Annex II - Sample Outcomes-based Syllabus

Course Title: **ELECTRICAL CIRCUITS 3**

Pre-requisite: Electrical Circuits 2

Co-requisite: Electrical Circuits 3 Laboratory

Credit: 3 units

Course Description: The course covers the study of three-phase systems with balanced and unbalanced loading conditions; symmetrical components; and the analysis of two-port networks and of magnetically-coupled circuits.

Course Outcomes and Relationship to Program Outcomes:

Course Outcomes	Program Outcomes														
After completion of the course, the student should be able to:	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
CO 1 - apply per phase analysis in the solution of problems involving three-phase systems with balanced and unbalanced loading conditions		E				D			I			I		I	
CO 2 - determine and use symmetrical components in the analysis of faulted three-phase power systems		E				E			I	I		I		I	
CO 3 – determine and interpret the characteristics and linear response of passive two-port networks		E				E			I			I			
CO 4 – obtain and interpret the linear response of circuits containing magnetically-coupled coils		E				E			I	I		I		I	

Course Coverage:

Course outcomes	Intended learning outcomes	Topic	Teaching and learning activities	Assessment tasks
		Orientation; discussion of course goals and expected outcomes; discussion of course policies, grading system		

CO 1	Explain voltage relations and current relations in balanced 3-phase systems	Generation of three-phase voltages; advantages of 3-phase systems; voltage relations and current relations in balanced 3-phase systems	Lecture; class discussion	Recitation
	Solve balanced 3-phase system problems using per phase analysis	Power calculations in 3-phase systems; power factor correction; multiple 3-phase loading; two or more 3-phase sources; systems with considerable line impedances	Lecture; class discussion; seatwork; homework	Quiz
	Determine required responses of balanced 3-phase systems using computer-aided circuit analysis	Computer simulation of 3-phase systems with balanced loading	Lecture; class discussion; computer simulation	Interpretation of computer simulation
	Analyse the behaviour of 3-phase systems with unbalanced loading conditions	Analysis of 3-phase systems with single-phase loading, with and without balanced 3-phase loading	Lecture; class discussion; seatwork	Quiz
CO 2	Understand the concept of per unit system and perform per unit calculations	Per unit quantities and per unit calculations	Lecture; class discussion; seatwork	Recitation; seatwork
	Obtain the symmetrical components of 3-phase unbalanced phasors	Symmetrical components	Lecture; class discussion; seatwork	Seatwork
	Apply the concept of symmetrical components in solving faulted power system problems	Three-phase faults; shunt faults in 3-phase systems	Lecture; class discussion	Quiz
CO 3	Understand the concept of two-port networks	Two-port networks, examples; network parameters; network responses	Lecture; class discussion	Recitation
	Determine required results from two-port network analysis	Determination of network parameters and network responses; interconnected two-port networks	Lecture; class discussion; seatwork	Quiz
	Differentiate passive two-port networks from those with internal sources	Defining equations and network responses	Lecture; class discussion; seatwork	Recitation
CO 4	Analyse the behaviour of circuits containing magnetically-coupled coils	Concept of mutual inductance and magnetic coupling; self- and mutually-induced voltages; analysis of circuits with coupled coils	Lecture; class discussion; seatwork	Quiz

	Understand the concept of a linear and an ideal transformer	The linear transformer; the ideal transformer; defining equations	Lecture; class discussion	Recitation
	Determine required responses using computer-aided circuit analysis for circuits with magnetically-coupled coils	Computer-aided analysis of circuits with coupled coils	Lecture; class discussion; computer simulation	Interpretation of computer simulation
		Overall assessment of student performance		Final exam

Textbook:

Fundamentals of Electric Circuits, C. K. Alexander & M. N. O. Sadiku, McGraw Hill, 3rd ed., 2007.

Course Assessment:

As per standard grading system, thoroughly discussed during the orientation meeting;

Aside from academic deficiency, other grounds for a failing grade are:

- Grave misconduct and /or cheating during examinations
- Unexcused absences of more than 20% of required number of meetings per term
- A failing academic standing and failure to take the final exam

Suggested References:

a. Introduction to Electric Circuits (7^{th} ed.) by Dorf and Svoboda, 2006
b. Basic Electricity (2^{nd} ed.) by Milton Gussow, 2007
c. Introduction to PSPice using CAD for Circuits and Electronics by M. H. Rashid, 2004
d. Engineering Circuit Analysis by W. Hayt, Jr, et.al, McGraw Hill, 7^{th} ed., 2007
e. Electric Circuits by Nilsson and Riedel, Pearson Prentice Hall, 7^{th} ed., 2005
f. Elements of Power System Analysis by Stevenson
g. Analysis of Faulted Power Systems by Anderson

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SAMPLE OR SUGGESTED CURRICULUM ALIGNED TO OUTCOMES-BASED EDUCATION (OBE) FOR BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING

PROGRAM SPECIFICATIONS

I. Program Description

1.1 Degree Name

The degree program herein shall be called **BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (BSEE)**.

