Higher Education Curriculum
Bachelor of Electrical Engineering
Year 2022

FACULTY OF ENGINEERING
UNIVERSITY OF MATARAM

GLOSSARY

ABET	:	Accreditation Board for Engineering and Technology
BEE	:	Bachelor of Electrical Engineering
BAN-PT	:	National Accreditation Board of Higher Education
CLO	:	Course Learning Outcomes
DIKTI	:	Higher Education
GPM	:	Quality Assurance Board
IABEE	:	Indonesian Accreditation Board for Engineering Education
IPS	:	Semester Achievement Index
KKNI	:	Indonesian Qualification Framework
KRS	:	Lesson Plan
KHS	:	Student Academic Achievement
MBKM	:	Independent Learning, Independent Campus
OBE	:	Outcome-Based Education
Permendikbud	:	Regulation of the Minister of Education and Culture
PLO	:	Program Learning Outcomes
RPS	:	Lesson Plan
RTM	:	Student Assignment Plan
SN-DIKTI	:	National Standard of Higher Education
SCU	:	Semester Credit Unit
UNRAM	:	University of Mataram
UPM	:	Quality Assurance Unit

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SALINAN

KEPUTUSAN REKTOR UNIVERSITAS MATARAM
NOMOR 14476/UN18/HK/2022

TENTANG

PENETAPAN KURIKULUM PROGRAM STUDI TEKNIK ELEKTRO FAKULTAS TEKNIK

REKTOR UNIVERSITAS MATARAM,

Menimbang :

a. bahwa sehubungan dengan hasil rapat senat Fakultas Teknik dan review oleh Lembaga Penjaminan Mutu dan Pengembangan Pendidikan (LPMPP) tentang Penyusunan Perubahan Kurikulum Tahun 2022, maka perlu ditetapkan melalui Keputusan Rektor;
b. bahwa berdasarkan Surat Wakil Rektor Bidang Akademik Nomor 14350/UN18.1/EP/2022 tanggal 26 Oktober 2022, perihal mohon diterbitkannya Surat Keputusan Rektor tentang Penetapan Kurikulum Program Studi Teknik Elektro Fakultas Teknik;
c. bahwa berdasarkan pertimbangan sebagaimana dimaksud dalam huruf a dan b, perlu menetapkan Keputusan Rektor tentang Penetapan kurikulum Program Studi Teknik Elektro Fakultas Teknik;

Mengingat :

1. Undang-Undang Republik Indonesia Nomor 20 Tahun 2003 tentang Sistem Pendidikan Nasional (Lembaran Negara Republik Indonesia Tahun 2003 Nomor 78, Tambahan Lembaran Negara Republik Indonesia Nomor 4301);
2. Undang-Undang Republik Indonesia Nomor 12 Tahun 2012 tentang Pendidikan Tinggi (Lembaran Negara Republik Indonesia tahun 2012 Nomor 158, Tambahan Lembaran Negara Republik Indonesia Nomor 5336);
3. Peraturan Pemerintah Republik Indonesia Nomor 4 Tahun 2014 tentang Penyelenggaraan Pendidikan Tinggi dan Pengelolaan Perguruan Tinggi (Lembaran Negara Republik Indonesia tahun 2014 Nomor 16, Tambahan Lembaran Negara Republik Indonesia Nomor 5500);
4. Keputusan Presiden Republik Indonesia Nomor 257 Tahun 1963 tentang Pendirian Universitas Negeri di Mataram;
5. Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 116 Tahun 2014 tentang Organisasi dan Tata Kerja Universitas Mataram (Berita Negara Republik Indonesia Tahun 2014 Nomor 1549);
6. Peraturan Menteri Riset, Teknologi dan Pendidikan Tinggi Republik Indonesia Nomor 45 Tahun 2017 tentang Statuta Universitas Mataram (Berita Negara Republik Indonesia Tahun 2017 Nomor 1215);
7. Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 3 Tahun 2020 tentang Standar Nasional Pendidikan Tinggi (Berita Negara Republik indonesia Tahun 2020 Nomor 47);
8. Peraturan Menteri Pendidikan dan Kebuadayaan Republik Indonesia Nomor 25 Tahun 2020 tentang Standar Satuan Biaya Operasional Perguruan Tinggi pada Perguruan Tinggi Negeri di Lingkungan Kementerian Pendidikan dan Kebudayaan;

9. Keputusan Menteri Pendidikan, Kebudayaan, Riset, dan Teknologi Republik Indonesia Nomor 11686/MPK.A/KP.07.00/2022 Tahun 2022 tentang Pengangkatan Rektor Universitas Mataram Periode 2022-2026;

MEMUTUSKAN:

Menetapkan : KEPUTUSAN REKTOR TENTANG PENETAPAN KURIKULUM PROGRAM STUDI TEKNIK ELEKTRO FAKULTAS TEKNIK.

KESATU : Menetapkan kurikulum Program Studi Teknik Elektro Fakultas Teknik.

KEDUA : Keputusan Rektor ini mulai berlaku pada tanggal ditetapkan.

Ditetapkan di Mataram
pada tanggal 28 Oktober 2022

REKTOR UNIVERSITAS MATARAM,

TTD.

BAMBANG HARI KUSUMO

Salinan sesuai dengan aslinya
UNIVERSITAS MATARAM
Kepala Biro Umum dan Keuangan

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FOREWORD

Alhamdulillah, Praise Allah SWT, God Almighty, for His grace and guidance so that the Drafting Team can complete the OBE-MBKM curriculum.

This curriculum is structured in 4 stages: analysis, planning, development, and implementation. The first stage has defined the vision, mission, goals and objectives, and graduate profiles. The second stage determined program learning outcomes (PLOs), which consisted of 4 (four) aspects: attitudes, general skills, specific skills, and knowledge. This PLOs refers to SN-DIKTI, FORTEI and IABEE.

Furthermore, the study material (body of knowledge) has been determined, which is grouped into basic science, mathematics, basic engineering, and expertise consisting of 4 (four) fields: electric power systems engineering, telecommunications engineering, electronics engineering, and computer engineering.

Hopefully, implementing this curriculum will impact the quality of graduates according to the expected profile.

Authors

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IDENTITY OF STUDY PROGRAM

1	University	UNIVERSITAS MATARAM
2	Faculty	Engineering
3	Department	Electrical Engineering
4	Study program	Bachelor of Electrical Engineering (BEE)
5	Accreditation Status	B
6	Validity period	December 30, 2025
7	Determination Date	No. SK: 265/SK/BAN-PT/Ak-PPJ/S/I/2021
8	Number of Students	811 (Odd semester 2021)
9	Number of Lecturers	38
10	Study Program Address	Jl. Majapahit No. 62 Mataram, West Nusa Tenggara.
11	Phone number	+62 370 636755
12	Study Program website	http://te.unram.ac.id/jte2

1. INTRODUCTION

1.1 Background

Globalization of the world in the 21st century has led to the goal of national education not only educating the nation and liberating humans. However, this has shifted towards education as a commodity because it emphasises the mastery of Science, Technology, and Arts (IPTekS), which are pragmatic and materialist. The function of National Education in Law No. 20 of 2003, Article 3, National education functions to develop capabilities and form dignified national character and civilization in the context of educating the nation's life, aiming at developing the potential of students to become human beings who believe and fear God Almighty, have a exemplary character, be healthy, knowledgeable, capable, creative, independent, and be a democratic and responsible citizen. This goal is not only oriented towards pragmatism and materialism. Still, it aims to form people with faith and piety (IMTAQ) and master science, technology, and art (IPTekS). The shift in national education goals is increasingly being felt at this time with a character crisis in the field of education. Pragmatism in responding to the needs of the labor market places more emphasis on materialistic matters. It overrides teaching with the spirit of nationality, social justice, and humane qualities with high morals as citizens.

The regulation of the minister of education and culture of the Republic of Indonesia No. 3 of 2020 concerning National Education Standards states; Curriculum is a set of plans and arrangements regarding objectives, content, and learning materials as well as the methods used as guidelines for organizing learning activities to achieve Higher Education goals. The content and form of a curriculum will reflect the nature/character of the higher education program system. The curriculum plays a crucial role in shaping the character of graduates (output) of a study program. A carefully planned curriculum based on the institution's vision and mission and national and international educational standards will produce graduates with solid personalities, strong knowledge bases, and capable and ready to develop in society.

The condition of society and the world of engineering that continues to develop is one of the factors that will influence the content and form of the engineering higher education curriculum. This curriculum also applies to the field of electrical engineering. The needs of government agencies, industry, and services, which are the pillars of the progress of the Indonesian nation and trigger the development of science and technology, are the basis for

consideration of the review of the curriculum for the Bachelor of Electrical Engineering (BEE) of the Faculty of Engineering, UNRAM.

The preparation of a new curriculum for the Bachelor of Electrical Engineering (BEE) needs to pay attention to graduate competency standards (SKL) or program learning outcomes (PLOs), which are the primary reference or basis. The Higher Education Curriculum developed based on SN-Dikti uses the Outcome Based Education (OBE) approach. This curriculum supports the Study Program when participating in international accreditation based on the OBE approach.

1.2 Objectives

The objectives of the curriculum reconstruction of the Bachelor of Electrical Engineering (BEE) in the 2022 Curriculum are :

a. Evaluating and changing the curriculum according to the duration of 4-5 years.
b. Adjusting the contents of the curriculum to the development of science and technology in achieving national education goals
c. Completion of the new curriculum within the framework of competency-based education curriculum (Outcome Based Education/OBE)
d. Preparing a curriculum to support the implementation of the Independent Learning, Independent Campus (MBKM) program.

2. Curriculum Evaluation & Tracer Study

2.1 Curriculum Evaluation & Tracer Study

Self-evaluation of the Electrical Engineering curriculum has been carried out by an evaluation team representing four fields of specialisation. The self-evaluation report is one of the considerations in preparing the 2022 curriculum. Over the past five years, science and technology in electrical engineering have undergone many changes due to the rapid development of science and technology coupled with developments in services, companies, and industry. Therefore some new topics included in the 2022 curriculum are:

1. The emphasis of education remains on the field of electrical engineering in general. It is then focused on four fields of specialisation after entering the fifth semester or 3rd year because the target workplace for alumni is focused on various agencies, companies, and industries that require electrical engineering expertise.

2. The scope of work activities for electrical engineering graduates is comprehensive and varied, including assignments:
    a. Supervision on the operation and maintenance of equipment and systems
    b. Development Planning; electrical installation, telecommunications, electronics, control, and computer-informatics.
    c. Education and training in science and technology/
    d. Services in the fields of government, education, and finance.
    e. Technology entrepreneur.
3. Current development of science and technology in electrical engineering is strongly influenced by advances in microelectronics, telecommunications, computing, and informatics.
4. The development of system simulation methods using computer assistance will facilitate the design, manufacture and operation, and analysis of the system optimally.
5. Efficiency and conservation of electrical energy is the main thing in planning, manufacturing and operating systems in various agencies, companies and industries.
6. The curriculum's content emphasizes the fundamental principles of electrical practice, techniques for applying mathematics in engineering and computer applications in system simulation and optimization.
7. Work in engineering fields that are complex and comprehensive requires team work between various fields, which is based on leadership with due regard to ethics, good and appropriate communication, presentation and discussion skills.

Curriculum changes were made based on several considerations, including scientific developments, government policies, graduate users' needs, and the ongoing curriculum evaluation results. Several models can be used in evaluating the curriculum, including 1) Formative-Summative Evaluation Model; 2) Provus Discrepancy Evaluation Model; 3) Daniel Stufflebeam's CIPP Evaluation Model (Context, Input, Process, Product); 4) Donald L. Kirkpatrick's Four Level Evaluation Model; and others, each model has advantages and disadvantages. A guidebook for curriculum development based on KPT from the Director General of Higher Education uses the example of the Provus Discrepancy Evaluation Model to evaluate curriculum based on national higher education standards, arguing that each tertiary institution has educational standards compiled based on SN-Dikti.

The condition of the 2017 curriculum for Program Learning Outcomes (PLOs) according to SN-Dikti, FORTEI, and IABEE, as shown in Table 1, where there are 125 courses.

Table 1. Conditions of the 2017 Curriculum for Program Learning Outcomes (PLOs) according to SN-Dikti, FORTEI, IABEE.

LO	Max.	Medium	Min.	Max.	Medium	Min.
Attitude (S)	S9	S7	S5	78.40%	20.80%	3.20%
General Skills (KU)	KU2	KU3, KU11	KU6	63.20%	20.00%	3.20%
Knowledge (P)	P4	P8	P14	33.60%	20.00%	8.80%
Specific Skills (KK)	KK4	KK1, KK7	KK10	56.80%	33.60%	8.80%

Description:

1. Learning Outcomes related to attitude, 78.40% of the 2017 curriculum subjects are highly related to S9, while 3.20% have low relevance to S5. Associated subjects related to attitudes tend to lead to S7 with a relationship of 20.8%.
2. Learning Outcomes related to General Skills, 63.20% of the 2017 curriculum subjects are highly related to KU2, while 3.20% have low relevance to KU6. The linkage of courses related to General Skills tends to lead to KU3 and Ku11 with a relationship of 20.00%.
3. Learning Outcomes related to Knowledge, 33.60% of the 2017 curriculum subjects are highly related to P4, while 8.80% have low relevance to P14. The relevance of courses related to Knowledge tends to lead to P8 with a relationship of 20.00%.
4. Learning Outcomes related to specific skills, 56.80% of the 2017 curriculum subjects are highly related to KK4, while 8.80% have low relevance to KK10. The linkage of courses related to specific skills tends to lead to KK1 and KK7, with a relationship of 33.60%.

2.2 Tracer Study

Tracer studies carried out formally and informally by the Department of Electrical Engineering, FT UNRAM show that the fields of work for electrical engineering graduates vary greatly. This is because almost every government agency, banking, education, company and industry, and service sector require electrical engineering personnel.

There are generally four fields of expertise in electrical engineering: electric power systems, electronics, telecommunications, and computers. The four fields of expertise are still closely related to one another. The electrical engineering work fields of the four areas of expertise are divided into two categories, namely;

a. Working in a field that is by the area of expertise, namely working in engineering companies, such as AMMAN NTB, Trakindo, Telecommunications Companies, Cellular Operators, PT PLN, PT Pertamina, and several National and Local Companies.
b. Working in fields that require general electrical expertise, namely working in government agencies (local government and government agencies), banking, insurance, education and training.

