techniques, Region-based segmentation, Classification, Morphological Methods for Biomedical Image Analysis), Image Visualization (2-dimensional visualization, 3-dimensional visualization methods: surface rendering, volume rendering, Algorithm for 3-D visualization), Image Management (Fundamentals of Standards Compression Storage and Communication, Image archive and retrieval, three-dimensional compression).

Prerequisites: None

Textbook:
1. Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition, "Medical Devices and Systems," CRC Press: 2006, Section II.
2. Avinash C. Kak and M. Slaney, "Principle of Computerized Tomographic Imaging," IEEE Press: 1999.
3. Isaac Bankman, "Handbook of Medical Imaging: Processing and Analysis Management," Academic Press: 2000, CA, USA.
4. E. S. Gopi, "Digital Signal Processing for Medical Imaging Using Matlab," Springer:2013, New York.
5. Medical Image Processing, Reconstruction and Restoration: Concepts and Methods, Jirí Jan, CRC Press: Taylor & Francis Group 2006, Boca Raton, FL, USA.

Tambahan:
6. Handbook of Medical Imaging, Vol. 2: Medical Image Processing and Analysis, M. Sonka & J.M. Fitzpatrick, SPIE Press, 2009, Washington, USA
7. Biomedical Image Processing, Thomas M. Deserno, Springer-Verlag Berlin Heidelberg, 2011
8. Biomedical Signal and Image Processing, Kayvan Najarian and Robert Splinter, CRC Press: Taylor & Francis Group 2012, Boca Raton, FL, USA.

BIOMECHANICS

ENBE605019
3 CREDITS
Learning Outcomes:

After completing this course, students are able to design applied biomechanics, as well as biomechanics applications in various biomedical and clinical problems (C6)

Topics:

Newton Law, Fluid Mechanics, Bernoulli, Drag Forces, Reynold Number, Static System Mechanic and Moving System, the Body's Kinetic and Force and the influence on Movement and Stability, Basic Mathematics on Movement, Analysis and Instrumentation on body motion, the Basic concept of the human body bone and muscle mechanics, ergometry, the Basic concept of energy.

Prerequisites: None

Textbook:
1. N. Ozkaya, and M. Nordin, "Fundamental of Biomechanics: Equilibrium, Motion and Deformation", 2nd Ed., Springer, 1998.
2. E. Okuno, and L. Fratin, "Biomechanics of the Human Body", Springer, 2013.

BIOMATERIALS

ENBE605020
3 CREDITS
Learning Outcomes:

At the end of the course, students are expected to be able to:

1. Explain the basic concept of biomaterial and its characteristics.
2. Use modern analysis technique for biomaterial characterization.
3. Analyze the issue in surface area and toxicity.
4. Recommend suitable biomaterials for applications in biomedical engineering.
5. Design the material process and cost analysis.

Topics:

Introduction and Overview/Importance of biomaterials, Classes of Materials Used in Medicine, Metalic Biomaterials, Polymeric Materials and composite, Ceramic biomaterials, Biodegradable materials, Soft and Hard tissue replacement, Tissue Engineering, Surface Properties and characterization of Biomaterials, Surface & Protein Interactions, Dental Implants, Biosensors, Biodevices, Targeted drug delivery, Biomaterials corrosion and degradation.

Prerequisites: None

Textbook:
1. J.Y. Wong and J.D. Bronzino, "Biomaterials", CRC Press, 2007.
2. D. Sihm, "Introduction to Biomaterials", World Scientific, 2006.

BASIC BIOMEDICAL AUTOMATION SYSTEM

ENBE605021
3 CREDITS
Learning outcomes:

After finishing this course, students are able to:

1. analyze stability, transient response, and steady-state error in a control system (C4)

2. choose a control system design method according to the control problem (C5)

3. designing a controller on an example of a biomedical system (C6)

Topics:

Basic concept of biomedical system system-model-simulation, biomedical system state space equations and transfer functions, model analysis via simulation, identification of biomedical system model parameters, parameter estimation methods, biomedical system model simulation, biomedical system optimization models, PID control and optimal design, biomedical automation system design, biomedical automation system simulation and analysis.