1.2 Nature of the Field of Study

The fields of specialization may include, among others, the following:

- Power System Operation and Protection
- Power Plant Operation and Maintenance
- Advanced Electrical Systems Design and Inspection
- Sales and Entrepreneurship
- Engineering Education and Research
- Instrumentation and Control Systems
- Construction and Project Management
- Software Development
- Consultancy
- Electricity Market

1.3 Program Educational Objectives (PEOs)

As per CMO 37 s. 2012, program educational objectives (PEOs) are "broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve within two to five years after graduation. " PEOs are based on the needs of the program's constituencies.

Each HEI, SUC and LUC should define a set of PEOs compliant to the definition as provided under CMO 37 s. 2012. **PEOs must be aligned to the mission of the HEI/SUC/LUC offering the BSEE program.**

Sample program educational objective (PEO):

The BSEE program shall produce graduates who:

- *Are fully equipped with the fundamentals of electrical engineering that will allow them to be immediately competitive in industry or in graduate work while providing the best opportunity for achieving their full potential; and*
- *Have developed a strong sense of professional responsibility and social awareness.*

1.4 Specific Professions/Careers/Occupations for Graduates

The graduates of the BSEE program may practice as a/an:
- Construction and Project engineer/ manager
- Power Plant administrator/manager
- Instrumentation and Control Systems engineer
- Power Systems engineer/manager
- Electrical Systems Software developer
- Electrical Design manager/inspector/evaluator/estimator
- Maintenance engineer
- Technopreneur and/or Sales engineer
- Educator and/or Researcher
- Electrical consultant
- Electricity Market trader
- Electrotechnical officer

1.5 Allied Programs

The following programs may be considered as allied to Electrical Engineering:
- Computer Engineering
- Electronics Engineering
- Computer Science
- Information Technology
- Mechanical Engineering
- Industrial Engineering
- Audio Engineering
- Chemical Engineering
- Marine Engineering

II. Student/Program Outcomes

As per CMO 37 s. 2008, student/program outcomes specify what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that the students have acquired and developed as they go through the program.

The minimum standards for the **BS Electrical Engineering** program are expressed in the following minimum set of student/program outcomes.

2.1 Common to all programs in all types of schools

The graduates should have developed the ability to:

a) Articulate and discuss the latest developments in the specific field of practice ***(PQF level 6 descriptor)*****;**

b) Effectively communicate orally and in writing;

c) Work effectively and independently in multi-disciplinary and multi-cultural teams ***(PQF level 6 descriptor);***

d) Act in recognition of professional, social, and ethical responsibilities; and

e) Preserve and promote "*Filipino historical and cultural heritage*" **(based on RA 7722).**

2.2 Common to Engineering

Engineering graduates should have developed the ability to:

f) Apply knowledge of mathematics and sciences to solve engineering problems;
g) design and conduct experiments, as well as to analyze and interpret data;
h) design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability, in accordance with standards;
i) identify, formulate and solve engineering problems;
j) understand the impact of engineering solutions in a global, economic, environmental, and societal context;
k) recognize the need for and engage in life-long learning;
l) apply techniques, skills, and modern engineering tools necessary for engineering practice; and
m) know and understand engineering and management principles as a member and/or leader in a team to manage projects in multidisciplinary environments

2.3 Specific to Electrical Engineering

A BSEE graduate should have developed the ability to:

n) assess and evaluate power systems operations under normal and abnormal conditions; and
o) analyze the operating principles related to power generation from non-conventional sources of energy

2.4 Common to a horizontal type as defined in CMO 46 s 2012

1) ***Graduates of professional institutions*** should be able to demonstrate a service orientation in one's profession

2) ***Graduates of colleges*** should be able to participate in various types of employment, development activities and public discourses, particularly in response to the needs of the communities one serves

3) ***Graduates of universities*** should be able to participate in the generation of new knowledge or in research and development projects

Graduates of State Universities and Colleges must, in addition, have the competencies to support "national, regional and local development plans." (RA 7722)

A PHEI, at its option, may adopt mission-related program outcomes that are not included in the minimum set as specified above.

III. Sample Performance Indicators

Performance Indicators are specific, measurable statements identifying the performance(s) required to meet the outcome; confirmable through evidence(s).

Student/program Outcomes Specific to Electrical Engineering	Sample Performance Indicators
[n] assess and evaluate power systems operations under normal and abnormal conditions	1. Assess and evaluate various aspects of power systems operations under normal conditions 2. Assess and evaluate the effects of various fault conditions on power systems operations
[o] analyze the operating principles related to power generation from non-conventional sources of energy	1. Discuss the operating principles of non-conventional sources of energy for power generation 2. Differentiate various non-conventional sources of energy in terms of advantages and disadvantages 3. Analyze the performance and effects of various types of non-conventional sources of energy

The student/program outcomes from (a) to (o) set the minimum requirements for a graduate of the BSEE program. PHEIs/LUCs/SUCs may add additional outcomes as necessary and appropriate.

CURRICULUM

I. Curriculum Description

The curriculum has a minimum total of 221 credit units, comprising of 168 units of technical courses.