From these two categories, the new electrical engineering curriculum will strive to achieve students' ability to think, act and act by the general competence of electrical students. The competencies that will be formed are based on the competence of electrical engineering graduates nationally and based on the competencies declared by ASIIN international accreditation.

The competence of each area of expertise is based on the availability of laboratory infrastructure and teaching staff owned by the Bachelor of Electrical Engineering. Developing electrical engineering in each field of expertise leads to progress in electrical energy, electronics, telecommunications, computing, and informatics. This impacts the operation and maintenance, design and manufacture of tools and systems that are faster, more efficient, and adequately controlled.

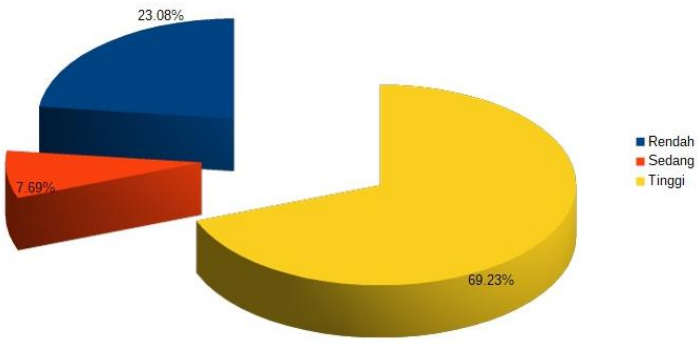

Figure 1. Suitability of Graduate Work Fields

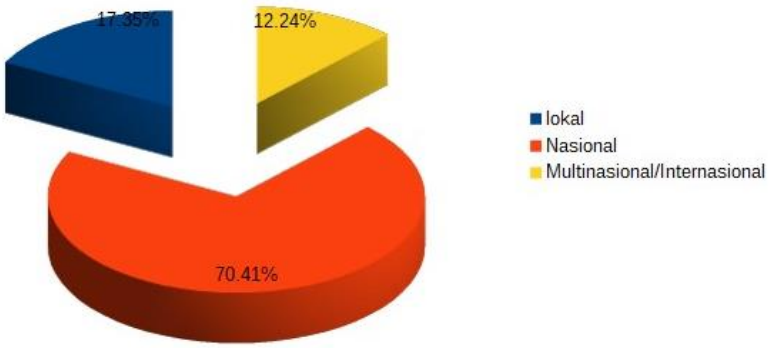

Figure 2. Graduates' Scope of Work

3. Foundation of Curriculum Development

3.1 Philosophical Foundation

The philosophy underlies the implementation of education in the Bachelor of Electrical Engineering (BEE):

a. Pancasila, Education in Indonesia must develop students with Pancasila characters.

b. The 1945 Constitution, fourth amendment to article 3; The government seeks and organizes a national education system, which increases faith and piety as well as a exemplary character in the context of educating the nation's life, which is regulated by law.

Curriculum development and empowerment are based on a philosophical foundation that has the function of:

a) To determine the basic educational footing

b) To determine the direction and goals of education

c) To determine the content and subject matter.

d) To determine the strategy and how to achieve the goal

3.2 Psychological Foundation

The psychological foundation for curriculum development for the Bachelor of Electrical Engineering consists of 2 (two) references, namely; learning psychology and teaching psychology.

a. Continuously encouraging student curiosity and motivating them for lifelong learning so that they can realize their roles and functions in their lives.
b. Encouraging students to think conceptually, critically, creatively, and innovatively in achieving higher-order thinking skills and optimizing the development of students' abilities.
c. Facilitating students to learn to become perfect human beings, namely human beings who are free, responsible, confident, have moral or exemplary character, able to collaborate, tolerant, and become educated human beings full of determination to contribute to achieving the ideals in the preamble of the 1945 Constitution

3.3 Historical Foundation

The BEE curriculum reconstruction is carried out regularly every five (5) years. The evaluation of the curriculum implementation is carried out every semester. The BEE Curriculum, first compiled in 1997, was then evaluated and produced in the 2003 curriculum. Then, it was re-evaluated in conjunction with the implementation of the Computer-Informatics Expertise Field in 2005. In 2009, BEE carried out curriculum revisions in several courses of specializations courses.

In 2014, BEE implemented a new curriculum. In line with the dynamics of learning at the University of Mataram, the 2014 curriculum was revised to become the 2017 curriculum. The BEE 2017 curriculum used the IQF and ABET as guidance. After 5 years of implementation, BEE revised the 2017 curriculum to become the 2022 curriculum. The 2022 curriculum is guided by the OBE (Outcome Base Education) Curriculum Guidelines and aligns with the MBKM (Independent Learning-Independent Campus) and relies on the provisions of the IABEE (Indonesian Accreditation Board for Engineering Education) and ABET (Accreditation Board for Engineering and Technology). This curriculum is also prepared for ASIIN international accreditation.

3.4 Juridical Foundation

Legal foundation as a basis or reference in the stages of design, development, implementation, and evaluation stages as a quality assurance system. This will ensure the implementation of the curriculum and the achievement of curriculum objectives. The legal foundation as the references in the preparation and implementation of the curriculum are:

a. Law of the Republic of Indonesia Number 14 of 2005 concerning Teachers and Lecturers (State Gazette of the Republic of Indonesia of 2005 Number 157, Supplement to the State Gazette of the Republic of Indonesia Number 4586);
b. Law of the Republic of Indonesia Number 12 of 2012 concerning Higher Education (State Gazette of the Republic of Indonesia of 2012 Number 158, Supplement to the State Gazette of the Republic of Indonesia Number 5336);
c. Presidential Regulation of the Republic of Indonesia Number 8 of 2012, concerning the Indonesian Qualifications Framework (KKNI);
d. Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 73 of 2013, concerning the Application of IQF in Higher Education;
e. Regulation of the Minister of Research, Technology and Higher Education of the Republic of Indonesia Number 62 of 2016 concerning the Higher Education Quality Assurance System;
f. Regulation of the Minister of Research, Technology, and Higher Education Number 59 of 2018, concerning Diplomas, Competency Certificates, Professional Certificates, Degrees, and Procedures for Writing Degrees in Higher Education;
g. Decree of the Minister of Research, Technology and Higher Education No. 123 of 2019 concerning Internships and Recognition of Industrial Internship Credit Units for Bachelor and Applied Bachelor Programs.
h. Regulation of the Minister of Education and Culture No. 3 of 2020, concerning National Higher Education Standards;
i. Regulation of the Minister of Education and Culture No. 5 of 2020, concerning Accreditation of Study Programs and Higher Education
j. Regulation of the Minister of Education and Culture No. 22 of 2020, concerning the Strategic Plan of the Ministry of Education and Culture.
k. Rector of the University of Mataram Regulation Number 2 of 2020, concerning the Implementation of the Independent Learning-Independent Campus.

l. Rector of the University of Mataram Regulation Number 3 of 2020, concerning University of Mataram Academic Guidelines.

4. Vision, Mission, Objective, Strategy, and University Values

4.1 Vision, Mission, Objective, and Strategy of the University of Mataram

a. Vision

Becoming a Research-Based and Internationally Competitive Higher Education Institution by 2025

b. Mission

i. To carry out higher education processes with national and international quality standards based on strong research to produce human resources who believe and have faith in the God Almighty, are virtuous, have competence in their fields, and have a global outlook

ii. To carry out research activities with national and international quality standards to produce science and technology that can add the reference of knowledge, and become a reference for solving problems in society, to support quality learning processes for students and community service

iii. To carry out community service activities based on research results, contribute to solving various problems that arise in society, encourage economic growth, and develop Indonesian society's social and cultural aspects.

iv. To build an extensive network of cooperation with various parties, government, and private institutions, domestically and abroad to support the implementation of the Three Pillars of Higher Education with national and international quality standards.

v. To carry out financial and administrative asset management that meets good, efficient, effective, transparent, and accountable university governance standards (good university governance), to support the implementation of the

Three Pillars of Higher Education with national and international quality standards.

c. Objective

To realize UNRAM as a research-based higher education institution that has international competitiveness, the objectives are set as follows:

i. Creating and implementing the higher education system with national and international quality standards based on strong research at UNRAM, so as to be able to produce human resources who have faith in the God Almighty, have an exemplary character, have competence in their fields, and have a global outlook.

ii. Creating and implementing a research system with national and international quality standards at UNRAM, so as to be able to produce science and technology that can add to the body of knowledge, become a reference for solving problems in society, continuously support quality learning processes for students and community service.

iii. Creating and implementing a community service system based on research results at UNRAM, so that UNRAM can make a significant contribution to solving various problems that arise in society, driving economic growth, and building social and cultural Indonesian society.

iv. Creating an extensive network of cooperation with various parties, government, and private institutions, at home and abroad, so as to be able to support the implementation of the tri dharma of higher education with national and international quality standards.

4.2 Vision, Mission, Objective, and Strategy of Faculty

a. Vision

To become a Faculty of Excellence in Developing Appropriate Technology with International Competitiveness by 2025

b. Mission

1. To develop research-based education and teaching on appropriate Technology and the latest technology based on exemplary morals and ethics
2. To develop research based on Appropriate Technology
3. To develop community service programs based on Appropriate Technology
4. To establish cooperation with related parties in developing and utilising the Three Pillars of Higher Education results.
5. To strengthen conducive institutions in supporting the achievement of the vision
6. To develop an entrepreneurial spirit based on appropriate technology

4.3 Vision, Mission, Objective, and Strategy of Bachelor

a. Vision

Our vision is "*to become an international and competitive electrical engineering study program in teaching, research, innovations*".

b. Mission

Our missions are:

1. to carry out education with religious character, good attitude, and creative thinking in the development of sustainable innovation;
2. to provide a conducive research atmosphere for the development of sustainable innovation;
3. to carry out community services that harmonises innovation with the needs of community and industries;
4. to develop cooperation at the national, regional, and international levels to support the development of sustainable innovation.

c. Objective

1. To produce graduates with good character, quality and global competitiveness
2. Produce superior research and innovation
3. Realizing innovations that are beneficial to humans
4. Establishing sustainable cooperation

d. Strategy

To achieve the four missions as stated above, the BEE of UNRAM has related targets and strategies, as the following:

Target and strategies to achieve the 1st mission:

(i) develop an integrated curriculum that refers to national and international standards,

(ii) actualize integrations between religious- and social-attitudes as well as soft- and hard-skills, and

(iii) implement the 4.0 learning system and life-long learning.

Target and strategies to achieve the 2nd mission:

(i) establish an excellent research roadmap,

(ii) provide good research infrastructures, and

(iii) create a synergized academic community in a conducive, effective, and productive research climate.

Target and strategies to achieve the 3rd mission:

(i) develop technology and business incubators,

(ii) initiate community services based on research and innovation, and

(iii) increase quantity and quality of community services.

Target and strategies to achieve the 4th mission:

(i) intensify collaboration with national and international universities / institutions,

(ii) expand collaboration with corporates and industries, and

(iii) increasing revenue generating.

e. Values

We aspire to UNRAM *values* which are based on the highest professional and academic standards in terms of personal growth and collegial respects of our staff and students:

1. **Religious**, reflected in our adherence to the highest norms standards as commanded by God.
2. **Integrity**, reflected in our consistency to apply the highest ethical standards in personal and professional behaviour.
3. **Innovative**, reflected in our openness to new ideas, intellectual curiosity, willingness to take risks, entrepreneurial spirit, and our capacity to create new fields of inquiry.
4. **Responsibility**, reflected in our focus on improving the quality of humanity and our care to social situations as well as global awareness.
5. **Teamwork**, reflected in our interdisciplinary approach and our focus on internal and external partnerships.

4.4 *University Value*

The University of Mataram (UNRAM) is a research-based higher education institution with international competitiveness based on piety, independence, and intelligence.

The University of Mataram is committed to continuing to play a role in the development of science and technology for the nation's progress to lecturers and students to conduct research and create innovations to bring the University of Mataram into an internationally competitive research-based institution.

The aim of education at the University of Mataram, in general, is to produce graduates who have faith in the God Almighty, have an exemplary character, have academic competence in their fields, and have global insight, so they are able to compete in national and international levels in the era of globalization.

5. Graduate Profiles and Formulating Program Learning Outcomes

5.1 Graduate Profiles

1. **Engineer**: Graduates are able to have a career in electrical engineering practice in analysing, designing, developing, and operating system.
2. **Researcher/Academic:** Graduates are able to continue their education to postgraduate level and/or have a career in R&D or as academics
3. **Technopreneur (Entrepreneur):** Graduates are able to independently pioneer and develop types of business fields related to Electrical Engineering expertise, thereby contributing significantly to the expansion of employment opportunities.

5.2 Formulating Program Learning Outcomes (PLOs)

Referring to the Law of Higher Education No.12 of 2012, Presidential Regulation of the Republic of Indonesia Number 8 of 2012 concerning the Indonesian Qualification Framework, and Regulation of the Minister of Education and Culture Number 3 of 2020 concerning National Higher Education Standards and Presidential Regulation of the Republic of Indonesia Number 8 of 2012 concerning the Indonesian Qualification Framework, graduates of the Bachelor of Electrical Engineering have graduate competency standards which are stated in the formulation of Program Learning Outcomes (PLOs). Every graduate of the Bachelor of Electrical Engineering must have abilities that include Attitudes (S), General Skills (KU), Specific Skills (KK), and Knowledge (P).

PLOs of General Attitudes and Skills refer to Regulation of the Minister of Education and Culture Number 3 of 2020 concerning National Higher Education Standards. The tertiary institutions that manage the Bachelor of Electrical Engineering Cluster add the learning achievements of General Attitudes and Skills. Meanwhile, Specific Skills (KK) and Knowledge (P) refer to PLOs of FORTEI and IABEE.