Prerequisites: None

Textbook:
1. Automatic Control Systems in Biomedical Engineering, Springer Verlag, 2018
2. Control Systems Engineering 6th ed, John Wiley & Sons, 2011
3. Feedback Control of Dynamic Systems 7th, Pearson, 2015
4. Control Engineering: MATLAB Exercises, Springer Verlag, 2019
5. Control Theory in Biomedical Engineering: Applications in Physiology and Medical Robotics, Academic Pres, 2020.

NUMERICAL COMPUTATION

ENEE604020
3 CREDITS
Learning Outcomes:

Able to design algorithms with computational methods.

Topics:

Biner Computing System, computer memory, algorithm and system efficiency, the dynamics and Monte Carlo, Stochastic and random, error and error reduction.

Prerequisites: Engineering Mathematics

Textbook:
1. Wen Shen, "An Introduction to Numerical Computation," World Scientific Publishing, 2016.
2. T.A. Driscoll and R.J. Braun, "Fundamental of Numerical Computation," SIAM, 2018.

MEDICAL SIGNAL PROCESSING

ENBE606022
3 CREDITS
Learning Outcomes:

After completing this course, students are expected to:

1. Able to analyze medical signal processing methods

2. Able to analyze medical image processing methods

3. Able to apply medical signal and image processing methods using MATLAB software

4. Able to use correct Indonesian language in presenting ideas/opinions.

Topics:

Introduction to medical image and signal processing, Fourier transform application, Image Filtering, Enhancement, and Restoration, edge detection and image segmentation, Wavelet transform, artificial neural network recognition, deep learning recognition, basic signal processing EEG, ECG, PET, CT, X-Ray, MRI, Ultrasound and SEM.

Prerequisites: Signal and System

Textbook:
1. Kayvan Najarian and Robert Splinter, "Biomedical Signal

and Image Processing, 2nd Ed", Taylor & Francis, 2012
2. E. S. Gopi "Digital Signal Processing for Medical Imaging Using Matlab", Springer, 2013

DESIGN OF BIOMEDICAL SENSORS

ENBE606023
3 CREDITS
Learning Outcomes:

After completing this course, students will be able to design biosensors for medical applications (C6)

Topics:

The basis of the sensor which includes sensor characteristics, sensor calculation technology, and biocompatibility of the sensor, Physical sensor which includes resistance sensor, inductive sensor, capacitive sensor, piezoelectric sensor, magnetoelectric sensor, photoelectric, and thermoelectric sensor, optical sensor, Chemical sensor includes ion sensor , gas sensors, humidity sensors, sensor arrays, and sensor networks, and biosensors including catalytic biosensors, affinity biosensors, cell and tissue biosensors, biochips, and nano-biosensors.

Prerequisites: None

Textbook:
1. Enderle J., Bronzino J. - Introduction to biomedical engineering-AP (2011).
2. Wang, P. Q. Liu. Biomedical Sensor and Measurement. Springer (2011).

RF MEDICAL SYSTEM DEVICE AND MICRO-WAVE

ENBE606024
3 CREDITS
Learning Outcomes:
After completing this course, students are expected to:
1. Able to design RF and microwave devices and circuits
2. Able to develop microwave technology in the future in Indonesia

Topics:

Introduction to microwave engineering, Transmission line theory, Transmission Line and Waveguide, Network analysis, Impedance matching and tuning, Microwave Resonators, Microwave power dividers and couplers, Microwave Filters, Noise in Microwave Circuits & Active RF Components, Microwave Amplifier, Microwave Oscillators and Mixers.

Prerequisites: Electromagnetic Field Theory

Textbook:
1. Microwave Engineering, David M. Pozar, Publisher: John Wiley & Sons, 4th Ed. 2012.
2. RF & Microwave Design Essentials, Matthew M. Radmanesh, Publisher: AuthorHouse, 2007.