The technical courses include 26 units of mathematics, 12 units of natural/physical sciences, 21 units of basic engineering sciences, 44 units of allied courses, 53 units of professional courses, and 12 units of technical electives.

The general education - B courses are in accordance with the requirements of the CHED Memorandum Order No. 59, s. 1996- The New General Education Curriculum (GEC-B), which consists of 12 units of social sciences, 9 units of humanities, 15 units of languages,

3 units of life and works of Rizal, 8 units of physical education, and 6 units of National Service Training Program (NSTP).

II. Sample Curriculum

The BSEE curriculum is designed to develop engineers who have a background in mathematics, natural, physical and allied sciences. As such, the curriculum contains courses in mathematics, science and engineering fundamentals with emphasis on the development of analytical and creative abilities. It also contains language courses, social sciences and humanities. This is to ensure that the electrical engineering graduate is articulate and is able to understand the nature of his/her special role in society and the impact of his or her work on the progress of civilization.

The curriculum is designed to guarantee a certain breadth of knowledge of the Electrical Engineering discipline through a set of core courses. It ensures depth and focus in certain disciplines through areas of specialization. It provides a recommended track of electives that HEIs may adopt or develop. The curriculum develops the basic engineering tools necessary to solve problems in the field of Electrical Engineering. This enables the graduate to achieve success in a wide range of career opportunities.

Institutional electives are prescribed in order to give a certain degree of specialization so that institutions of learning will develop strengths in areas where they already have a certain degree of expertise.

Emphasis is given to the basic concepts. Previously identified courses are strengthened to take into account new developments. New courses and/or topics are introduced so that the student's knowledge of the fundamentals may be enhanced. This is to allow the student to achieve a degree of knowledge compatible with international standards.

BSEE Curriculum Outline

Classification/ Field / Course	Minimum No. of Hours/Week		Minimum Credit Units
	Lecture	Laboratory	
I. TECHNICAL COURSES			
A. Mathematics			
College Algebra	3	0	3
Advanced Algebra	2	0	2
Plane and Spherical Trigonometry	3	0	3
Analytic Geometry	2	0	2
Solid Mensuration	2	0	2
Differential Calculus	4	0	4
Integral Calculus	4	0	4
Differential Equations	3	0	3
Probability and Statistics	3	0	3
Sub – Total	**26**	**0**	**26**

B Physical Sciences			
General Chemistry	3	3	4
Physics 1	3	3	4
Physics 2	3	3	4
Sub – Total	**9**	**9**	**12**
Classification/ Field / Course	**Minimum No. of Hours/Week**		**Minimum Credit Units**
	Lecture	**Laboratory**	
C. Basic Engineering Sciences			
Engineering Drawing	0	3	1
Computer Aided Drafting	0	3	1
Computer Fundamentals and Programming	0	6	2
Statics of Rigid Bodies	3	0	3
Dynamics of Rigid Bodies	2	0	2
Mechanics of Deformable Bodies	3	0	3
Engineering Economy	3	0	3
Engineering Management	3	0	3
Environmental Engineering	2	0	2
Safety Management	1	0	1
Sub - Total	**17**	**12**	**21**
D. Allied Courses			
Advanced Engineering Mathematics for EE	3	0	3
Numerical Methods with Computer Application	2	3	3
Basic Thermodynamics	3	0	3
Fundamentals of Material Science and Engineering	3	0	3
Electronic Circuits and Devices	2	3	3
Electronic Circuits Analysis and Design	2	3	3
Industrial Electronics	3	3	4
Electromagnetics	3	0	3
Mechanics of Fluid	2	0	2
Principles of Communications	3	3	4
Logic Circuits and Switching Theory	3	3	4
Microprocessor System	2	3	3
Control Systems Analysis	3	0	3
Information Technology	2	3	3
Sub - Total	**36**	**24**	**44**
E. Professional Courses			
1. Core Courses			
EE Laws, Contracts, and Ethics	2	0	2
Electrical Circuits 1	3	3	4
Electrical Circuits 2	3	3	4
Electrical Circuits 3	2	3	3
DC Machinery	2	3	3
AC Machinery	3	3	4
AC Apparatus and Devices	2	3	3
Research Methods for EE	1	0	1
Electrical Transmission and Distribution System	3	3	4