Table 3. Aspects of Attitudes in Program Learning Outcomes of Graduates according to National Standard of Higher Education

CODE	**Description of Program Learning Outcomes (PLOs)**
	ATTITUDE ASPECTS (S)
S1	Being faithful to the God Almighty and able to show a religious attitude
S2	Upholding human values in carrying out duties based on religion, morals, and ethics
S3	Contributing to improving the quality of life in society, nation, state and civilization based on Pancasila
S4	Acting as a citizen who is proud and loves the motherland, has nationalism and a sense of responsibility to the state and nation
S5	Respecting the diversity of cultures, views, religions, and beliefs, as well as the opinions or original findings of others
S6	Working together and having social sensitivity and concern for society and the environment
S7	Obeying the law and discipline in the life of society and the state
S8	Internalizing academic values, norms, and ethics
S9	Demonstrating a responsible attitude towards work in the field of expertise independently
S10	Internalizing the spirit of independence, struggle, and entrepreneurship
S11	Working thoroughly to achieve the best results
S12	Demonstrating an attitude of enthusiasm for continuous learning

Table 4. Aspects of General Skills in Program Learning Outcomes of Graduates according to National Standard of Higher Education

CODE	**Description of Program Learning Outcomes (PLOs)**
	GENERAL SKILL ASPECTS (KU)
KU1	Able to apply logical, critical, systematic, and innovative thinking in the context of the development or implementation of science and technology that pays attention to and applies humanities values in accordance with their field of expertise
KU2	Able to demonstrate independent, quality, and measurable performance
KU3	Able to study the implications of the development or implementation of technological science that pays attention to and applies the values of the humanities in accordance with their expertise based on scientific principles, procedures and ethics to produce solutions, ideas, designs or art criticism
KU4	Compile a scientific description of the results of the study mentioned above in the form of a thesis or final project report, and upload it on the college website
KU5	Able to make appropriate decisions in the context of solving problems in their area of expertise, based on the results of information and data analysis
KU6	Able to maintain and develop a network with mentors, colleagues, and peers both inside and outside the institution
KU7	Able to be responsible for the achievement of group work results and supervise and evaluate the completion of work assigned to workers who are under their responsibility
KU8	Able to carry out the process of self-evaluation of work groups under their responsibility, and able to manage to learn independently
KU9	Able to document, store, secure, and retrieve data to ensure validity and prevent plagiarism
KU10	Able to apply entrepreneurship and understand technology-based entrepreneurship

Table 5. Aspects of Knowledge in Program Learning Outcomes of Graduates refers to FORTEI, IABEE, and ABET

CODE	**Description of Program Learning Outcomes (PLOs)**
	KNOWLEDGE ASPECTS (P)
P1	Able to acquire and apply university-level knowledge of mathematics including differential integral calculus, finer algebra, complex variables, and probability and statistics.
P2	Able to apply knowledge and practicum of physics and other basic sciences in accordance with the field of Electrical Engineering.
P3	Able to apply computational knowledge required to analyze and design complex devices or systems
P4	Able to apply core knowledge in the field of electrical engineering including electrical circuits, systems and signals, digital systems, electromagnetics, and electronics.
P5	Able to apply breadth knowledge which covers a number of engineering topics according to the name of the study program
P6	Able to apply at least one field of depth knowledge according to the field of Electrical Engineering.
P7	Able to apply skills acquired from previous lectures in engineering design activities.
P8	Able to apply natural science, mathematics, basic theory of engineering, and other relevant fields to solve complex engineering problems
P9	Able to analyze and use existing methods, resources, and appropriate equipment to solve complex engineering problems and activities related to the field of electrical engineering
P10	Able to design components, systems and processes related to the context of Electrical Engineering to solve problems based on specific needs and existing contextual considerations
P11	Able to carry out data collection activities through a series of analysis and synthesis activities to solve complex problems using experimental data and processing the results
P12	Having a strong personality, exemplary character and being able to keep up with dynamic technological developments
P13	Able to describe the problems faced, able to choose the appropriate approach/method/technique/algorithm and able to represent knowledge and reasoning power in finding a solution
P14	Having a business spirit, the ability to master information technology devices, communicate well, be honest, ethical, responsible and establish communication

Table 6. Aspects of Specific Skills in Program Learning Outcomes of Graduates refers to FORTEI, IABEE and ABET

CODE	**Description of Program Learning Outcomes (PLOs)**
	SPECIAL SKILL ASPECTS (KK)
KK1	Able to apply knowledge of mathematics, natural and/or materials science, information technology and engineering to gain a thorough understanding of the principles in the field of electrical engineering.
KK2	Able to design components, systems and/or processes to meet expected needs within realistic constraints, for example legal, economic, environmental, social, political, health and safety, and sustainability and to recognize and/or utilize local and national resource potential with a global outlook.
KK3	Able to design and carry out laboratory and/or field experiments as well as analyze and interpret data to strengthen technical judgements
KK4	Able to identify, formulate, analyze and solve technical problems.
KK5	Able to apply modern technical methods, skills and tools required for engineering practice.
KK6	Able to communicate effectively both orally and in writing.
KK7	Able to plan, complete and evaluate tasks within the constraints that exist systematically.
KK8	Able to work in cross-disciplinary and cross-cultural teams.
KK9	Able to be responsible to society and comply with professional ethics in solving technical problems.
KK10	Able to understand the need for lifelong learning, including access to knowledge regarding relevant contemporary issues.
KK11	Having the ability to create, select, and apply modern techniques, resources, and devices based on Electrical Engineering to solve complex problems
KK12	Having the ability to understand various contemporary issues in the field of Electrical Engineering and related fields

5.3 Reformulating Program Learning Outcomes (PLOs)

Table 7a. Matrix of PLO Reformulation and PLO Dikti

No	**PLO**	**Scope of PLO** (According to SN Dikti and Fortei)
1	**Religious and ethical** Able to demonstrate a religious attitude, apply ethical principles and be committed to professional responsibilities and ethics as well as engineering practice norms and care for the community and the environment.	S : 1, 2, 3, 4, 5, 6, 7, 8, 9 P ; 12, 14 KU ; 1, 3, 7, 10 KK ; 2, 9
2	**Knowledge** Able to apply knowledge of science and mathematics, electrical technology, information technology and/or materials technology to gain a thorough understanding of the principles in the field of electrical engineering.	S ; 9 P ; 1, 2, 3, 4, 6, 8 KU ; 1, 2, 7, 8 KK ; 1, 7, 10, 12
3	**Engineering Analysis** Able to choose methods, make literature reviews, design experiments with simulations, and analyse results to reach the right conclusions, as well as develop guidelines for using tools.	S ; 5, 8, 9 P ; 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 13 KU ; 1, 2, 3, 4, 5, 9 KK ; 1, 4, 5, 10, 11, 12
4	**Engineering Design**	S ; 5, 6, 7, 9, 11, 12

	Able to design and develop components, systems and/or processes to support engineering activities and create technological innovations by optimally utilizing potential resources.	P ; 2, 3, 4, 5, 6, 7, 8, 9, 10 KU ; 1, 2, 3, 4, 9 KK ; 2, 3, 11, 12
5	**Experiment** Able to design and carry out experiments using basic and modern technical tools and analyze and interpret data based on the correct methodology to strengthen engineering assessments.	S ; 7, 8, 9, 11 P ; 7, 8, 10, 11, 13 KU ; 2, 4, 7, 8, 9, 10 KK ; 3, 5, 6, 7, 8, 11
6	**Communication** Able to interact and express ideas effectively both orally and in writing within the engineering environment and the public in the national and international scope.	S ; 4, 5, 6, 7, 8, 12 P ; 5, 6, 7, 12, 13, 14 KU ; 1, 3, 4, 6, 9, 10 KK ; 3, 4, 6, 8, 9, 10, 12
7	**Individual and Teamwork** Able to plan, implement, complete, and evaluate tasks both individually and in collaboration in interdisciplinary, multidisciplinary, multinational, and multicultural teams.	S ; 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 P ; 3, 5, 6, 7, 12, 13, 14 KU ; 1, 2, 4, 5, 6, 7, 8, 10 KK ; 6, 7, 8, 9
8	**Entrepreneurship** Able to apply entrepreneurial principles and methods in starting a business independently and building technology-based business networks	S ; 1 – 12 P ; 1, 2, 3, 5, 6, 7, 10, 11, 12, 13, 14 KU ; 1, 2, 3, 5, 6, 7, 8, 9, 10 KK ;1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
9	**Life-long learning** Able to understand the need for life-long learning with data literacy, technology literacy, information literacy and human literacy.	S ; 1, 3, 8, 10, 11 P ; 5, , 7, 12 KU ; 1, 2, 3, 4, 5, 6, 8, 9, 10 KK ; 1, 6, 8, 10, 12

Table 7b. Matrix of PLO Reformulation and PLO Dikti

CPL (SN Dikti)	**PLO**								
	#1	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**	**#8**	**#9**
S1	√							√	√
S2	√						√	√	
S3	√						√	√	√
S4	√					√	√	√	
S5	√		√	√		√	√	√	
S6	√			√		√	√	√	
S7	√			√	√	√	√	√	
S8	√		√		√		√	√	√
S9	√	√	√	√	√		√	√	
S10								√	√
S11				√	√		√	√	√
S12				√		√	√	√	

CPL (SN Dikti)	PLO								
	#1	#2	#3	#4	#5	#6	#7	#8	#9
KU1	√	√	√	√		√	√	√	√
KU2		√	√	√	√		√	√	√
KU3	√		√	√		√			√
KU4			√	√	√	√	√	√	√
KU5			√				√	√	√
KU6						√	√	√	√
KU7	√	√			√		√	√	
KU8		√			√		√	√	√
KU9			√	√	√	√		√	√
KU10					√	√	√	√	√

CPL (FORTEI)	PLO								
	#1	#2	#3	#4	#5	#6	#7	#8	#9
P1		√	√					√	
P2		√	√	√				√	
P3		√	√	√			√	√	
P4		√	√	√					
P5			√	√		√	√	√	√
P6		√	√	√		√	√	√	√
P7			√	√	√	√		√	√
P8		√	√	√	√				
P9			√	√					
P10				√	√			√	
P11			√		√			√	
P12	√					√	√	√	√
P13			√		√	√	√	√	
P14	√					√	√	√	

CPL (FORTEI)	PLO								
	#1	#2	#3	#4	#5	#6	#7	#8	#9
KK1		√	√					√	√
KK2	√			√				√	
KK3				√	√	√		√	
KK4			√			√		√	
KK5			√		√			√	
KK6					√	√	√	√	√
KK7		√			√		√	√	
KK8						√	√	√	√
KK9	√				√	√	√	√	
KK10		√	√			√		√	√
KK11			√	√	√			√	
KK12		√	√	√		√		√	√

5.4 Relationship Program Learning Outcomes (PLOs), Program Education Outcomes (PEO) and Graduate Profile

Table 8. PLO and Graduate Profile

No / Code	Program Learning Outcomes (PLOs) Reformulation	**Graduate Profiles**		
		PL1	PL2	PL3
PLO#1	Religious and Ethical	√	√	√
PLO#2	Knowledge	√	√	√
PLO#3	Engineering Analysis	√	√	
PLO#4	Engineering Design	√	√	√
PLO#5	Experiment	√	√	
PLO#6	Communication	√	√	√
PLO#7	Individual and Teamwork	√	√	√
PLO#8	Entrepreneurship			√
PLO#9	Life-long learning	√	√	√

Table 9. PLO and PEO

No / Kode	Program Learning Outcomes (PLOs) Reformulation	Program Educational Objectives (PEO)		
		PEO#11	PEO#2	PEO#3
PLO#1	Religious and Ethical	√		
PLO#2	Knowledge		√	√
PLO#3	Engineering Analysis		√	√
PLO#4	Engineering Design		√	√
PLO#5	Experiment		√	√
PLO#6	Communication	√	√	√
PLO#7	Individual and Teamwork	√	√	√
PLO#8	Entrepreneurship	√		√
PLO#9	Life-long learning	√		√

Table 10. Program Educational Objectives of BEE

No / Kode	**Program Educational Objectives**	**Description of Study Program Educational Objectives**
PEO#1	Character Graduates	Graduates are able to have a career in electrical engineering practice in analysing, designing, developing, and operating system.
PEO#2	Quality Graduates	Graduates are able to continue their education to postgraduate level and/or have a career in R&D or as academics.
PEO#3	Global Competitive Graduates	Graduates are able to independently pioneer and develop types of business fields related to Electrical Engineering expertise, thereby contributing significantly to the expansion of employment opportunities

6. Determination of Study Materials

6.1 Overview of Study Program *Body of Knowledge* (BoK)

Based on the PLOs reformulation, BEE determines the standard of study in the curriculum preparation. This study material consists of:

a. Indonesian Literacy
b. Academic Literacy/Language
c. Science Literacy
d. Numeracy Literacy
e. Data Literacy
f. Digital Literacy
g. Financial Literacy
h. Basic Engineering
i. Basic Electrical Engineering
j. Electrical Analysis Capability
k. Electrical Design Capability

Table 11. PLO and Study Materials

No / Kode	Program Learning Outcomes (PLOs) Reformulation	Study Materials
PLO#1	Religious and Ethical	a. Indonesian Literacy
PLO#2	Knowledge	b. Science Literacy c. Numeracy Literacy d. Data Literacy e. Digital Literacy f. Basic Engineering g. Basic Electrical Engineering
PLO#3	Engineering Analysis	h. Engineering Analysis Capability i. Electrical Analysis Capability
PLO#4	Engineering Design	j. Electrical Design Capability
PLO#5	Experiment	k. Electrical Experiment Capability
PLO#6	Communication	l. Communication Literacy
PLO#7	Individual and Teamwork	m. Social Literacy
PLO#8	Entrepreneurship	n. Financial Literacy
PLO#9	Life-long learning	o. Life-skill Literacy