BIOMEDICAL ENGINEERING PROJECT DESIGN 1

ENBE606025
2 CREDITS
Learning outomes:

After completing this course, students are expected to be able to handle general and specific problems in the field of biomedical engineering (C6).

Topics:

Engineering design concepts, engineering design process, selection of objects/tools needed, selection and decision making, Introduction to marketing, Business organization, accounting management, Business Finance, Business Analysis for new project proposals, Introduction to the concept of entrepreneurship, Marketing risk analysis. Understanding of project and project management, organizational structure, function management, leadership in the project environment, conflict management, investment analysis, control analysis for infrastructure development, cost and wealth allocation, risk management and quality management, work break-down structure, scheduling, resource budgeting, controlling (S-curve), Engineering Economics (NPV, IRR, BEP), TOR of technical proposals.

Prerequisites: None

Textbook:
1. H. Kerzner, "Project Management: A System Approach to Planning, Scheduling and Controlling', John Willey & Sons, 2009.
2. J.R. Meredith, S.J. Mantel, Jr. "Project Mangement: A Managerial Approach', 6th Edition, John Wiley & Sons, 2006.
3. G. Pahl and W.Beitz, Engineering Design: A Systematic Approach, 3rd ed. Springer, 2007.
4. Leland Blank, Anthony Tarquin - Engineering Economy-McGraw-Hill Science_Engineering_Math (2011)

BIOMEDICAL ENGINEERING STANDARD AND REGULATION

ENBE606026
2 CREDITS
Learning Outcomes:

After completing this course, students are expected to:
1. Able to recommend biomedical engineering standards and regulations
2. Able to recommend patient safety and security standards.

Topics:

Medical devices design and manufacturing control, ISO 13485, How to Manufacture Good Health Device (CPAKB) di Indonesia, International Standard for Medical Devices: IEC 60601; EC Medical device directed (MDD), Medical devices design and control in the hospital.

Patient safety and the biomedical engineer, Risk management, Patient safety best practices model, Hospital safety program, System approach to medical device safety, Electromagnetic interference in the hospital; Electrical safety in the hospital; Accident investigation, Medical devices Failure modes, accidents and liability.

Prerequisites: None

Textbook:
1. National Institutes of Health (NIH), Ethical Guidelines & Regulations.
2. 2. International Organization for Standardization (ISO). IEC 60601 Series.
3. 3. Ethics, Research Methods and Standards in Biomedical Engineering, Monique Frize, Publisher: Morgan & Claypool, 2011.

BIOMEDICAL ENGINEERING PROJECT DESIGN 2

ENBE607027
3 CREDITS
Learning outcomes:

Students have capability to design the development concept in biomedical project and its implementation.

Topics:

Biomedical engineering project design

Prerequisite: Biomedical Engineering Project Design 1

Textbook:
1. H. Kerzner, "Project Management: A System Approach to Planning, Scheduling and Controlling', John Willey & Sons, 2009.
2. J.R. Meredith, S.J. Mantel, Jr. "Project Mangement: A Managerial Approach', 6th Edition, John Wiley & Sons, 2006.
3. G. Pahl and W.Beitz, Engineering Design: A Systematic Approach, 3rd ed. Springer, 2007.
4. Leland Blank, Anthony Tarquin - Engineering Economy-McGraw-Hill Science_Engineering_Math (2011).

Special Subjects

SEMINAR
ENBE607028
2 CREDITS
Learning Outcomes:

After finishing this course, students are expected to be able to design and analyze a guided research, and able to write the findings of said research into a scientific writing in the form of seminar book. Students are expected to think critically, creatively, and innovatively and have intellectual curiosity to provide alternative solutions to existing problems. Students are also expected to show their research in front of lecturers.

Topics: Not Available

Prerequisites: Earns more than 114 credits.