Illumination Engineering Design	2	3	3
Electrical System Design	2	3	3
Electrical Equipment: Operation and Maintenance	3	0	3
Electrical Engineering Safety	1	0	1
Classification/ Field / Course	**Minimum No. of Hours/Week**		**Minimum Credit Units**
	Lecture	**Laboratory**	
Power System Analysis and Design	3	3	4
Power Plant Engineering	2	3	3
Research Project	0	3	1
On-the Job Training	0	240	3
Instrumentation and Control	2	3	3
Seminars and Field Trips	1	0	1
Sub-total	**37**	**279**	**53**
2. Technical Electives			
EE Elective 1 (Track)	3	0	3
EE Elective 2 (Track)	3	0	3
EE Elective 3 (Track)	3	0	3
EE Elective 4 (Track)	3	0	3
Sub-total	**12**	**0**	**12**
II. NON - TECHNICAL COURSES			
A. Social Sciences			
Social Science 1	3	0	3
Social Science 2	3	0	3
Social Science 3	3	0	3
Social Science 4	3	0	3
Sub-total	**12**	**0**	**12**
B. Humanities			
Humanities 1	3	0	3
Humanities 2	3	0	3
Humanities 3	3	0	3
Sub-total	**9**	**0**	**9**
English 1	3	0	3
English 2	3	0	3
English 3 (Technical Communications)	3	0	3
Pilipino 1	3	0	3
Pilipino 2	3	0	3
Sub-total	**15**	**0**	**15**
D. Mandated Course			
Rizal's Life, Works and Writings	3	0	3
Sub-total	**3**	**0**	**3**
E. Physical Education			
P.E. 1			2
P.E. 2			2
P.E. 3			2
P.E. 4			2
Sub-total			**8**
F. National Service Training Program			

NSTP 1			3
NSTP 2			3
Sub-total			**6**
GRAND TOTAL	**176**	**84**	**221**

Suggested Track Elective Courses

- **Power System Operation**
  - Power System Operation Planning
  - Power System Operation and Control
  - Power System Dynamics and Stability
  - Power System Market Operation

- **Power System Protection**
  - Protection of Generators, Transformers, Bus-bars and Lines
  - Protective Relaying
  - Surge Protection in Power System
  - High Voltage Insulation Engineering

- **Power System Economics**
  - Power System Planning
  - Power System Reliability
  - Economic Operation of Power System
  - Power Quality & Demand Side Management (DSM)

- **Advanced Power System Design**
  - Distribution Design
  - Transmission Design
  - CAD in Power System Analysis & Design
  - Systems Protection Design

- **Advanced Electrical Systems Design**
  - Illumination Design
  - High Rise Building Design
  - Substation Design
  - High-Voltage Underground Cable Design (AC/DC Systems)

- **Entrepreneurship**
  - Project Management
  - Project Acceptance, Testing & Documentation
  - Total Quality Management
  - Sales and Marketing Management

- **Machine Automation and Process Control**
  - Pneumatics & Process Control
  - Electropneumatics
  - Programmable Logic Controllers in Manufacturing
  - Variable Frequency Drives for Speed Control

- **Special Studies in Renewable Energy Resources**
  - Solar Energy

- Wave / Ocean Energy
- Wind Energy
- Biomass Energy

**Note: The school may adopt and develop course specification for each course.*

SUMMARY OF THE BSEE CURRICULUM

Classification/ Field	Total no. of Hours		Total No. of Units
	Lecture	Laboratory	
I. Technical Courses			
A. Mathematics	26	0	26
B. Natural Sciences	9	9	12
C. Basic Engineering Sciences	17	12	21
D. Allied Courses	36	24	44
E. Professional Courses	37	39	53
F. Electives	12	0	12
TOTAL (TECHNICAL)	**137**	**324**	**168**
II. Non-Technical Courses			
A. Social Sciences	12	0	12
B. Humanities	9	0	9
C. Language	15	0	15
D. Mandated Course	3	0	3
Physical Education			**8**
NSTP			**6**
TOTAL (NON-TECHNICAL)			**53**
GRAND TOTAL	**176**	**324**	**221**

III. Curriculum Map

As per CMO 37 s. 2012, curriculum map is “a matrix relating all the courses listed in the program curriculum with one or more of the declared student/program outcomes.”

The HEIs/LUCs/SUCs shall create a complete curriculum map for their current or existing BSEE curriculum. Refer to Annex I for a sample curriculum map that relates all the courses in the sample curriculum with the minimum set of student/program outcomes.

IV. Sample Means of Curriculum Delivery

Institutions may enrich the sample/model program of study depending on the needs of the industry, provided that all prescribed courses required in the curriculum outline are offered and pre-requisites are complied with.

FIRST YEAR

First Year - First Semester

Subjects	No. of Hours		Total units	Pre-Requisite
	Lec	Lab		
College Algebra	3	0	3	none
Plane and Spherical Trigonometry	3	0	3	None
General Chemistry	3	3	4	None
Engineering Drawing	0	3	1	None
Pilipino 1	3	0	3	None
English 1	3	0	3	None
Social Science 1	3	0	3	None
PE 1	2	0	2	
SUB-TOTAL	**20**	**6**	**22**	

First Year - Second Semester

Subjects	No. of Hours		Total Units	Pre-Requisite
	Lec	Lab		
Advanced Algebra	2	0	2	College Algebra,
Analytic Geometry	2	0	2	College Algebra, Plane and Spherical Trigonometry
Solid Mensuration	2	0	2	College Algebra, Plane and Spherical Trigonometry
Pilipino 2	3	0	3	
English 2	3	0	3	
Social Science 2	3	0	3	
Humanities 1	3	0	3	
PE 2	2	0	2	
SUB-TOTAL	**20**	**0**	**20**	