6.2 Relationship PLO, Study Materials and Courses

Table 12. PLO, Study Materials and Course

No / Kode	Program Learning Outcomes (PLOs) Reformulation	Study Materials	Mata Kuliah
PLO#1	Religious and Ethical	a. Indonesian Literacy	1. Religion; 2. Pancasila; 3. Character Bulding; 4. Citizenship
PLO#2	Knowledge	b. Science Literacy c. Numeracy Literacy d. Data Literacy e. Digital Literacy f. Basic Engineering g. Basic Electrical Engineering	5. Calculus I; 6. Calculus II; 7. Physics I; 8. Physics II; 9. Electrical Materials; 10. Numeric Analysis; 11. Basic Information Techn. 12. Basic Programming; 13. Logic Circuit; 14. Telecommunications Basics; 15. Probability and Statistics; 16. Electrical Circuit I; 17. Electric Circuit II; 18. Basic Programming; 19. Engineering Mathematics I; 20. Engineering Mathematics II; 21. Stochastic Process 22. Basic Electric Power; 23. Basic Electronics; 24. Electromagnetic; 25. Microprocessor Systems; 26. Signal and System 27. Control System
PLO#3	Engineering Analysis	h. Engineering Analysis Capability; i. Electrical Analysis Capability	Elective Concentration
PLO#4	Engineering Design	j. Electrical Design Capability	28. Pre-Thesis; 29. Thesis;
PLO#5	Experiment	k. Electrical Experiment Capability	30. Basic Programming Lab.; 31. Logic Circuit Lab.; 32. Electric Measurement Lab.; 33. Basic Telecom. Lab.; 34. Electrical Circuit Lab.; 35. Basic Electronics Lab.; 36. Basic Electric Power Lab.; 37. Control System Lab.; 38. Microprocessor Lab;
PLO#6	Communication	l. Communication Literacy	39. Academic Indonesian Language; 40. Academic English;

PLO#7	Individual and Teamwork	m. Social Literacy	41. Intership; 42. Field study Program
PLO#8	Entrepreneurship	n. Financial Literacy	43. Engineering Economics; 44. Tehnopreneurship;
PLO#9	Life-long learning	o. Life-skill Literacy	45. Concept of Science and Technology 46. Environment and Engineering Ethics;

7. Formation of Courses and Determination of Weight

Code	Course	SKS	ECTS	Religious & ethical	Knowledge	Engineering Analysis	Engineering Design	Experiment	Communication	Individual & Teamwork	Entrepreneur-ship	Lifelong learning
FBS1101	Religion	2	3.2	H								H
FBS1102	Academic Indonesian Language	2	3.2	M					H			L
FBS1103	Physics I	3	4.8		H	M				L		
FBS1104	Calculus I	3	4.8		H	M				L		
FBS1105	Electrical Materials	2	3.2		H	M					L	
FBS1106	Concept of Science and Technology	2	3.2		H	M						L
FBS1107	Logic Circuit	2	3.2		H	M	L					
FBS1108	Pancasila	2	3.2	H						M		L
FBS1109	Basic Information Technology	2	3.2		H	M						L
FBS1210	Character Building	2	3.2	H						M		L
FBS1211	Physics II	3	4.8		H	M	L					
FBS1212	Calculus II	3	4.8		H	M	L					
FBS1213	Electrical Circuit I	3	4.8		H	M	L					
FBS1214	Probability and Statistics	2	3.2		H	M					L	
FBS1215	Basic Programming	3	4.8		H	M						L
FBS1216	Basic Programming Laboratory	1	1.6			M	L	H				
FBS1217	Basic Telecommunications	3	4.8		H	M	L					
FBS1218	Logic Circuit Laboratory	1	1.6			M	L	H				
FBS2119	Academic English	2	3.2		M				H	L		
FBS2120	Engineering Mathematics I	3	4.8		H	M				L		
FBS2121	Stochastic Process	2	3.2		H	M	L					

FBS2122	Electrical Circuit II	3	4.8		H	M	L					
FBS2123	Electrical Measurement	2	3.2		H	M					L	
FBS2124	Electrical Measurement Laboratory	1	1.6			M	L	H				
FBS2125	Basic Electronics	3	4.8		H	M	L					
FBS2126	Basic Electric Power	3	4.8		H	M	L					
FBS2127	Basic Telecom. System Laboratory	1	1.6			M	L	H				
FBS2228	Engineering Mathematics II	3	4.8		H	M	L					
FBS2229	Signal and System	3	4.8		H	M	L					
FBS2230	Numerical Method	2	3.2		H	M	L					
FBS2231	Electrical Circuits Laboratory	1	1.6			M	L	H				
FBS2232	Electromagnetics	3	4.8		H	M						L
FBS2233	Basic Electronics Laboratory	1	1.6			M	L	H				
FBS2234	Basic Electric Power Laboratory	1	1.6			M	L	H				
FBS2235	Microprocessor System	3	4.8		H	M	L					
FBS2236	Engineering Economics	2	3.2		L	M					H	
FBS3137	Citizenship	2	3.2	H	M							L
FBS3138	Microprocessor System Laboratory	1	1.6			M	L	H				
FBS3139	Control System	3	4.8		H	M	L					
FBS3140	Control System Laboratory	1	1.6			M	L	H				
FBS3241	Internship	4	6.4			L			M	H		
FBS4142	Field Study Program	4	6.4						M	H	L	
FBS4143	Pre-Thesis	2	3.2			H			L	M		
FBS4244	Technopreneurship	2	3.2						M	L	H	
FBS4245	Environment and Engineering Ethics	2	3.2	H	H							
FBS4246	Thesis	4	6.4	M	M	H	H	M	M	M	M	M

Code	Course	SKS	ECTS	Religious & ethical	Knowledge	Engineering Analysis	Engineering Design	Experiment	Communication	Individual & Teamwork	Entrepreneur-ship	Lifelong learning
FBA3101	Power System Analysis I	2	3.2			H	M	L				
FBA3102	Electric Power Transmission	2	3.2			H	M	L				
FBA3103	Hydro-Thermal Energy Conversion	2	3.2			H	M	L				
FBA3104	Electric Machines	3	4.8			H	M	L				
FBA3105	Electric Machines Laboratory	1	1.6			L	M	H				
FBA3106	Power Electronics	2	3.2			H	M	L				
FBA3107	Power Electronics Laboratory	1	1.6			L	M	H				
FBA3208	Power System Analysis II	2	3.2			H	M	L				
FBA3209	Power System Analysis Laboratory	1	1.6			L	M	H				
FBA3210	Renewable Energy Conversion	2	3.2			H	M	L				
FBA3211	Modern Distribution System	2	3.2			H	M	L				
FBA3212	Transmission & Distribution Lab.	1	1.6			L	M	H				
FBA3213	Electrical Installation Design	3	4.8			L	H	M				
FBA4114	Power Systems Operation Management	2	3.2			H	M	L				
FBA4115	Power Systems Protection	2	3.2			H	M	L				
FBA4116	Power Systems Protection Lab.	1	1.6			L	M	H				
FBA4117	Power Quality	2	3.2			H	M	L				
FBA4118	High Voltage Engineering	2	3.2			H	M	L				
FBA0001	EPS Dynamic and Stability	2	3.2			H	M					L
FBA0002	Computer Application on EPS	2	3.2			H	M					L
FBA0003	Distributed Generation	2	3.2			H	M					L
FBA0004	EPS Substation Technology & Grounding	2	3.2			H	M					L
FBA0005	Maintenance of EPS Equipment	2	3.2			H	M					L

FBA0006	Design of Electrical Machines	2	3.2			M	H					L
FBA0007	Utility & Control of Electrical Machine	2	3.2			H	M					L
FBA0008	Programmable Logic Control	2	3.2			M	H					L
FBA0009	EPS Reliability	2	3.2			H	M					L
FBA0010	High Fields Phenomena	2	3.2			H	M	L				
FBA0011	SCADA	2	3.2			H	M					L
FBA0012	Optimization of Modern EPS	2	3.2			H	M					L
FBA0013	Energy Planning	2	3.2			M	H				L	
FBA0014	Occupational Health and Safety	2	3.2			H	M					L
FBA0015	Geothermal Exploration & Utilization	2	3.2			H	M				L	

Code	Course	SKS	ECTS	Religious & ethical	Knowledge	Engineering Analysis	Engineering Design	Experiment	Communication	Individual & Teamwork	Entrepreneur-ship	Lifelong learning
FBB3101	Electronic Circuit	3	4.8			H	M	L				
FBB3102	Electronic Circuit Laboratory	1	1.6			L	M	H				
FBB3103	Digital Electronics	2	3.2			H	M	L				
FBB3104	Digital Electronics Laboratory	1	1.6			L	M	H				
FBB3105	Electronic Instrumentation System	3	4.8			H	M	L				
FBB3106	Industrial Electronics	3	4.8			H	M	L				
FBB3207	Advanced Electronics Laboratory	1	1.6			M	L	H				
FBB3208	Digital Signal Processing	3	4.8			H	M	L				
FBB3209	Digital Signal Processing Lab.	1	1.6			L	M	H				
FBB3210	Analog Electronics	2	3.2			H	M	L				
FBB3211	Programmable Logic Control	2	3.2			H	M	L				
FBB3212	Mechatronic	2	3.2			H	M	L				

FBB3213	Interface Engineering & Embedded Systems	3	4.8			H	M	L				
FBB4114	Robotic	2	3.2			M	H	L				
FBB4115	Electronic Systems Design	2	3.2			M	H	L				
FBB4116	Digital Controls Engineering	2	3.2			H	M	L				
FBB0001	Algorithm and Data Structure	2	3.2			H	M					L
FBB0002	Image Processing	2	3.2			H	M					L
FBB0003	Optoelectronics	2	3.2			H	M					L
FBB0004	Artificial Intelligence	2	3.2			H	M					L
FBB0005	Biomedical Instrumentations	2	3.2			H	M					L
FBB0006	Advanced Mechatronics	2	3.2			H	M					L
FBB0007	Geo-electromagnetic Instrumentation	2	3.2			H	M				L	
FBB0008	Power Electronics	2	3.2			H	M					L
FBB0009	Fast Algorithm	2	3.2			H	M					L

Code	Course	SKS	ECTS	Religious & ethical	Knowledge	Engineering Analysis	Engineering Design	Experiment	Communication	Individual & Teamwork	Entrepreneur-ship	Lifelong learning
FBC3101	Advanced Electromagnetics	2	3.2			H	M	L				
FBC3102	Telecommunication System	3	4.8			H	M	L				
FBC3103	Telecommunication Network	3	4.8			H	M	L				
FBC3104	Digital Communication	2	3.2			H	M	L				
FBC3105	Traffic Engineering	2	3.2			H	M	L				
FBC3206	Wave Transmission and Propagation	3	4.8			H	M	L				
FBC3207	Digital Signal Processing	3	4.8			H	M	L				
FBC3208	Telecommunication Electronics	3	4.8			H	M	L				
FBC3209	Telecommunication Network Lab.	1	1.6			L	M	H				
FBC3210	Data Communication and Computer Network	3	4.8			H	M	L				

FBC3211	Telecommunication Systems Lab.	1	1.6			L	M	H				
FBC4112	Digital Signal Processing Laboratory	1	1.6			L	M	H				
FBC4113	Antenna	2	3.2			M	H	L				
FBC4114	Telecommunication System Measurement	3	4.8			H	M				L	
FBC4115	Telecommunication System Measurement Laboratory	1	1.6			L	M	H				
FBC0001	Deep Neural Network	2	3.2			H	M					L
FBC0002	Mobile Communication	2	3.2			H	M					L
FBC0003	Microwave Communication	2	3.2			H	M					L
FBC0004	Satellite Communication	2	3.2			H	M	L				
FBC0005	Digital Image Processing	2	3.2			H	M	L				
FBC0006	Radar and Remote Sensing	2	3.2			H	M					L
FBC0007	Optical Fiber Communication System	2	3.2			H	M					L
FBC0008	Telemetry	2	3.2			H	M	L				
FBC0009	Specials Topic on Telecommunication	2	3.2			H	M					L
FBC0010	Software Defined Radio	2	3.2			H	M					L
FBC0011	Geo-Electromagnetic Data and Signal Processing	2	3.2			H	M	L				

Code	Course	SKS	ECTS	Religious & ethical	Knowledge	Engineering Analysis	Engineering Design	Experiment	Communication	Individual & Teamwork	Entrepreneurship	Lifelong learning
FBD3101	Discrete Mathematics	3	4.8			H	M	L				
FBD3102	Database	3	4.8			H	M	L				
FBD3103	Software Engineering	2	3.2			H	M	L				
FBD3104	Object Oriented Programming	2	3.2			H	M	L				
FBD3105	Operating System	2	3.2			H	M	L				

FBD3106	Database Laboratory	1	1.6			L	M	H				
FBD3207	Computer Organization and Architecture	2	3.2			H	M	L				
FBD3208	Data Communication and Computer Network	3	4.8			H	M	L				
FBD3209	Algorithms and Data Structures	2	3.2			H	M	L				
FBD3210	Object Base Programming Lab.	1	1.6			L	M	H				
FBD3211	Artificial Intelligence	2	3.2			H	M	L				
FBD3212	Web and Mobile Programming	2	3.2			L	H	M				
FBD3213	Algorithms and Data Structures Lab.	1	1.6			L	M	H				
FBD3214	Computer Networks Laboratory	1	1.6			L	M	H				
FBD4115	Information Systems Security	2	3.2			H	M	L				
FBD4116	Cloud Computing Technology	2	3.2			M	H	L				
FBD4117	IoT Technology	2	3.2			M	H				L	
FBD0001	Pattern Recognition	2	3.2			H	M					L
FBD0002	Data Engineering	2	3.2			H	M					L
FBD0003	Machine Learning	2	3.2			H	M					L
FBD0004	Software Project	2	3.2			H	M				L	
FBD0005	Computer Network Security	2	3.2			H	M					L
FBD0006	IoT Wireless Communication	2	3.2			M	H				L	
FBD0007	Smart IoT Device	2	3.2			M	H				L	
FBD0008	Computer Graphics	2	3.2			H	M					L
FBD0009	Game Development Techniques	2	3.2			M	H				L	
FBD0010	Information System Audit	2	3.2			H	M					L
FBD0011	Digital Forensic	2	3.2			H	M					L
FBD0012	Distributed System	2	3.2			H	M					L
FBD0013	Special Topics on Computer	2	3.2			H	M					L