Textbook:
1. Technical Guidance for Universitas Indonesia Students' Final Project
2. IEEE Citation Reference
3. IEEE Transactions on Parallel and Distributed Systems, Vol. 21, No. 2, February 2010, "How To Write Research Articles in Computing and Engineering Disciplines"

INTERNSHIP
ENBE607029
2 CREDITS
Learning Outcomes:

In this course, students are be expected to participate in an internship in industries, institutions, or laboratories related to biomedical engineering. Upon completion of this course, students are expected to be able to combine and implement engineering knowledge that they have learnt before with new knowledge given by their supervisors. Students are also expected to be able to show professional conduct such as teamwork, discipline, responsibility, initiative, and interest, leadership, and improvement prospect.

Topics: Not Available

Prerequisites:

Earn 90 credits. Internship locations are industries, institutions, and laboratories connected to biomedical engineering with appointed supervisors and person in charge that can guide the students daily. The choice of companies or laboratories will start with an administrative process in the Biomedical Engineering Study Program.

Textbook: Not Available

UNDERGRADUATE THESIS
ENBE608030
4 CREDITS
Learning Outcomes:

After completing the study, students are expected to be able to design and plan a guided research and be able to write the results of their research in a scientific paper in the form of a thesis book. Students are expected to be able to think critically, creatively, and innovatively and have intellectual curiosity to provide alternative solutions to existing problems. Under the guidance of a lecturer, students are expected to integrate and implement their concept and write their research results into scientific writing in the form of undergraduate thesis book. Students are also expected to present and defend their concept and findings in front of a panel of examiners on thesis examination day.

Syllabus: Not Available

Prerequisites: Earns more than 120 credits

Textbook:
1. Technical Guidance for Universitas Indonesia Students' Final Project
2. IEEE Citation Reference
3. IEEE Transactions on Parallel and Distributed Systems, Vol. 21, No. 2, Feb. 2010, "How To Write Research Articles in Computing and Engineering Disciplines"

Elective Courses for Biomedical Engineering

MEDICAL COMMUNICATION SYSTEM
ENBE605031
3 CREDITS
Learning Outcomes:
After completing this course, students are expected to be able to recommend wired/wireless medical communication systems

Topics:

Introduction to medical communication system, e-healthcare and telemedicine. Several special topics will be delivered include body-centric wireless communications, electromagnetic properties and modeling of the human body, portable wearable devices, medical implant communication systems, e-healthcare infrastructure, wireless body area network, mobile-based telemedicine system, and wireless power technology in medical devices.

Prerequisites: None

Textbook:
1. E-Healthcare Systems and Wireless Communications: Current and Future Challenges, Mohamed K. Watfa, Publisher: IGI Global, 2012.
2. Antennas and Propagation for Body Centric Wireless Communications, P.S. Hall, Publisher: Artech House, 2006.

HEALTH, SAFETY & ENVIRONMENT (HSE) FOR HOSPITAL
ENBE605032
2 CREDITS
Learning Outcomes:
After completing this course, students are expected to:
1. 1. apply the principles of occupational safety and health in the hospital environment (C3)
2. 2. express the concept of the application of policies related to occupational safety and health in the health care facility environment (C3).

Syllabus:

Patient safety and the biomedical engineer; Risk management; Patient safety best practices model; Hospital safety program; System approach to medical device safety; Electromagnetic interference in the hospital; Electrical safety in the hospital; Accident investigation; Medical devices Failure modes, accidents and liability

Prerequisites: None

Textbook:
1. Kemenkes RI, Pedoman manajemen Risiko di Fasilitas Pelayanan Kesehatan, 2013.
2. Joseph Dyro (ed.), Clinical Engineering Handbook, Elsevier Academic Press, 2004.
3. Keputusan Menteri Kesehatan Republik Indonesia Nomor: 1087/Menkes/Sk/Viii/2010 Tentang Standar Kesehatan Dan Keselamatan Kerja Di Rumah Sakit
4. Myer Kutz, Biomedical Engineering and Design Handbook (Volume 2: Applications), McGraw Hill, New York, 2nd edition, 2009.
5. Improving Patient safety: Insights from American, Australian and British Healthcare, ECRI Europe, 2012.
6. Elizabeth Mattox, Medical Devices and Patient Safety, AACN Journals Vol. 32, No.4 Agust 2014.