SECOND YEAR

Second Year - First Semester

Subjects	No. of Hours		Total Units	Prerequisite
	Lec	Lab		
Differential Calculus	4	0	4	Analytic Geometry, Solid Mensuration, Advanced Algebra
Physics 1	3	3	4	College Algebra, Plane and Spherical Trigonometry
English 3 Technical Communication	3	0	3	
Social Science 3	3	0	3	
Humanities 2	3	0	3	
Rizal Life, Works and Writing	3	0	3	
PE 3	2	0	2	
NSTP 1	3	0	3	
SUB-TOTAL	**24**	**3**	**25**	

Second Year - Second Semester

Subjects	No. of Hours		Total Units	Prerequisite
	Lec	Lab		
Integral Calculus	4	0	4	Differential Calculus
Physics 2	3	3	4	Physics 1
Humanities 3	3	0	3	
Social Science 4	3	0	3	
Probability & Statistics	3	0	3	College Algebra
PE 4	2	0	2	
NSTP 2	3	0	3	
Computer Fundamentals & Programming	0	6	2	Second Year Standing
SUB-TOTAL	**21**	**9**	**24**	

THIRD YEAR

Third Year - First Semester

Subjects	No. of Hours		Total Units	Pre-Requisite
	Lec	Lab		
Computer Aided - Drafting	0	3	1	Third Year Standing
Differential Equation	3	0	3	Integral Calculus
Fundamentals of Materials Science and Engineering	3	0	3	General Chemistry, Physics 2
Statics of Rigid Bodies	3	0	3	Physics 1, Integral Calculus
Electromagnetics	3	0	3	Physics 2, Integral calculus
Electrical Circuits I	3	3	4	Physics 2, Integral Calculus
Electronic Circuits and Devices	2	3	3	Physics 2, Integral Calculus
Engineering Economy	3	0	3	Third Year Standing
SUB-TOTAL	**20**	**9**	**23**	

Third Year - Second Semester

Subjects	No. of Hours		Total Units	Pre-Requisite
	Lec	Lab		
Advanced Engineering Mathematics for EE	3	0	3	Differential Equation
Dynamics of Rigid Bodies	2	0	2	Statics of Rigid Bodies
Environmental Engineering	2	0	2	General Chemistry
Mechanics of Deformable Bodies	3	0	3	Statics of Rigid Bodies
Electronic Circuits Analysis and Design	2	3	3	Electronic Circuits and Devices
Basic Thermodynamics	3	0	3	Integral Calculus, Physics 2
Electrical Circuits 2	3	3	4	Electrical Circuits 1

Safety Management	1	0	1	Third Year Standing
SUB-TOTAL	**19**	**6**	**21**	

FOURTH YEAR

Fourth Year - First Semester

Subjects	Minimum Hours			Pre-Requisite
	Lec	Lab	Units	
Logic Circuit and Switching Theory	3	3	4	Electronic Circuits Analysis and Design
DC Machinery	2	3	3	Electrical Circuits 2
Principles of Communication	3	3	4	Electronic Circuits Analysis and Design, Advanced Eng'g Math for EE
Control System Analysis	3	0	3	Advanced Eng'g Math for EE
Electrical Circuits 3	2	3	3	Electrical Circuits 2
Mechanics of Fluid	2	0	2	Mechanics of Deformable Bodies
Numerical Methods with Computer Application	2	3	3	Advanced Eng'g Math for EE
SUB-TOTAL	**17**	**15**	**22**	

Fourth Year - Second Semester

Subjects	No. of Hours		Units	Pre-Requisite
	Lec	Lab		
Microprocessor System	2	3	3	Logic Circuit and Switching Theory
AC Machinery	3	3	4	DC Machinery, Electrical Circuits 3
Industrial Electronics	3	3	4	Electronic Circuits Analysis and Design
Professional Elective 1	3	0	3	Fourth year standing
EE Laws, Contract and Ethics	2	0	2	Fourth year standing
AC Apparatus and Devices	2	3	3	co- requisite-AC machinery
Research Methods for EE	1	0	1	Fourth year standing

SUB-TOTAL	**16**	**12**	**20**	

SUMMER

OJT			**3**	

FIFTH YEAR

Fifth Year - First Semester

Subjects	No. of Hours		Total Units	Pre-Requisite
	Lec	Lab		
Instrumentation and Control	2	**3**	3	Industrial Electronics
Electrical Transmission & Distribution system	3	3	4	AC Machinery, Electrical Circuits 3
Information Technology	2	3	3	Principle of Communication
Professional Elective 2	3	0	3	
Illumination Engineering Design	2	3	3	Co-requisite-Electrical System Design
Electrical System Design	2	3	3	AC Apparatus and Devices
Research Project	0	3	1	Research Methods for EE
SUB-TOTAL	**14**	**18**	**20**	

Fifth Year - Second Semester

Subjects	No. of Hours		Total Units	Pre-Requisite
	Lec	Lab		
Electrical Equipment Operation & Maintenance	3	0	3	AC Apparatus and Devices
Power Plant Engineering	2	3	3	Co-requisite-Power System Analysis & Design
Seminars and Field Trips	1	0	1	Fifth year standing
Professional Elective 3	3	0	3	
Professional Elective 4	3	0	3	
EE Safety	1	0	1	Safety Management
Power System Analysis & Design	3	3	4	Electrical System Design