8. Organization of Study Program Subjects

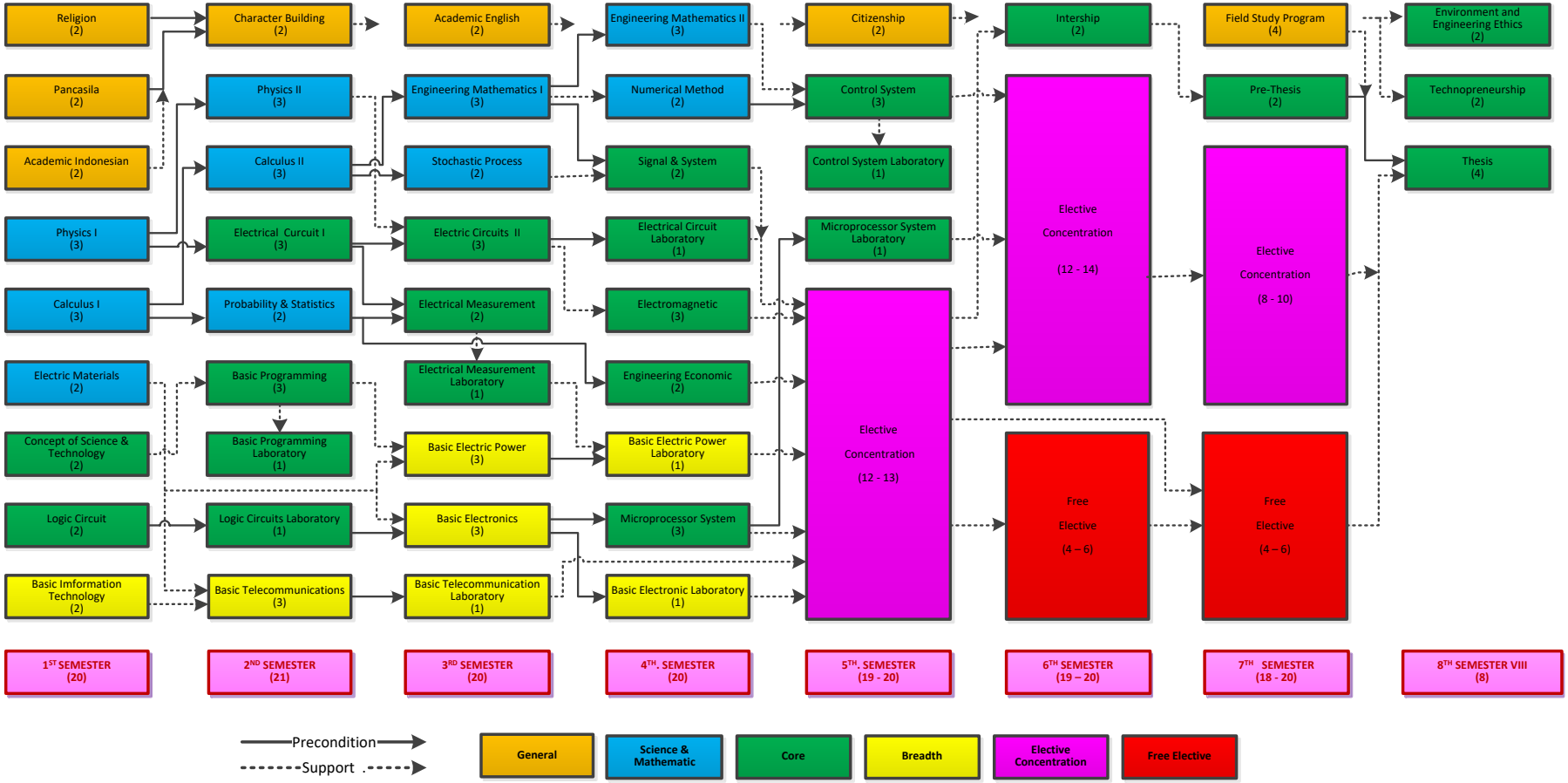

Figure 5. Flow Diagram for Course in Bachelor of Electrical Engineering

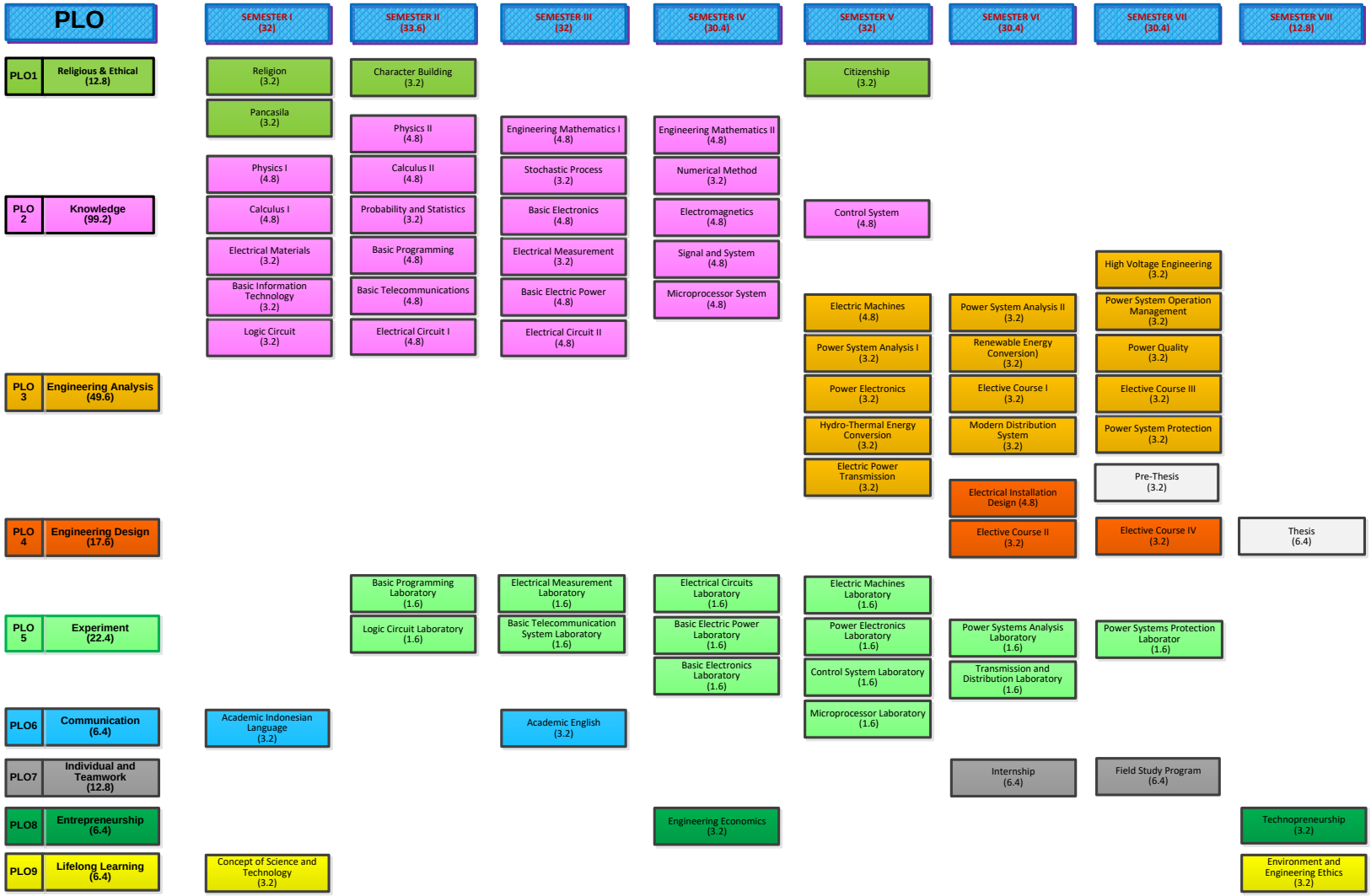

Figure 6. Flow Diagram for Electrical Power System Engineering

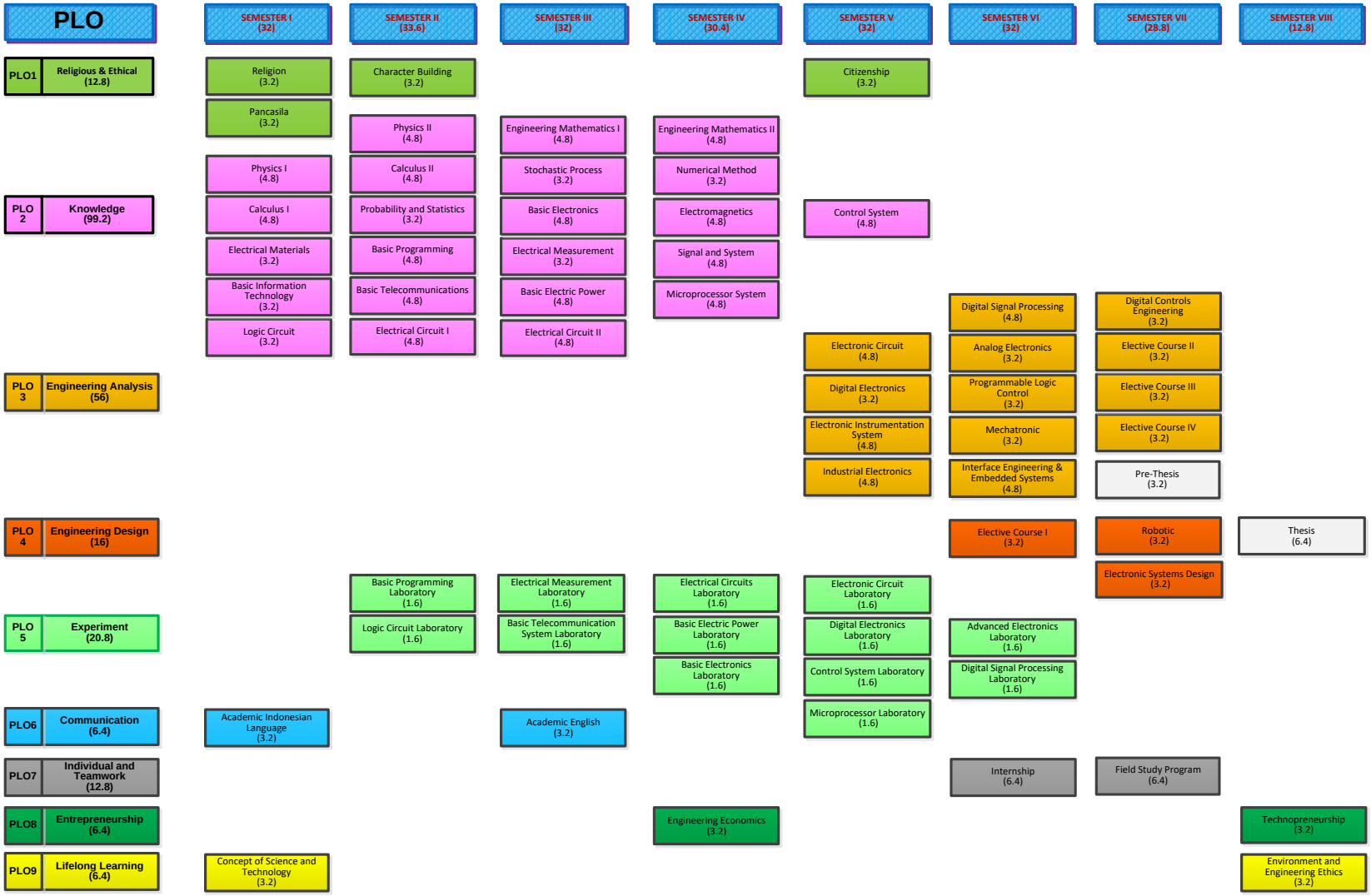

Figure 7. Flow Diagram for Electronics Engineering

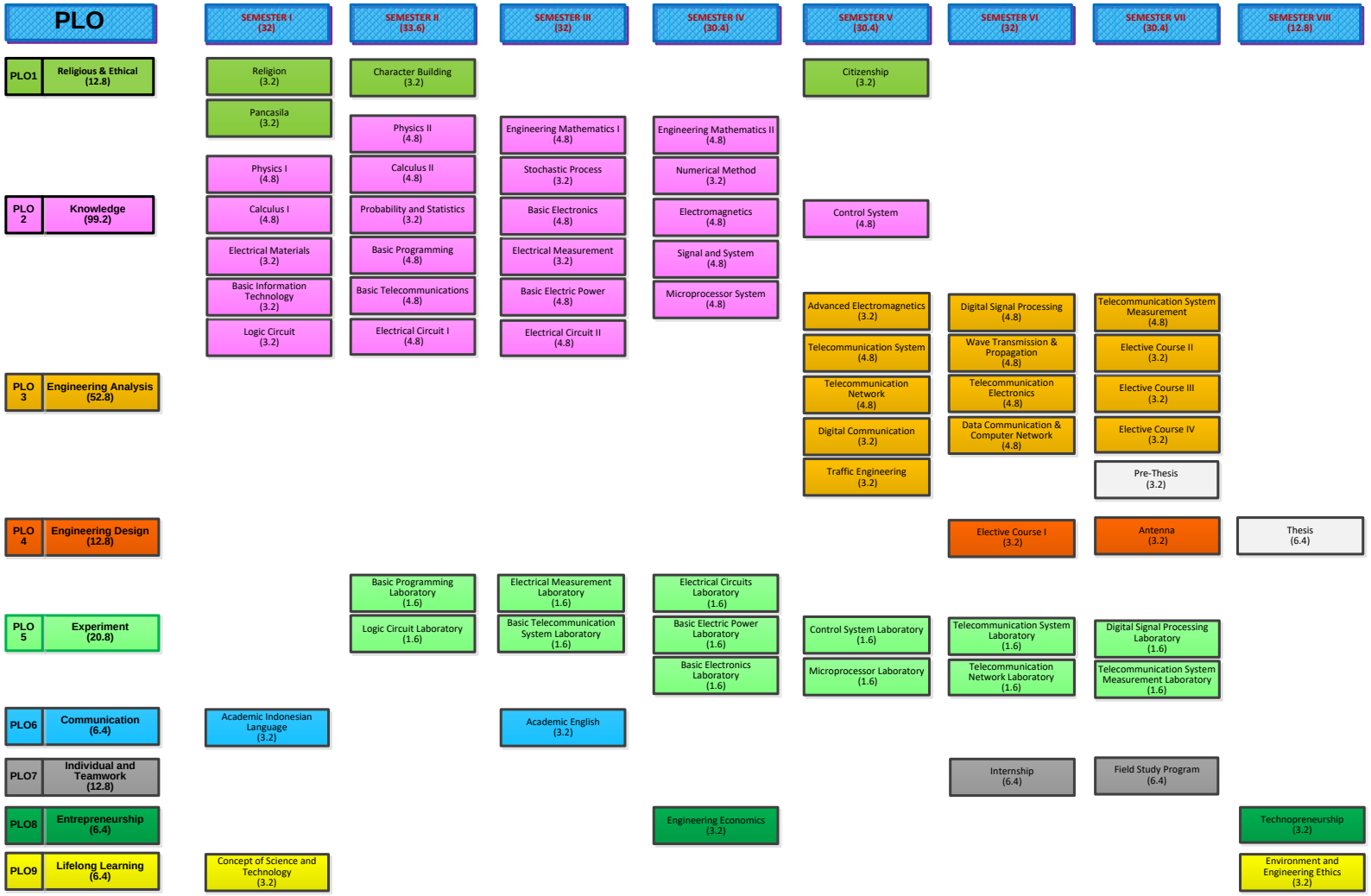

Figure 8. Flow Diagram for Telecommunication Engineering

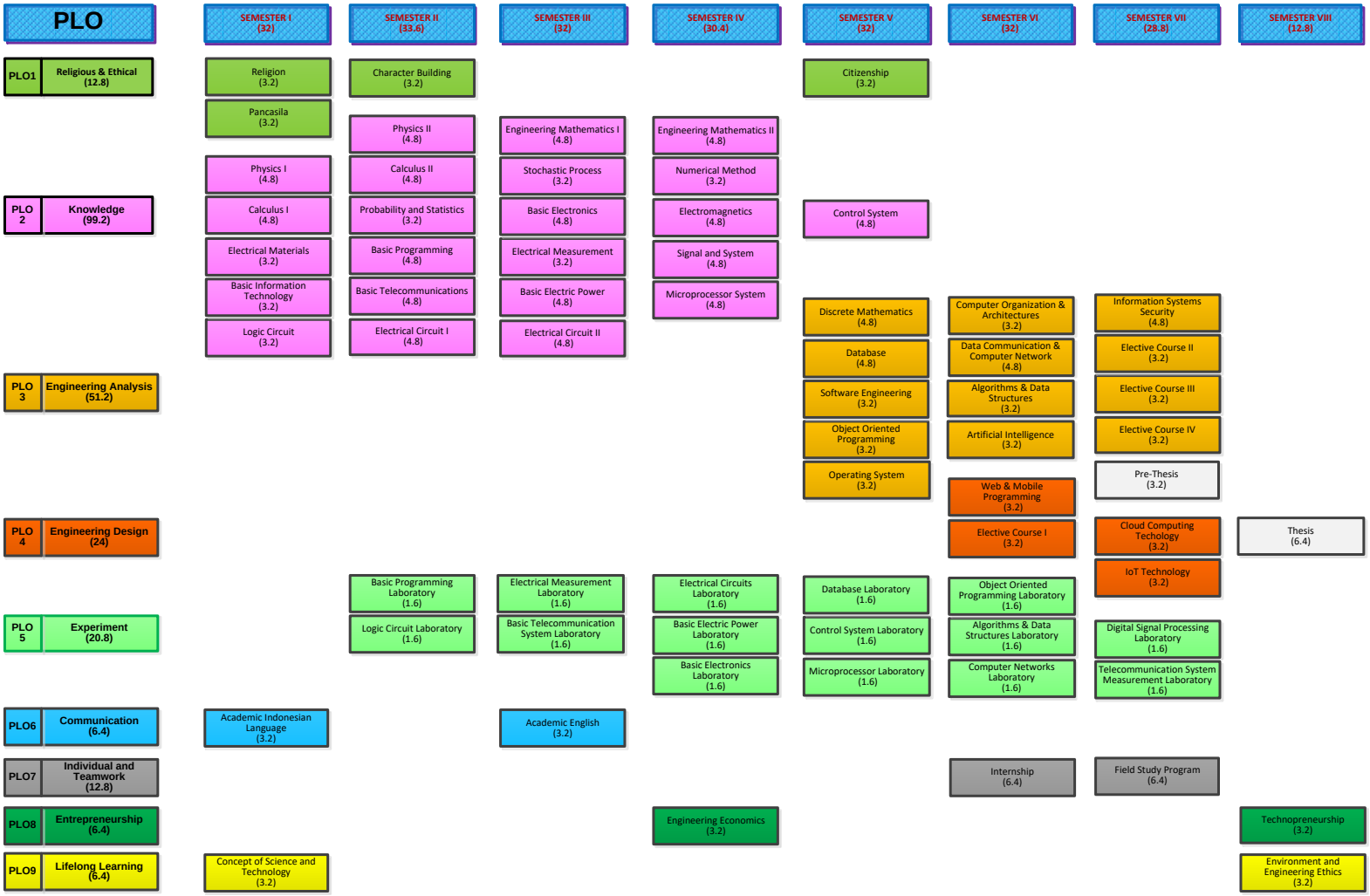

Figure 9. Flow Diagram for Computer Engineering

9. Distribution of Courses Every Semester

Mandatory Courses

Code	1st Semester	SKS	ECTS
FBS1101	Religion	2	3.2
FBS1102	Academic Indonesian Language	2	3.2
FBS1103	Physics I	3	4.8
FBS1104	Calculus I	3	4.8
FBS1105	Electrical Materials	2	3.2
FBS1106	Concept of Science and Technology	2	3.2
FBS1107	Logic Circuit	2	3.2
FBS1108	Pancasila	2	3.2
FBS1109	Basic Information Technology	2	3.2
		20	**32**
Code	**2nd Semester**	**SKS**	**ECTS**
FBS1210	Character Building	2	3.2
FBS1211	Physics II	3	4.8
FBS1212	Calculus II	3	4.8
FBS1213	Electrical Circuit I	3	4.8
FBS1214	Probability and Statistics	2	3.2
FBS1215	Basic Programming	3	4.8
FBS1216	Basic Programming Laboratory	1	1.6
FBS1217	Telecommunications Basics	3	4.8
FBS1218	Logic Circuit Laboratory	1	1.6
		21	**33.6**
Code	**3rd Semester**	**SKS**	**ECTS**
FBS2119	Academic English	2	3.2
FBS2120	Engineering Mathematics I	3	4.8
FBS2121	Stochastic Process	2	3.2
FBS2122	Electrical Circuit II	3	4.8
FBS2123	Electrical Measurement	2	3.2
FBS2124	Electrical Measurement Laboratory	1	1.6
FBS2125	Basic Electronics	3	4.8
FBS2126	Basic Electric Power	3	4.8
FBS2127	Basic Telecommunication System Laboratory	1	1.6
		20	**32**
Code	**4th Semester**	**SKS**	**ECTS**
FBS2228	Engineering Mathematics II	3	4.8
FBS2229	Signal and System	3	4.8
FBS2230	Numerical Method	2	3.2
FBS2231	Electrical Circuits Laboratory	1	1.6
FBS2232	Electromagnetics	3	4.8
FBS2233	Basic Electronics Laboratory	1	1.6
FBS2234	Basic Electric Power Laboratory	1	1.6
FBS2235	Microprocessor System	3	4.8
FBS2236	Engineering Economics	2	3.2
		19	**30.4**
Code	**8th Semester**	**SKS**	**ECTS**
FBS4244	Technopreneurship	2	3.2
FBS4245	Environment and Engineering Ethics	2	3.2
FBS4246	Thesis	4	6.4
		8	**12.8**

A. Electrical Power System

Code	5th Semester	SKS	ECTS
FBS3137	Citizenship	2	3.2
FBS3138	Microprocessor System Laboratory	1	1.6
FBS3139	Control System	3	4.8
FBS3140	Control System Laboratory	1	1.6
FBA3101	Power System Analysis I	2	3.2
FBA3102	Electric Power Transmission	2	3.2
FBA3103	Hydro-Thermal Energy Conversion	2	3.2
FBA3104	Electric Machines	3	4.8
FBA3105	Electric Machines Laboratory	1	1.6
FBA3106	Power Electronics	2	3.2
FBA3107	Power Electronics Laboratory	1	1.6
		20	**32.0**
Code	**6th Semester**	**SKS**	**ECTS**
FBS3241	Internship	4	6.4
FBA3208	Power System Analysis II	2	3.2
FBA3209	Power System Analysis Laboratory	1	1.6
FBA3210	Renewable Energy Conversion	2	3.2
FBA3211	Modern Distribution System	2	3.2
FBA3212	Transmission & Distribution Laboratory	1	1.6
FBA3213	Electrical Installation Design	3	4.8
FBA30xx	Free-Elective I	2	3.2
FBA30xx	Free-Elective II	2	3.2
		19	**30.4**
Code	**7th Semester**	**SKS**	**ECTS**
FBS4142	Field Study Program	4	6.4
FBS4143	Pre-Thesis	2	3.2
FBA4114	Power Systems Operation Management	2	3.2
FBA4115	Power Systems Protection	2	3.2
FBA4116	Power Systems Protection Laboratory	1	1.6
FBA4117	Power Quality	2	3.2
FBA4118	High Voltage Engineering	2	3.2
FBA40xx	Free-Elective III	2	3.2
FBA40xx	Free-Elective IV	2	3.2
		19	**30.4**
Code	**Free-Elective Courses**	**SKS**	**ECTS**
FBA0001	EPS Dynamic and Stability	2	3.2
FBA0002	Computer Application on EPS	2	3.2
FBA0003	Distributed Generation	2	3.2