BIOMEDICAL SPECIAL TOPIC 1

ENBE607033
3 CREDITS
Learning Outcomes:

After completion this course, students are expected to be able to review the latest developments in biomedical engineering covering aspects of technology, business and regulation.

Topics:

The latest issues on technology, application, business, and regulation aspects in the health field.

Prerequisites: None

Textbook: None

IMMUNE ENGINEERING

ENBE607034
3 CREDITS
Learning outcomes:

After completing this course, students are able to make basic application concepts in the field of biomedical technology using the principles of immunology (C4).

Topics:

The principles in immunity, includes innate and adaptive immunity; antibody and antigen interaction; hipersensitivity; autoimmune and host defense; vaccine; immune regulation; immune response against microbiological infection; diagnostic methods of infection; synthetic biology; biomimetic; personalized medicine; in vitro diagnostic.

Prerequisite: Engineering Biology and Laboratory

Textbook:
1. Delves PJ, et al, 2017, Roitt's Essential Immunology, Wiley Blackwell.
2. Silvestre R and Torrado e, 2018, Metabolic Interaction in Infection, Springer.

BASIC THERMODYNAMICS

ENBE607035
3 CREDITS
Learning outcomes:

After completing this course, students are expected to:
1. apply the laws and basic concepts of thermodynamics, thermodynamic processes, and equations of state (C3).
2. design thermodynamic systems and information technology needed to achieve competence in the discipline of Biomedical Engineering (C6).

Topics:

Scope and basic understanding of thermodynamics system, temperature concept, pressure, thermodynamics equilibrium, reversible/irreversible process, zero law of thermodynamics and absolute temperature, first law of thermodynamics, second law of thermodynamics, thermodynamics equation, gas power cycle, gas compressor, combustion engine cycle, internal combustion engine, simple gas turbine cycle, brayton's cycle, stirling's cycle, steam power cycle, refrigeration, carnot's cycle, simple rankine's cycle, rankine's cycle with modification, biner cycle, phsycometrich chart, cooling tower, real gas, real gas equation, enthalpy and entrophy.

Prerequisite: Basic Chemistry

Textbook:
1. Moran, Michael J. and Shapiro, Howard N. Fundamentals of Engineering Thermodynamics 5th edition. Danvers: John Wiley & Sons, 2006.
2. Cengel, Yunus A. and Boles, Michael A. Thermodynamic: an Engineering Approach 5th edition. Boston: McGraw-Hill, 2006.

ARTIFICIAL INTELLIGENCE

ENBE607036
3 CREDITS
Learning outcomes:
At the end of the course, students are expected to:
1. analyze mathematical model and statistics in basic introduction
2. use good learning method either supervised or unsupervised algorithm in pattern recognition, classification and clustering

Topics:

Basic pattern recognition, artificial neural networks (ANN), supervised learning (generative/discriminative learning, parametric/non-parametric learning, neural networks, support vector machines); unsupervised learning (clustering, dimensionality reduction, kernel methods), learning theory (bias/variance tradeoffs; VC theory; large margins), Principal Component Analysis, current application in machine learning.

Prerequisite:

Engineering Mathematics 2, Biomedical Statistics and Probabililty, Numeric Computation, Basic Computer and Programming

Textbook:
1. Christopher Bishop, "Pattern Recognition and Machine Learning," Springer, 2006.
2. Richard Duda, Peter Hart and David Stork, "Pattern Classification," 2nd ed. John Wiley &Sons, 2001.
3. Tom Mitchell, "Machine Learning," McGraw-Hill, 1997.

BIOMEDICAL EMBEDDED SYSTEM

ENBE606037
4 CREDITS
Learning Outcomes:

This course teaches students to design medical application from embedded system. By the end of the course, students should be able to design the concept of developing embedded

system and plan the implementation by using programming language such as Assembly Language, C Programming Language and other Programming Language.