Engineering Management	3	0	3	Third Year Standing
SUB-TOTAL	**18**	**9**	**21**	
GRAND TOTAL	**176**	**84**	**221**	

Thesis/Research/Project – shall focus on any of the following areas:

1. Alternative Energy Resources
2. Innovative Electrical Equipment Design
3. Development of software for Electrical Circuit Analysis and Design, Power System Analysis and Design, Illumination Engineering Design
4. Design of means of transportation using electricity
5. Development of low-cost sustainable eco-materials for electrical installations
6. Other projects related to the practice of the Electrical Engineering profession

On-the-job-training / practicum – shall require a minimum of 240 hours. At the discretion of the HEIs, OJT may be substituted with student projects that will enhance, modernize, and elevate the level of effectiveness and relevance of electrical engineering education.

V. Sample OBE-Compliant Course Syllabus

The teaching and learning activities and assessment tasks should be constructively aligned toward the attainment of the course outcomes. Course outcome refers to what learners are expected to know and be able to do at end of the course. Teaching and learning activity refers to an activity or set of activities that will engage the student in achieving the course outcome. Assessment task refers to a tool that determines how well the student has met the course outcome.

The OBE-compliant course syllabus should contain at least the following components:

1. General course information (title, description, credit units, prerequisite requirements)
2. Course outcomes and their relationship to the student/program outcomes
3. Course coverage that relates the course outcomes to topics covered, teaching and learning activities and assessment methods
4. Other information such as learning resources, classroom policies, grading system, etc.

Refer to Annex -II for a sample OBE-compliant course syllabus.

ANNEX I - Sample Curriculum Mapping

The graduates of the BSEE program should have developed the ability to:

a) Articulate and discuss the latest developments in the specific field of practice ***(PQF level 6 descriptor)*****;**
b) Effectively communicate orally and in writing;
c) Work effectively and independently in multi-disciplinary and multi-cultural teams ***(PQF level 6 descriptor);***
d) Act in recognition of professional, social, and ethical responsibilities;
e) Preserve and promote "*Filipino historical and cultural heritage*" **(based on RA 7722);**
f) Apply knowledge of mathematics and sciences to solve engineering problems;
g) Design and conduct experiments, as well as to analyze and interpret data;
h) Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability, in accordance with standards;
i) Identify, formulate and solve engineering problems;
j) Understand the impact of engineering solutions in a global, economic, environmental, and societal context;
k) Recognize the need for and engage in life-long learning;
l) Apply techniques, skills, and modern engineering tools necessary for engineering practice;
m) Know and understand engineering and management principles as a member and/or leader in a team to manage projects in multidisciplinary environments;
n) Assess and evaluate power systems operations under normal and abnormal conditions; and
o) analyze the operating principles related to power generation from non-conventional sources of energy

Key: I – Introductory E – Enabling D – Demonstrated

Courses	**Student/program outcomes**														
Mathematics	**a**	**b**	**c**	**D**	**e**	**F**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
College algebra		I				I			I						
Advanced Algebra		I				I			I						
Plane and Spherical Trigonometry		I				I			I						
Analytic Geometry		I				I			I						
Solid Mensuration		I				I			I						
Differential Calculus		I				I			I						
Integral Calculus		I				I			I						
Differential Equations		I				E		I	I						
Probability and Statistics		I	I			E		I	I			I	I		

Physical Sciences															
General Chemistry		I		I		I	I		I						
Physics 1		I				I	I		I						
Physics 2		I				E	E		I						
Basic Engineering Sciences															
Engineering Drawing		I													
Computer Aided Drafting	I	E	I					I	I			E	I		
Computer Fundamentals and Programming	I	I						I							
Statics of Rigid Bodies		I	I			E									
Dynamics of Rigid Bodies		I	I			E									
Mechanics of Deformable Bodies		I	I			E									
Engineering Economy		E	I	I		E		I		I			I		
Engineering Management		E	I	I									D		
Environmental Engineering	I	E	I	I				I	I	E	I		I		E
Safety Management		I	I					I					D	I	E
Allied Courses															
Advanced Engineering Mathematics for EE		E				E		I	E					I	
Numerical Methods with Computer Application	I	E				E		I	E			E		I	
Basic Thermodynamics		E	I			E									I
Fundamentals of Material Science and Engineering	I	E	I	I		E		I	I	E			I		E
Electronic Circuits and Devices		E	I			E	D	I	I						
Electronic Circuits		E	I			D		I	E						