FBA0004	EPS Substation Technology & Grounding	2	3.2
FBA0005	Maintenance of EPS Equipment	2	3.2
FBA0006	Design of Electrical Machines	2	3.2
FBA0007	Utility & Control of Electrical Machine	2	3.2
FBA0008	Programmable Logic Control	2	3.2
FBA0010	EPS Reliability	2	3.2
FBA0011	High Fields Phenomena	2	3.2
FBA0012	SCADA	2	3.2
FBA0013	Optimization of Modern EPS	2	3.2
FBA0014	Energy Planning	2	3.2
FBA0015	Occupational Health and Safety	2	3.2
FBA0016	Geothermal Exploration & Utilization	2	3.2

B. Electronics Engineering

Code	5th Semester	SKS	ECTS
FBS3137	Citizenship	2	3.2
FBS3138	Microprocessor System Laboratory	1	1.6
FBS3139	Control System	3	4.8
FBS3140	Control System Laboratory	1	1.6
FBB3101	Electronic Circuit	3	4.8
FBB3102	Electronic Circuit Laboratory	1	1.6
FBB3103	Digital Electronics	2	3.2
FBB3104	Digital Electronics Laboratory	1	1.6
FBB3105	Electronic Instrumentation System	3	4.8
FBB3106	Industrial Electronics	3	4.8
		20	**32.0**
Code	**6th Semester**	**SKS**	**ECTS**
FBS3241	Internship	4	6.4
FBB3207	Advanced Electronics Laboratory	1	1.6
FBB3208	Digital Signal Processing	3	4.8
FBB3209	Digital Signal Processing Laboratory	1	1.6
FBB3210	Analog Electronics	2	3.2
FBB3211	Programmable Logic Control	2	3.2
FBB3212	Mechatronic	2	3.2
FBB3213	Interface Engineering & Embedded Systems	3	4.8
FBB30xx	Free-Elective I	2	3.2
		20	**32.0**
Code	**7th Semester**	**SKS**	**ECTS**
FBS4142	Field Study Program	4	6.4
FBS4143	Pre-Thesis	2	3.2
FBB4114	Robotic	2	3.2
FBB4115	Electronic Systems Design	2	3.2
FBB4116	Digital Controls Engineering	2	3.2
FBB40xx	Free-Elective II	2	3.2
FBB40xx	Free-Elective III	2	3.2
FBB40xx	Free-Elective IV	2	3.2
		18	**28.8**
Code	**Free-Elective Courses**	**SKS**	**ECTS**
FBB0001	Algorithm and Data Structure	2	3.2
FBB0002	Image Processing	2	3.2
FBB0003	Optoelectronics	2	3.2
FBB0004	Artificial Intelligence	2	3.2
FBB0005	Biomedical Instrumentations	2	3.2
FBB0006	Advanced Mechatronics	2	3.2
FBB0007	Geo-electromagnetic Instrumentation	2	3.2
FBB0008	Power Electronics	2	3.2
FBB0009	Fast Algorithm	2	3.2

C. Telecommunication Engineering

Code	5th Semester	SKS	ECTS
FBS3137	Citizenship	2	3.2
FBS3138	Microprocessor System Laboratory	1	1.6
FBS3139	Control System	3	4.8
FBS3140	Control System Laboratory	1	1.6
FBC3101	Advanced Electromagnetics	2	3.2
FBC3102	Telecommunication System	3	4.8
FBC3103	Telecommunication Network	3	4.8
FBC3104	Digital Communication	2	3.2
FBC3105	Traffic Engineering	2	3.2
		19	**30.4**
Code	**6th Semester**	**SKS**	**ECTS**
FBS3241	Internship	4	6.4
FBC3206	Wave Transmission and Propagation	3	4.8
FBC3207	Digital Signal Processing	3	4.8
FBC3208	Telecommunication Electronics	3	4.8
FBC3209	Telecommunication Network Laboratory	1	1.6
FBC3210	Data Communication and Computer Network	3	4.8
FBC3211	Telecommunication Systems Laboratory	1	1.6
FBC30xx	Free-Elective I	2	3.2
		20	**32.0**
Code	**7th Semester**	**SKS**	**ECTS**
FBS4142	Field Study Program	4	6.4
FBS4143	Pre-Thesis	2	3.2
FBC4112	Digital Signal Processing Laboratory	1	1.6
FBC4113	Antenna	2	3.2
FBC4114	Telecommunication System Measurement	3	4.8
FBC4115	Telecommunication System Measurements Laboratory	1	1.6
FBC40xx	Free-Elective II	2	3.2
FBC40xx	Free-Elective III	2	3.2
FBC40xx	Free-Elective IV	2	3.2
		19	**30.4**
Code	**Free-Elective Courses**	**SKS**	**ECTS**
FBC0001	Deep Neural Network	2	3.2
FBC0002	Mobile Communication	2	3.2
FBC0003	Microwave Communication	2	3.2
FBC0004	Satellite Communication	2	3.2
FBC0005	Digital Image Processing	2	3.2
FBC0006	Radar and Remote Sensing	2	3.2
FBC0007	Optical Fiber Communication System	2	3.2
FBC0008	Telemetry	2	3.2
FBC0009	Specials Topic on Telecommunication	2	3.2
FBC0010	Software Defined Radio	2	3.2
FBC0011	Geo-Electromagnetic Data and Signal Processing	2	3.2

