Note: Any section shaded blue **must** be completed for Engineering related courses **in addition** to the other sections

CURRICULUM COMMITTEE TEMPLATE
NEW COURSE PROPOSAL FORM

Faculty: Indicate all relevant Faculty(ies) i.e. LAPS/SC/LE	LE

Department: Indicate department and course prefix (e.g. Languages, GER)	EECS	**Date of Submission:**	Mar 31, 2015

Course Number: Special Topics courses Include variance (e.g. HUMA 3000C 6.0, Variance is "C")	EECS4613	**Var:**		**Academic Credit Weight:** Indicate both the fee, and MET weight if different from academic weight (e.g. AC=6, FEE=8, MET=6)	4

Accreditation Unit Breakdown:

Indicate the proposed accreditation unit breakdown as a percentage and unit(s) in the appropriate subject matter areas. Definitions are provided in Appendix A

	Math	Natural Science	Compl Studies	Eng. Science	Eng. Design
Percentage				50%	50%
Units (**54 AUs**)				27	27
If the sum of engineering science and engineering design exceeds 50% of the total, indicate which P.Eng. faculty could be possible instructors for this course:					

Course Title: The official name of the course as it will appear in the Undergraduate Calendar and on the Repository	Power Electronics

Short Title: Appears on any documents where space is limited - e.g. transcripts and lecture schedules - **maximum 40 characters**	Power Electronics

Brief Course Description: ***Maximum 300 words or 2000 characters.*** The course description should be carefully written to convey what the course is about. It should be followed by a statement of prerequisites and co-requisites, if applicable. This description appears in the calendar. For editorial consistency, and in consideration of the various uses of the Calendars, verbs should be in the present tense (i.e., "This course analyzes the nature and extent of...," rather than "This course will analyze...")	**The objective of this course is to understand the basic operating principles of the power conversion using advanced electronic devices. The structure and characteristics of switching devices are reviewed. Basic power converters such as AC/DC rectifiers, DC/DC converters and DC/AC inverters are studied. Computation of circuit quantities such as average and RMS value, power, power factor and harmonics are also studied.**
Prerequisites:	***LE/ENG2210***
Co-requisites:	

Will this course be cross-listed? (Yes/No) [ ] **If *yes*, cross-listed to:** *(please complete details below)*

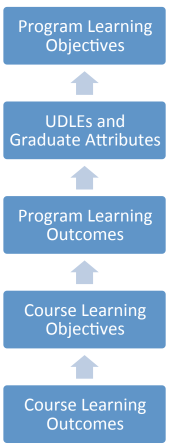
Faculty:		**Rubric:**		**Course #:**		**Weight:**	
Faculty:		**Rubric:**		**Course #:**		**Weight:**	
Faculty:		**Rubric:**		**Course #:**		**Weight:**	

Additional cross-listings (if applicable):

Generic Course Description: This is the description of the "Parent/Generic course" for Special Topics courses under which variances of the "Generic" course can be offered in different years (Max. 40 words). Generic course descriptions are published in the calendar. Please list all degree credit exclusions, prerequisites, integrated courses, and notes below the course description (these will be in addition to the 40 word brief course description).	

Expanded Course Description:

Please provide a detailed course description, including topics/theories and learning objectives, as it will appear in supplemental calendars.



Expanded Description including topics and theories:

Please include the following as part of your submission, as appropriate:

- details of how engineering design (if any) will be included in the course
- a detailed schedule of topics, especially as they relate to engineering science and engineering design content
- a description of the laboratory experience and computer experience included in the course

This course focuses on the basic operating principles of the power conversion using advanced electronic devices. The structure and characteristics of switching devices are reviewed. Basic converters such as AC/DC rectifiers, DC/DC switching converters and DC/AC inverters are studied. Resonant power converters and inverters are introduced. The course includes a mandatory lab that analyzes the operating principles of the basic power converters and inverters. The topics covered in the course will be selected from the following list.

List of Topics

1. Introduction to power electronics
2. Power semiconductor switches
3. Uncontrolled diode rectifiers
4. Three-phase diode rectifiers
5. Controlled rectifiers
6. Basic DC/DC converters (Continuous mode, boundary conduction mode, discontinuous mode)
7. Isolated DC/DC converters
8. Single-phase DC/DC inverters
9. Resonant DC/AC inverters
10. Resonant DC/DC converters

Course Learning Objectives: Course learning objectives are statements of the overall learning and teaching intentions for the course and represent what the instructor would expect students to learn and retain in the course. They articulate what the teacher plans to achieve in the course.