Analysis and Design															
Industrial Electronics		E	I			E	D	I	E						I
Electromagnetics		E	I			E		I	I						I
Mechanics of Fluid		I	I			E									
Principles of Communications		I	I			E									
Logic Circuits and Switching Theory		I	I			E	D	I	I						
Microprocessor System	I	E	I			E		I	E	I		I	I		I
Control Systems Analysis	I	E	I			E		I	E	I		I	I		I
Information Technology		I	I									I	I		I
Professional Courses															
EE Laws, Contracts, and Ethics		E		D	I			I					I	I	I
Electrical Circuits 1		E				D	D	I	I			I			
Electrical Circuits 2		E				D	D	I	E			E		I	
Electrical Circuits 3		E				D	D	I	E			E		I	
DC Machinery		E				D	D	I	E			E	I	I	
AC Machinery		E				D	D	I	E			E	I	I	
AC Apparatus and Devices		E				D	D	I	E			I	I	I	
Research Methods for EE		E	I	E				I	I	I	I	E	E	E	E
Electrical Transmission and Distribution System	I	E		E	I	D		E	E	I	I	E	D	D	E
Illumination Engineering Design	I	E	I	E		D		E	E	I	I	E	E	E	E
Electrical System Design	I	E		D		D		D	D	I	I	E	D	E	E
Electrical Equipment: Operation and Maintenance	I	E		E		E	D	I	E	I		E	I	D	I
Electrical Engineering		E		E				I	I				E	D	D

Safety															
Power System Analysis and Design	I	E		D		D		E	E	I		E	E	D	E
Power Plant Engineering	I	E	I	E		E		I	I	I			E	E	D
Research Project	I	E	I	D	I	I	D	E	E	I	E	D	D	E	E
On-the Job Training		D	E	D		I		I	I	I	I	E	E	I	I
Instrumentation and Control	I	E	I	I		I	D	I	I	I		I	I	I	I
Seminars and Field Trips	I	E		D				I	I	I	I		I	I	I
Elective 1	I	E	I	E		E		E	E	I	I	E	I	E	E
Elective 2	I	E	I	E		E		E	E	I	I	E	I	E	E
Elective 3	I	E	I	E		E		E	E	I	I	E	I	E	E
Elective 4	I	E	I	E		E		E	E	I	I	E	I	E	E
Non-Technical Courses															
Social Science 1, 2, 3, 4		E		I	I										
Humanities 1, 2, 3		E		I	I										
English 1, 2		E													
English 3 (Technical Communications)		D													
Pilipino 1, 2		E			E										
Rizal's Life, Works and Writing		E			D										
Physical Education		I													
NSTP		I													

Annex II - Sample Outcomes-based Syllabus

Course Title: **ELECTRICAL CIRCUITS 3**

Pre-requisite: Electrical Circuits 2

Co-requisite: Electrical Circuits 3 Lab

Credit: 3 units

Course Description: The course covers the study of three-phase systems with balanced and unbalanced loading conditions; symmetrical components, analysis of two-port networks and of magnetically-coupled circuits.

Course Outcomes and Relationship to Program Outcomes:

Course Outcomes	Program Outcomes														
After completion of the course, the student should be able to:	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO 1 - apply per phase analysis in the solution of problems involving three-phase systems with balanced and unbalanced loading conditions		**E**				**D**			**I**			**I**		**I**	
CO 2 - determine and use symmetrical components in the analysis of faulted three-phase power systems		**E**				**E**			**I**	**I**		**I**		**I**	
CO 3 – determine and interpret the characteristics and linear response of passive two-port networks		**E**				**E**			**I**			**I**			
CO 4 – obtain and interpret the linear response of circuits containing magnetically-coupled coils		**E**				**E**			**I**	**I**		**I**		**I**	

Course Coverage:

Course outcomes	Intended learning outcomes	Topic	Teaching and learning activities	Assessment tasks
		Orientation; discussion of course outcomes and how they are related to the program outcomes; discussion of teaching/learning activities, assessment methods; course policies, grading system		
CO 1	Explain voltage relations and current relations in balanced 3-phase systems	Generation of three-phase voltages; advantages of 3-phase systems; voltage relations and current relations in balanced 3-phase systems	Lecture; class discussion	Recitation
	Solve balanced 3-phase system problems using per phase analysis	Power calculations in 3-phase systems; power factor correction; multiple 3-phase loading; two or more 3-phase sources; systems with considerable line impedances	Lecture; class discussion; seatwork; homework	Quiz
	Determine linear responses of balanced 3-phase systems using computer-aided circuit analysis	Computer simulation of 3-phase systems with balanced loading	Lecture; class discussion; computer simulation	Interpretation of the output from computer simulation
	Analyse the behaviour of 3-phase systems with unbalanced loading conditions	Analysis of 3-phase systems with single-phase loading, with and without balanced 3-phase loading	Lecture; class discussion; seatwork	Quiz
CO 2	Understand the concept of per unit system and perform per unit calculations	Per unit quantities and per unit calculations	Lecture; class discussion; seatwork	Recitation; seatwork
	Obtain the symmetrical components of 3-phase unbalanced phasors	Symmetrical components	Lecture; class discussion; seatwork	Seatwork
	Apply the concept of symmetrical components in solving faulted power system problems	Three-phase faults; shunt faults in 3-phase systems	Lecture; class discussion	Quiz