D. Computer Engineering

Code	5th Semester	SKS	ECTS
FBS3137	Citizenship	2	3.2
FBS3138	Microprocessor System Laboratory	1	1.6
FBS3139	Control System	3	4.8
FBS3140	Control System Laboratory	1	1.6
FBD3101	Discrete Mathematics	3	4.8
FBD3102	Database	3	4.8
FBD3103	Software Engineering	2	3.2
FBD3104	Object Oriented Programming	2	3.2
FBD3105	Operating System	2	3.2
FBD3106	Database Laboratory	1	1.6
		20	**32.0**
Code	**6th Semester**	**SKS**	**ECTS**
FBS3241	Internship	4	6.4
FBD3207	Computer Organization and Architecture	2	3.2
FBD3208	Data Communication and Computer Networks	3	4.8
FBD3209	Algorithms and Data Structures	2	3.2
FBD3210	Object Base Programming Laboratory	1	1.6
FBD3211	Artificial Intelligence	2	3.2
FBD3212	Web and Mobile Programming	2	3.2
FBD3213	Algorithms and Data Structures Laboratory	1	1.6
FBD3214	Computer Networks Laboratory	1	1.6
FBD30xx	Free-Elective I	2	3.2
		20	**32.0**
Code	**7th Semester**	**SKS**	**ECTS**
FBS4142	Field Study Program	4	6.4
FBS4143	Pre-Thesis	2	3.2
FBD4115	Information Systems Security	2	3.2
FBD4116	Cloud Computing Technology	2	3.2
FBD4117	IoT Technology	2	3.2
FBD40xx	Free-Elective II	2	3.2
FBD40xx	Free-Elective III	2	3.2
FBD40xx	Free-Elective IV	2	3.2
		18	**28.8**
Code	**Free-Elective Courses**	**SKS**	**ECTS**
FBD0001	Pattern Recognition	2	3.2
FBD0002	Data Engineering	2	3.2
FBD0003	Machine Learning	2	3.2
FBD0004	Software Project	2	3.2
FBD0005	Computer Network Security	2	3.2
FBD0006	IoT Wireless Communication	2	3.2
FBD0007	Smart IoT Device	2	3.2
FBD0008	Computer Graphics	2	3.2
FBD0009	Game Development Techniques	2	3.2
FBD0010	Information System Audit	2	3.2
FBD0011	Digital Forensic	2	3.2
FBD0012	Distributed System	2	3.2
FBD0013	Special Topics on Computer	2	3.2

10. Lesson Plan (RPS)

Systematic learning design is carried out in order to produce learning tools, namely Lesson Plans (RPS), assessment instruments, task plans, teaching materials, and others that can be carried out in the learning process efficiently and effectively. The stages of learning design are carried out in a systematic, logical, and structured manner in the implementation of learning, and can guarantee the achievement of program learning outcomes (PLOs). Based on the book "Guidelines for preparing higher education curriculum in the industrial era 4.0 to support independent learning-independent campus (MBKM)", the learning design stages are at least carried out in the following stages:

b. Identify the PLOs for each course;
c. Formulate course learning outcomes (CLOs) that are specific to courses based on the PLOs imposed on the course;
d. Formulate sub-CLOs as the final capability planned at each learning stage which is formulated based on CLOs;
e. Conduct learning analysis to give students an overview of the stages of learning that will be undertaken;
f. Analyze learning needs to determine the breadth and depth of learning materials needed, as well as the learning tools needed;
g. Determine indicators of achievement of Sub-CLOs as the final capability planned at each learning stage to fulfill PLOs;
h. Establish assessment criteria and develop learning assessment instruments based on achievement indicators for Sub-CLOs;
i. Select and develop learning forms, learning methods, and student assignments as learning experiences;
j. Develop learning materials in the form of appropriate teaching materials and learning resources;
k. Develop and carry out learning evaluations. Learning evaluation consists of two evaluations. First, formative evaluation which aims to improve the learning process. Second, a summative evaluation which aims to determine the results of student learning outcomes;

Lesson Plan (RPS) for each subject in the BEE 2022 curriculum were made based on the RPS document template from the UNRAM's Institute of Quality Assurance and Education Development (LPMPP).

11. Learning Assessment

Learning assessment in the BEE curriculum assesses learning processes and outcomes. This learning assessment is based on the Regulation of the Minister of Education and Culture No. 3 of 2020, concerning National Higher Education Standards, the fifth part; learning assessment standards. Learning assessment standards are criteria at least regarding the assessment of student learning processes and outcomes in the framework of fulfilling program learning outcomes (PLOs). Assessment of student learning processes and outcomes includes:

a. valuation principle;
b. assessment techniques and instruments;
c. assessment mechanisms and procedures;
d. assessment implementation;
e. assessment report; and
f. student graduation

11.1 Assessment Principles

The principle of assessment in Permendikbud No. 3 of 2020 includes educative, authentic, objective, accountable and transparent principles that are carried out in an integrated manner. These five principles are shown in Table. 13.

Table 13 Principles of Learning Assessment

No.	Assessment Principles	Explanation
1	Educative	assessment that motivates students to be able to: a. improve planning and ways of learning; and b. achieve program learning outcomes.
2	Authentic	assessment that is oriented towards a continuous learning process and learning outcomes that reflect students' abilities during the learning process
3	objective	assessment based on agreed standards between lecturers and students and free from the influence of the subjectivity of the assessor and those being assessed.
4	Accountable	assessment carried out in accordance with clear procedures and criteria, agreed at the beginning of the lecture, and understood by students
5	Transparent	assessment procedures and results of which are accessible to all stakeholders.

11.2 Assessment Techniques and Instruments

B. Assessment Techniques

Assessment of the learning process at BEE on aspects of attitudes, knowledge, general skills, and specific skills based on Permendikbud no. 4 in 2020 is described in *Table 14*.

Tabel 14 Aspects, Techniques, and Assessment Instruments.

<table>
<tr><th>No</th><th>Aspect</th><th>Technique</th><th>Instrument</th></tr>
<tr><td>1</td><td>Attitudes</td><td>Observation in every interaction and lecture activity</td><td rowspan="4">a. Process assessment in rubric and/or

b. Assessment results in portfolio or design work</td></tr>
<tr><td>2</td><td>Knowledge</td><td rowspan="3">a. Observation,
b. Participation,
c. Work method,
d. Written test,
e. Oral test, and
f. Questionnaire
(choose one or a combination)</td></tr>
<tr><td>3</td><td>General Skills</td></tr>
<tr><td>4</td><td>Special skill</td></tr>
<tr><td colspan="4">The final result of the assessment is an integration between the various assessment techniques and instruments used</td></tr>
</table>

B. Assessment Instrument

B.1 Rubric

A rubric is a roadmap for learning facilitators to conduct consistent and accountable assessments of the quality of student work. Rubrics can also be utilized as feedback on the quality of student work. In a rubric, there is a set of criteria used to e assess the performance of a specific job or task by an individual or group of students, as well as other information about the level of achievement. A rubric helps the facilitator provide a more objective assessment according to learning outcomes.

There are three different kinds of rubrics: analytical/descriptive rubrics, holistic rubrics, and perception scale rubrics. Analytical rubrics are generally used for assessing student performance. This rubric is used to assess tasks that may be broken down into distinct domains or criteria, each of which can be evaluated separately. Each criteria may be weighted in accordance with its significance for gaining program learning from the task. When it is challenging or impossible to evaluate an assignment using separate criteria, holistic rubrics are utilized. This is possible due to the interconnectedness and overlap of the criteria.

The benefits of the rubric are:

a. Rubric can be an objective and consistent assessment guideline with clear criteria;
b. Rubrics can provide information on the weight of the assessment at each level of student ability;
c. Rubrics can motivate students to learn more actively;
d. Students can use rubrics to determine their learning strategies and measure the achievements of their own abilities or study groups;
e. Students get fast and accurate feedback;
f. Rubrics can serve as tools for successful reflection on the learning process that has occurred;
g. As a guide for the process of learning and assessment of student learning outcomes.

Examples of project assessment rubrics and written test results can be seen in *Tables 15 and 16.*

Table 15. Example of a Holistic Rubric in Project Assessment

No.	Level of Achievement	Score / Value	Description of Achievement
1	Extremely good	85 – 100	- The project is created using the appropriate design process. - Technically operating accurately and correctly - Exhibit originality and ingenuity in regard to its functionality and usability. - Focus on security and safety - Aesthetic value
2	Good	70 - < 85	- The project is created using the appropriate design process. - Technically operating accurately and correctly - Exhibit originality and ingenuity in regard to its functionality and usability. - Pay close attention to safety and security - Lacks aesthetic merit.
3	Pretty good	65 - < 70	- The project is created using the appropriate design process. - Technically operating accurately and correctly - Exhibit originality and ingenuity in regard to its functionality and usability. - Have not considered security and safety - Lacks aesthetic merit.
4	Adequate	55 - < 65	- The project is created using the appropriate design process. - Technically operating accurately and correctly - Has not demonstrated originality and inventiveness in relation to its functionality and usability. - Have not considered security and safety - Lacks aesthetic merit.
5	Inadequate	45 - < 55	- The project is created using the appropriate design process. - Technically, it does not function correctly. - Has not demonstrated originality and inventiveness in relation to its functionality and usability. - Have not considered security and safety

			- Lacks aesthetic merit.
6	Extremely deficient / failed	< 45	- The project lacks a proper design methodology. - Technically, it does not function correctly. - Has not demonstrated originality and inventiveness in relation to its functionality and usability. - Have not considered security and safety - Lacks aesthetic merit.

Table 16. Example of a Holistic Rubric in Assessing Written Test Answers

No.	Level of Achievement	Score / Value	Description of Achievement
1	Extremely good	85 – 100	- Very precise answers to questions - Answers are well explained and easy to understand - Answers are very organized and neat - Very unit answers with other answers - Very creative answers
2	Good	70 - < 85	- Very precise answers to questions - Answers are well explained and easy to understand - Answers are very structured and neat - Unit answers with other answers - Uncreative answer
3	Pretty good	65 - < 70	- Very precise answers to questions - Answers are well explained and easy to understand - Structured and neat answers - Unit answers with other answers - Uncreative answer
4	Adequate	55 - < 65	- Exactly answer the questions - Answers are well explained and easy to understand - Unstructured answers - Answers do not unite with other answers - Uncreative answer
5	Inadequate	45 - < 55	- Inaccurate answer questions - Answers are not well explained - Unstructured and neat answers - Answers do not unite with other answers - Uncreative answer
6	Extremely deficient / failed	< 45	- The answer does not match the question - Answers are not well explained - Unstructured and neat answers - Answers do not unite with other answers - Uncreative answer

Table 17. Example of Analytical Rubric in Assessment of Paper Presentation

Criteria / Dimensions	Student Presentation					Mark criteria
	Very good	**Good**	**Fair**	**Poor**	**Very Poor**	
	(85-100)	**(75-84)**	**(55-74)**	**(45-54)**	**(0 – 44)**	
Organization	- well organized and clear - fact/data support - clear concept - results analyzed - precise and clear conclusion	- well organized and clear - fact/data support - clear concept - results analyzed - inaccurate conclusion	- well organized - fact/data support - clear concept - results not analyzed - inaccurate conclusion	- clearly organized - fact/data support - concept is not clear - results are not analyzed - inaccurate conclusion	- not clearly organized - not supported by facts/data - concept is not clear - results are not analyzed - inaccurate conclusion	
Contents	- complete and clear - neatly structured - add new insights - creative	- complete and clear - neatly structured - add new insights - not creative	- complete and clear - neatly structured - does not add new insights - not creative -	- complete - not neatly structured - does not add new insights - not creative	- incomplete - not neatly structured - does not add new insights - not creative	
Presentation	- calm and precise intonation - not relying on records - interact intensively - Always make eye contact with listeners - on time	- calm and precise intonation - not relying on records - interact intensively - Always make eye contact with listeners - not on time	- calm and precise intonation - not relying on records - interact intensively - rarely eye contact with listeners - not on time	- calm - not relying on notes - do not interact intensively - rarely eye contact with listeners - not on time	- not calm - focused on notes - do not interact intensively - rarely eye contact with listeners - not on time	

Table 18. Example of a Perception Scale Rubric in Oral Presentation Assessment

No.	Aspect/Dimension Evaluation	Very Poor	Poor	Fair	Good	Very Good
		<45	45-59	60-74	75-84	≥85
1	Communication Skills					
2	Material Mastery					
3	Ability to Answer Questions					
4	Use of Presentation Props					
5	Problem Solving Accuracy					

B.2 Portfolio Assessment

Portfolio assessment is a continuous assessment, based on a collection of information that shows the development of student learning outcomes in a certain period. This information can be in the form of student work from the learning process that is considered the best or student work that shows the development of their ability to achieve learning outcomes

Table 19 Example of Portfolio Assessment

No.	Sub CLOs	Score Percentage	Very Complete	Complete	Less Complete
			75 - 100	65 - 74	55 – 64
1	Able to understand (C2) the types of components, problems, and developments in SDTL	5 %	√		
2	Able to analyze (C4) load characteristics and their use in the field of SDTL	10 %	√		
3	Able to understand (C2) the components, types, and functions of each part of SDTL	5 %	√		
4	Able to evaluate (C5) V drop and power losses in SDTL networks.	20 %	√		
5	Able to evaluate (C5) the initial conditions of quality and efficiency of SDTL	10 %	√		
6	Able to analyze (C4) the proper use of capacitors in SDTL	10 %		√	
7	Able to analyze (C4) voltage regulation on JTM SDTL	10 %		√	
8	Able to analyze (C4) protection systems in SDTL	10%	√		
9	Able to analyze (C4) reliability on SDTL	5 %		√	
10	Able to evaluate (C5) quality improvement, efficiency, protection, and reliability of SDTL	10 %		√	

Types of portfolio assessment are:

(1) Development portfolio, containing a collection of student work that shows progress in achieving their abilities in accordance with the stages of learning that have been undertaken.