Topics: Specification and Model for Embedded System, Sensor and Actuator, Programming Language for Embedded System, Operation System for Embedded System, Evaluation and Validation for Embedded System.

Prerequisites: None

Textbook:

1. J. Liu, "Real-Time Systems", Prentice Hall, 2000.
2. P. A. Laplante, "Real-Time Systems Design and Analysis - An Engineer's Handbook", 2nd Edition, IEEE Press, 1997.

BIOMEDICAL EMBEDDED SYSTEM LABORATORY

ENBE606038
1 CREDITS
Learning Outcomes:

Students have capability to create 16 bits and 32bits Intel Microprocessor program and 8051 Microcontroller (8 bits) using low level language and design microcontroller 8051-based embedded system.

Topics: Assembly programming for 8086/8088 Intel Microprocessor; Assembly and interface programming microcontroller in LED, Switch, LCD, Keypad; Stepper Motor Assembly and interface programming. Mid test project: Assembly program development for Microprocessors 8086/8088. Final test project: Embedded systems development for Microcontroller 8051.

Prerequisites: Digital Circuit and Laboratory, Basic Computer and Programming

Textbook:

1. Digital Laboratory, "Microprocessor and Microcontroller Laboratory Modules"
2. The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium IV Architecture, Programming, and Interfacing, 7th Edition, Brey, Barry, B., PHI Inc, USA, 2006
3. The 8051 Microcontroller and Embedded Systems, 2nd Edition, Muhammad Ali Mazidi, Prentice Hall, 2006

BIOMEDICAL SPECIAL TOPIC 2

ENBE600039
3 CREDITS
Learning Outcomes:

Able to figure out the latest development of biomedical engineering including the technology, business, and regulation aspects.

Syllabus:

The latest issues on technology, application, business, and regulation aspects in the health field.

Prerequisites: None

Textbook: None

BIOINFORMATICS AND GENOMICS

ENBE600041
3 CREDITS
Learning outcomes:

After completing this course, students are expected to be able to conclude the results of genomic data analysis through the bioinformatics approach (C4).

Topics: Fundamental information of genome along with its database and software; sequencing technology; nucleotide analysis; DNA marker analysis; RNA analysis; wet lab application related to bioinformatics; pathway and GO annotation system; molecular analysis of protein; biological system.

Prerequisite: Engineering Biology and Laboratory.

Textbook:

1. Ibrahim KS, et al, 2017, Bioinformatics-A Student's Companion. Springer. Singapore.
2. Keith JM. 2017. Bioinformatics Volume II: Structure, Function, and Application. Humana Press. New York.
3. Li X, et al. 2018. Non-Coding RNAs in complex diseases. Springer. Singapore.

MEDICAL THERAPY TECHNOLOGY

ENBE600040
3 CREDITS
Learning Outcomes:

Able to analyze cancer and tumor issues and their treatment solution with radiotherapy and thermal therapy methods.

Topics:

Radiotherapy: Radioisotope physics principle, several cancer and tumor, radiotherapy method for benign and malignant cancer. Thermal Therapy: RF Ablation and Microwave Coagulation, Hyperthermia Method, Ultrasound Thermal Therapy.

Prerequisites: None

Textbook:

1. Peter Hoskin, "Radiotherapy in Practice - Radioisotope Therapy," Oxford University Press, 2007.
2. E.G. Moros, Physics of Thermal Therapy - Fundamentals and Clinical Applications, CRC Press, 2012.

UNIVERSITAS INDONESIA

FACULTY OF
ENGINEERING

ISBN 978-602-50431-3-0

Secretariate
FTUI Dean's Building 2nd Fltoor
Depok Campus, Depok 16242
Phone: +62217863504
Fax: +6221 7270050

Public Relation Office
Faculty Administration Center Building (PAF)
Depok Campus, Depok 16242
Phone: +6221 78888430, Fax: +6221 78888076,
Email: humas@eng.ui.ac.id /