CO 3	Understand the concept of two-port networks	Two-port networks, examples; network parameters; network responses	Lecture; class discussion	Recitation
	Determine linear responses from a driven passive two-port network with and without a "load"	Determination of network parameters and network responses; interconnected two-port networks	Lecture; class discussion; seatwork	Quiz
	Differentiate passive two-port networks from those with internal sources	Defining equations and network responses	Lecture; class discussion; seatwork	Recitation; seatwork
CO 4	Analyse the behaviour of circuits containing magnetically-coupled coils	Concept of mutual inductance and magnetic coupling; self- and mutually-induced voltages; analysis of circuits with coupled coils	Lecture; class discussion; seatwork	Quiz
	Understand the concept of a linear and an ideal transformer	The linear transformer; the ideal transformer; defining equations	Lecture; class discussion	Recitation
	Determine accessible responses using computer-aided circuit analysis for circuits with magnetically-coupled coils	Computer-aided analysis of circuits with coupled coils	Lecture; class discussion; computer simulation	Interpretation of computer simulation
		Overall assessment of student performance		Final exam

Textbook:

Fundamentals of Electric Circuits, C. K. Alexander & M. N. O. Sadiku, McGraw Hill, 3rd ed., 2007.

Course Assessment:

1. As per standard grading system, thoroughly discussed during the orientation meeting;

2. Aside from academic deficiency, other grounds for a failing grade are:
   - Grave misconduct and /or cheating during examinations
   - Unexcused absences of more than 20% of required number of meetings per term
   - A failing academic standing and failure to take the final exam

Suggested References:

a. ***Introduction to Electric Circuits (7th ed.)*** by Dorf and Svoboda, 2006
b. ***Basic Electricity (2nd ed.)*** by Milton Gussow, 2007
c. ***Introduction to PSPice using CAD for Circuits and Electronics*** by M. H. Rashid, 2004
d. ***Engineering Circuit Analysis*** by W. Hayt, Jr, et.al, McGraw Hill, 7th ed., 2007
e. ***Electric Circuits*** by Nilsson and Riedel, Pearson Prentice Hall, 7th ed., 2005

f. ***Elements of Power System Analysis*** by Stevenson
g. ***Analysis of Faulted Power System*** by Anderson

Committee Members:

Cesar C. Coronado - Chairman
Ronaldo C. Cabuang
Esperanza E. Chua

Reviewed by: **Approved by:**

_____ _____
Program Chair Dean

Date of revision: _____ **Date of effectivity:** _____

Sample Course Outcomes Assessment and Evaluation

Course outcomes	Intended learning outcomes	Assessment tasks	Performance target	Evaluation	Recommendation
CO 1	Explain voltage relations and current relations in balanced 3-phase systems	Recitation	70% will get passing grade		
	Solve balanced 3-phase system problems using per phase analysis	Quiz	70% will get passing grade		
	Determine required responses of balanced 3-phase systems using computer-aided circuit analysis	Interpretation of computer simulation	70% will get passing grade		
	Analyse the behaviour of 3-phase systems with unbalanced loading conditions	Quiz	70% will get passing grade		
CO 2	Understand the concept of per unit system and perform per unit calculations	Recitation; seatwork	60% will get passing grade		
	Obtain the symmetrical components of 3-phase unbalanced phasors	Seatwork	60% will get passing grade		
	Apply the concept of symmetrical components in solving faulted power system problems	Quiz	60% will get passing grade		

CO 3	Understand the concept of two-port networks	Recitation	60% will get passing grade		
	Determine required results from two-port network analysis	Quiz	60% will get passing grade		
	Differentiate passive two-port networks from those with internal sources	Recitation	60% will get passing grade		
CO 4	Analyse the behaviour of circuits containing magnetically-coupled coils	Quiz	60% will get passing grade		
	Understand the concept of a linear and an ideal transformer	Recitation	60% will get passing grade		
	Determine required responses using computer-aided circuit analysis for circuits with magnetically-coupled coils	Interpretation of computer simulation	60% will get passing grade		
		Final exam	60% will get passing grade		

Sample Program Assessment and Evaluation

Program Outcomes		Performance Indicators	Key Courses	Assessment Tools
[m]	assess and evaluate power systems operations under normal and abnormal conditions	1. Assess and evaluate various aspects of power systems operations under normal conditions	Power Systems Analysis	Manual calculations; hands-on exercises; computer simulation
		2. Assess and evaluate the effects on power systems operations of various fault conditions that may occur	Power Systems Analysis	Manual calculations; hands-on exercises; computer simulation
[n]	apply and analyze operating principles	1. Discuss the operating principles of non-conventional sources of energy	Power plant engineering;	Technical report; oral

	related to power generation from non-conventional sources of energy	for power generation	seminars and field trips	presentation
		2. Apply appropriate principles to distinguish the advantages and disadvantages of various non-conventional sources of energy	Power plant engineering; seminars and field trips	Technical report; hands-on exercises; oral presentation
		3. Analyze the performance and effects of various types of non-conventional sources of energy	Power plant engineering; seminars and field trips	Technical report; hands-on exercises; oral presentation