(2) Showcase portfolio, containing the results of student work that show the best learning performance results.

(3) Comprehensive portfolio, containing the results of student work as a whole during the learning process.

11.3 Appraisal Mechanisms and Procedures

A. Assessment Mechanism

Mechanisms for assessing learning outcomes in BEE are related; stages, techniques, instruments, criteria, indicators and assessment weights are carried out according to the flow in Figure 5.

a. preparation, delivery, agreement on stages, techniques, instruments, criteria, indicators, and assessment weights between assessors and those assessed according to the lesson plan;

b. implementation of the assessment process according to the stages, techniques, instruments, criteria, indicators, and assessment weights which contain the principles of assessment;

c. providing feedback and opportunities for students to question the results of the lecturer's assessment; And

d. documentation of process assessment and student learning outcomes in an accountable and transparent manner.

Figure 10 Assessment Mechanism

B. Assessment Procedure

The learning assessment procedure in BEE includes the following stages:

a. planning,
b. activity of giving assignments or questions,
c. performance observation,
d. return of observations, and
e. final grade

11.4 Assessment Implementation

The assessment is carried out according to the lesson plan and can be carried out by:

a) teaching lecturers or team teaching;
b) teaching lecturers or team teaching by involving students; and/or;
c) teaching lecturers or team teaching by involving relevant stakeholders.

11.5 Assessment Reporting

Mechanisms for reporting the assessment of learning outcomes in the form of:

a) Qualifications for student success in taking a course are stated in the assessment category (Table below) of the teaching lecturers or the teaching team;

Table 20. Assessment Category

Letter	Number	Category
A	4,0	Special
B+	3,5	Very good
B	3,0	Good
C+	2,5	Pretty good
C	2,0	Adequate
D+	1,5	Inadequate
D	1,0	Very inadequate
E	0,0	Not Pass

b) The results of the assessment of program learning outcomes in each semester are expressed by the Semester Achievement Index (IPS)
c) The results of the assessment of program learning outcomes at the end of each study program are expressed by the Cumulative Grade Point Average (GPA)

11.6 Student Graduation

The Electrical Engineering students at the University of Mataram are declared to graduate, when they have passed all of the prescribed study load (minimum 146 SCU) and reached the learning outcome of graduates targeted by the study program with a GPA ≥ 2.00 (two points zero). Graduation is predicated as:

a. GPA 2.76 – 3.00 Satisfactory
b. IPK 3.01 – 3.50 Highly satisfactory
c. IPK 4.00 – 3.51 Honorary

12. Implementation Plan on Learning Rights for Maximumly 3 Semesters Outside the Study Program

MBKM aims to encourage students to gain a learning experience with various additional competencies outside their study program and/or off their campus. The Independent Learning, Independent Campus (MBKM) is established, based on the Indonesian Ministry of Education and Culture Regulations Number 3 of 2020 concerning National Higher Education Standards on Learning Process Standards in articles 15 - 18. The fulfilment of the study period and load for undergraduate students or vocational undergraduate programs can be implemented by:

4. Following all of the learning processes in the Bachelor of Electrical Engineering at the University of Mataram based on the 2022's curriculum, study load (146 SCU) and learning period; and
5. Following the learning process in their own study program to fulfil half of the study load and learning period, while joining the learning process outside their study program

For the university, they are obliged to facilitate the MBKM establishment. Bachelor of Electrical Engineering (BEE) should notice 4 (four) essential components in developing and executing the curriculum with the implementation of MBKM, namely:

1. Focusing the graduate profile achievement and learning outcome of graduates in BEE.
2. Ensuring fulfillment of maximumly 3 semester off campus and learning experience gained with additional competence related to the learning outcome of graduates in BEE.

3. Ensuring implementation of MBKM will build the students with more learning experiences in the real world following their profiles or working scope.
4. Designing and executing the flexible curriculum, that can adapat to the science, technology, and art developments (scientific vision) and job demands (market signal).

12.1 MBKM Implementation Model

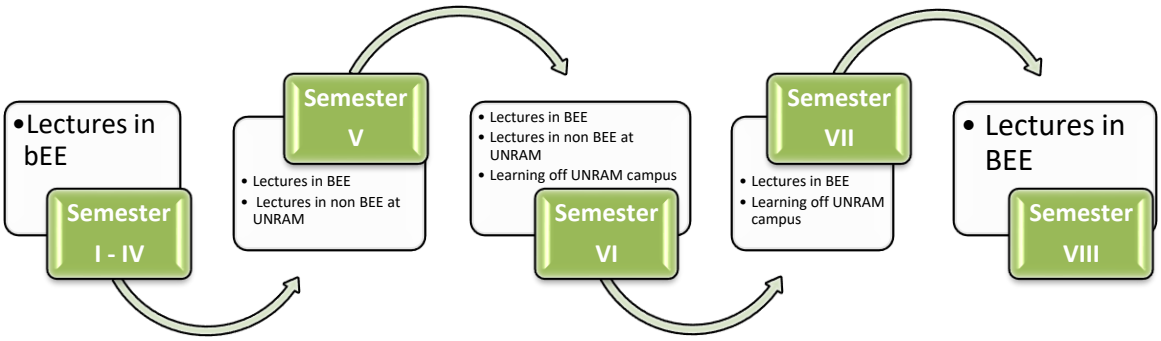

Figure 11. Implementation model of MBKM in BEE

The implementation model of MBKM on the 2022's curriculum contains:

1. Semester I – IV: Lectures in BEE and/or Faculty of Engineering (Basics for Engineering courses) and/or UNRAM (Religion, *Pancasila*, Civic education, and Indonesian Language courses)
2. Semester V – VII: Students can choose a learning program off from BEE, namely to other study program at the UNRAM.
3. Semester VI – VII: Students can apply one or two semesters off from UNRAM by joining the MBKM.
4. Semester VIII: Lectures in BEE for finishing the final study project in BEE.

12.2 Off-Campus MBKM Program

A learning activity based on the Indonesian Ministry of Education Regulations Number 3 of 2020 Article 15 Paragraph 1 can implemented inside and outside of the study programs, namely:

Figure 12. Eight Learning Models off Campus

Table 21. Forms of Learning Activities, Loads and Equivalence of 8 MBKM Models

No.	Form of Learning Activities	SCU Load		Descriptions
		Regular	MBKM	
1	Student Exchange	-	≤ 20	- Established in Semester VI/VII - Target campus/study program proportional or more than UNRAM/BEE UNRAM - Equivalent to 20 SCU: Similar to the SCU programmed by other campuses.
2	Practical Working/Internship	2	≤ 20	- Established in Semester VI/VII - Internship location is in accordance with the engineering field - Equivalent to 20 SCU: a. 10 SCU for Elective Courses b. 2 SCU for Pre-Final Project c. 2 SCU for Engineering Environment and Ethics d. 4 SCU for Final Project Courses e. 2 SCU for Expertise Field
3	Teaching Assistance in Educational Unit	-	≤ 20	- Established in Semester VI/VII - The target education is in accordance with the engineering field - Equivalent to 20 SCU: a. 10 SCU for elective courses

				b. 4 SCU for Community Service Program c. 6 SCU for expertise field
4	Experiment/Research	-	≤ 20	- Established in Semester VI/VII - Research experiments in accordance with the field of engineering - Equivalent to 20 SCU: a. 10 SCU for Elective Courses b. 2 SCU for Pre-Final Project c. 2 SCU for Engineering Environment and Ethics d. 4 SCU for Final Project Courses e. 2 SCU for Expertise Field
5	Humanity Project	-	≤ 20	- Established in Semester VI/VII - Association with the Engineering Utilization - Equivalent to 20 SCU: a. 10 SCU for Elective Courses b. 2 SCU for Engineering Environment and Ethics c. 8 SCU for Expertise Field
6	Entrepreneurial Activity	2	≤ 20	- Established in Semester VI/VII - Activities are supported with technological utilization - Equivalent to 20 SCU: a. 10 SCU for Elective Courses b. 2 SCU for Technopreneurship c. 2 SCU for Engineering Environment and Ethics d. 6 SCU for Expertise Field
7	Independent Study/Project	-	≤ 20	- Established in Semester VI/VII - In accordance with the engineering field - Equivalent to 20 SCU: a. 10 SCU for Elective Courses b. 2 SCU for Pre-Final Project c. 2 SCU for Engineering Environment and Ethics d. 6 SCU for Expertise Field
8	Thematic Community Service Program or Village Developing Program	4	≤ 20	- Established in Semester VI/VII - The main activities are in accordance with the engineering field - Equivalent to 20 SCU: a. 10 SCU for Elective Courses b. 4 SCU for Community Service Program c. 2 SCU for Civic Education d. 4 SCU for applied expertise field

13. Curriculum Implementation Management and Mechanism

13.1 Curriculum Transition

The implementation of the 2022 BEE curriculum begins in the odd semester of the 2022/2023 academic year. For a smooth transition from 2017 to the 2022 curriculum, BEE establishes the transition rules, namely:

1) The 2022's BEE UNRAM undergraduate curriculum will be implemented entirely in the odd semester of the 2022/2023 academic year
2) The classes of 2021 and 2022 are obliged to join the 2022 curriculum
3) The classes before the class of 2021 (class of 2020, 2019, 2018, 2017, and 2016), who have passed the 2017 curriculum must fulfil the SCU achievement in the 2022 curriculum, until reaching the minimum number of mandatory courses at 136 SCU and minimum 10 SCU for elective courses, thus the total minimum is 146 SCU.
4) Students as mentioned in point 3 are required to take equivalent courses in the 2022 curriculum. The equivalent courses can be seen in the equivalence table. The 2017 curriculum courses that are not listed in the equivalence table mean that they remain unchanged, either in terms of names or the number of credits.
5) If the mandatory courses in the 2017 curriculum have been erased (abolished) without any equivalent courses in the 2022 curriculum, then;
   a. Students who have passed the courses, are still counted in the credits as mandatory courses, following the passing requirement of 146 SCU
   b. Students who have not passed these courses, can take elective courses or new mandatory courses in the 2022 curriculum to pass a minimum total of 146 SCU.
6) If the mandatory courses in the 2017 curriculum have been changed as elective courses in the 2022 curriculum, then;
   a. Students who have passed these courses, are still counted in the credits as mandatory courses for passing the 146 SCU.
   b. Students who have not passed these courses, can take equivalent courses or change replace them with the latest mandatory courses in the 2022 curriculum.
7) If there are any changes in course credits, the number of credits counted for graduation is the number of credits during the taken course. Similar or equivalent courses with different

credit loads, whether repetitive or initially taken, will be listed with a new name and calculated with a new credit load (see Table of Course Equivalence).

8) For courses that have been shifted between the semesters (from Even to Odd, or *vice versa*, or semester IV to I or VII to VI shifts), if necessary, the courses will be opened in both semesters and or with several parallel classes, during the curriculum transition period (1 academic year).
9) The mandatory courses in the 2022 curriculum can become elective courses for the class of 2020 or previously.

13.2 Quality Assurance System

The 2022 BEE curriculum is implemented by noticing the curriculum quality assurance system, following the establishment, implementation, evaluation, control and improvement cycle (PPEPP). The BEE curriculum quality assurance system is monitored by the Quality Assurance Unit (UPM) in BEE, Quality Assurance Control Group in the Faculty of Engineering, and Quality Assurance and Educational Development Institute (LMPPP) in the university. The curriculum quality assurance system cycle follows the stages presented in *Table 22.*

Table 22. Stages of 2022's Curriculum Quality Assurance System in BEE

No	Stage	Action	Control
1	Curriculum Document establishment	- Establishment once in 4 – 5 years - Establishment of goals and profiles - Establishment of courses and SCU load - Establishment of an integrated curriculum structure	LPMPP
2	Learning process implementation	- Focusing on the program learning achievement (PLOs, course learning achievement (CLOs), and sub-CLOs - Following the Lesson Plan (RPS) and Student Assignment Plan (RTM) - Following the learning product assessment - Documenting the learning product assessment	UPM
3	Sustainability evaluation and improvement	- Formative a. The achievement of PLOs, CLOs, and sub-CLOs in each course b. RPS suitability in learning forms and methods, assessment methods, and supporting tools - Summative a. Gradually on 4-5 years b. Involving the internal and external parties c. Receiving reviews from the electrical field expert, industries, and association - Adjustments to science, technology, and art developments and user needs.	UPM
4	Control	- Conducted in every semester - The result indicator is based on the achievement of PLOs	UPM

5	Improvement	Based on the curriculum evaluation, both formative and summative.	GPM

14. Closing Remarks

The 2022's BEE Curriculum is an outcome-based education curriculum (OBE), following the guidelines for developing higher education curriculum in the 4.0 era to support the MBKM program. Therefore, several components have been established to reconstruct the 2017's BEE Curriculum. The analysis phase began in determining the vision, mission, curriculum foundation, and educational goals, thenneeds analysis, tracer study, and graduate profile determination. The next stage was PLOs planning, studying, and assessing, before developing the CLOs and sub-CLOs, courses and loads, besides course matrices, RPS, and RTM.

The BEE curriculum as a higher education curriculum is referred to the National Higher Education Standards, which includes the development of intellectual intelligence, exemplary character and skills. In accordance with the standards, the BEE at the University of Mataram implements a curriculum to encourage learning quality improvement to achieve educational goals that produce students with character, quality, and competitiveness. This educational objective is supported by 8 (eight) program learning outcomes (PLOs) with reformulation; religious and ethical knowledge, engineering analysis, engineering design, experimentation, communication, individual and team-work, entrepreneurship, and lifelong learning.

The 2022 BEE curriculum document is provided as a reference for the implementation of all teaching and learning processes by department managers, lecturers, students, and education staff in this study programs. Also, this curriculum is a reference for curriculum evaluation in 2022 – 2026, for further curriculum planning. The implementation of this curriculum is expected to motivate the students based on their learning enthusiasm, quality learning, continuous learning addiction, thus achieving the program learning outcomes.