Learning objectives for the course:

1. To understand the three basic power conversions: AC/DC, DC/DC, DC/AC
2. To analyze basic power electronics converters and inverters.
3. To apply power electronic converters and inverters for different types of power conversion
4. To perform laboratory works using different power electronics modules

Course Design: Indicate how the course design supports students in achieving the learning objectives. For example, in the absence of scheduled contact hours what role does student-to-student and/or student-to-instructor communication play, and how is it encouraged? Please detail any aspects of the content, delivery, or learning goals that involve "face-to-face" communication, non-campus attendance or experiential education components. Alternatively, please explain how the course design encourages student engagement and supports student learning in the absence of substantial on-campus attendance	The course will be conducted using traditional lectures, tutorials and laboratories. To prepare student for future job in power electronics circuit design, the course contains several lab sessions to introduce Cadence design tools. Student will learn how to do schematic entry, simulation, layout, and postl layout simulation under the Cadence environment. Once students are familiar with the tools, they will start a design project that allows them to design an operational amplifier based on circuit building blocks introduced in the classroom. Through the project, student learns how to formulate the problem based on given specification, to make tradel offs based on given constraints, and to achieve the design goals by selecting proper circuit topology.

Course Learning Outcomes: List the course learning outcomes/indicators that will be achieved by the end of this course, and map these to the appropriate CEAB graduate attributes and UDLEs. These course learning outcomes will be assessed and measured in the course for accreditation purposes.	***Please select those Degree Level Expectations that will be addressed in the course*** **Undergraduate Degree Level Expectations** ☐ Depth and breadth of knowledge ☐ Knowledge of methodologies ☐ Application of knowledge ☐ ☐ Awareness of limits of knowledge ☐	***Please select those CEAB Graduate Attributes that will be addressed in the course (see appendix B for definitions)*** **Graduate Attribute** ☐ Knowledge base for Engineering ☐ Problem Analysis ☐ Investigation ☐ Design ☐ Use of Engineering Tools ☐ Individual and Team Work ☐ ☐

	Upon successful completion of this course, student should be able to: 1. Perform small-signal and large-signal analysis for single-stage amplifiers, which include common-source stage with different types of load, source follower, common-gate stage, and cascade stage. 2. Perform large-signal and small-signal analysis for differential amplifiers. 3. Design of current mirrors as bias elements and signal processing components. 4. Determine the frequency response of single-stage amplifiers and differential amplifiers. 5. Analysis the noise performance of single-stage amplifiers. 6. Identify feedback topology used in a given circuit and determine the open-loop and closed-loop gains. 7. Evaluate the performance of an operational amplifier. 8. Design simple operational amplifiers. 9. Perform circuit simulation using computer-aided tools. 10. Draw layout based on given design rules.	☐ ☐ ☐ ☐ Life-Long Learning

Instruction:

1. Planned frequency of offering and number of sections anticipated (every year, alternate years, etc.).

2. Number of department/division members currently competent to teach the course.

3. Instructor(s) likely to teach the course in the coming year.

4. An indication of the number of contact hours (defined in terms of hours, weeks, etc.) involved, in order to indicate whether an effective length of term is being maintained OR in the absence of scheduled contact hours a detailed breakdown of the estimated time students are likely to spend engaged in learning activities required by the course.

Being a required course for the electrical engineering program (EE), one section of the course is to be offered once a year. Since the EE program is being launched in Fall 2013, the course will first be offered in 2016-2017 academic year.

A number of current engineering faculty members including John Lam and Hany Farag are competent to teach the course.

Scheduled contact hours include 3 hours per week for instructor's lectures and 3 hours per week for lab work.

Evaluation:

A detailed percentage breakdown of the basis of evaluation in the proposed course must be provided.

If the course is to be integrated, the additional requirements for graduate students are to be listed.

If the course is amenable to technologically mediated forms of delivery please identify how the integrity of learning evaluation will be maintained. (e.g. will "on-site" examinations be required, etc.)

The weight distribution of the course components is as follows:

Assignments and quizzes: 20%
Labs: 30%
Midterm: 20%
Final exam: 30%

Bibliography:

A READING LIST MUST BE INCLUDED FOR ALL NEW COURSES

The Library has requested that the reading list contain complete bibliographical information, such as full name of author, title, year of publication, etc., and that you distinguish between required and suggested readings. A statement is required from the bibliographer responsible for the discipline to indicate whether resources are adequate to support the course.

<u>Also please list any online resources</u>.

If the course is to be integrated (graduate/ undergraduate), a list of the additional readings to be required of graduate students must be included. If no additional readings are to be required, a rationale should be supplied.

LIBRARY SUPPORT STATEMENT MUST BE INCLUDE

Text book:

"Power Electronics: Converters, Applications, And Design", by Ned. Mohan., John Wiley & Sons, 2002, 3rd Edition

References:

1. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis and Robert G. Meyer "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons Inc., 2009 (5th Edition).
2. Phillip E. Allen and Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford University Press, 2012 (3rd Edition).

Other Resources:

A statement regarding the adequacy of physical resources (equipment, space, etc.) must be appended. If other resources will be required to mount this course, please explain

COURSESWILL NOT BE APPROVED UNLESS IT IS CLEAR THAT ADEQUATE RESOURCES ARE AVAILABLE TO SUPPORT IT.

One of the teaching labs in the new Engineering building will support the course. The EDA tool such as Cadence will be used for labs and projects.

Course Rationale:

The following points should be addressed in the rationale:

- How the course contributes to the educational objectives of the **program/degree/Faculty**.

-The relationship of the proposed course to other existing offerings, particularly in terms of overlap in objectives and/or content. If inter-Faculty overlap exists, some indication of consultation with the Faculty affected should be given.

- The expected enrolment in the course.

The course contributes to the following program outcomes of Electrical Engineering.

1. Be able to use knowledge of basic and engineering sciences to analyze and design complex devices and systems in the field of electrical engineering:
   This is the first course that deals with the CMOS analog circuit design. It covers the small-signal and large-signal analysis techniques to determine the circuit characteristics of basic analog building blocks such as single-stage amplifiers, differential amplifiers, and operational amplifiers. The design aspect is introduced by means of circuit design projects.
2. Be able to formulate and solve Electrical Engineering problems.
   Analog circuits are made by basic building blocks. The course introduces several techniques to divide a complex analog circuit into simple building blocks, then to solve it using formulas developed for basic building blocks. Students learn these skills through many real world examples.
3. Be able to design systems or processes to meet desired specifications in the field of Electrical Engineering.
   Analog circuit design involves trade-offs among many factors such as power, supply voltage, voltage swing, gain, linearity, noise, speed, and input/output impedance. It is important to select a right circuit topology to meet given design specifications. The projects are designed in such a way that student will make design choices based on given specifications.
4. Be able to communicate about engineering issues and projects in a variety of written and oral formats used by practicing professionals in Electrical Engineering.
   Each biweekly lab project is submitted for assessment in the form of a technical report.

Faculty and Department/ Division Approval for Cross-listings:

If the course is to be cross-listed with another department/division this section needs to be signed by all parties. In some cases there may be more than two signatures required (i.e. Mathematics, Women's Studies). In the majority of cases either the Undergraduate Director or Chair of a unit approves the agreement to cross-list. All relevant signatures must be obtained prior to submission to the Faculty curriculum committee.

Dept.: ______________________________ ______________ __________
Signature (Authorizing cross-list) Department Date

Dept.: ______________________________ ______________ __________
Signature (Authorizing cross-list) Department Date

Dept.: ______________________________ ______________ __________
Signature (Authorizing cross-list) Department Date

APPENDIX A: Accreditation Units

Accreditation Units (AUs) are defined on an hourly basis for an activity which is granted academic credit and for which the associated number of hours corresponds to the actual contact time between the student and the faculty members, or designated alternates, responsible for delivering the program:

1 AU	=	One hour of lecture (corresponding to 50 minutes of activity)
0.5 AU	=	One hour of laboratory or scheduled tutorial

Engineering design integrates mathematics, basic sciences, engineering sciences and complementary studies in developing elements, systems and processes to meet specific needs. It is a creative, iterative and often open-ended process subject to constraints which may be governed by standards or legislation to varying degrees depending upon the discipline. These constraints may relate to economic, health, safety, environmental, social or other pertinent interdisciplinary factors.
[The primary feature distinguishing engineering science from engineering design is the open ended nature of the problems. A design question runs along the lines of "design a system that meets the following specifications" whereas an engineering science question is "for the following example, calculate X, Y, and Z"]

Engineering science subjects normally have their roots in mathematics and basic sciences, but carry knowledge further toward creative applications. They may involve the development of mathematical or numerical techniques, modelling, simulation and experimental procedures. Application to the identification and solution of practical engineering problems is stressed. Such subjects include the applied aspects of strength of materials, fluid mechanics, thermodynamics, electrical and electronic circuits, soil mechanics, automatic control, aerodynamics, transport phenomena and elements of materials science, geoscience, computer science, environmental studies and other subjects pertinent to the discipline. In addition, the curriculum should include engineering science content which imparts an appreciation of important elements of other engineering disciplines.

[i.e. the subject may be science, but the aim is towards practical applications, with practical examples.]

The basic (natural) sciences component of the curriculum must include elements of physics and chemistry; elements of life sciences and earth sciences may also be included in this category. These subjects are intended to impart an understanding of natural phenomena and relationships through the use of analytical and/or experimental techniques.

Mathematics includes appropriate elements of linear algebra, differential and integral calculus, differential equations, probability, statistics, numerical analysis and discrete mathematics.

Complementary studies in humanities, social sciences, arts, management, engineering economics and communication that complement the technical content of the curriculum.

[If a course is to include a complementary studies component, a portion of the grading must be allocated accordingly, e.g. part of the grade is for the grammar of a report.]

APPENDIX B: CEAB GRADUATE ATTRIBUTES

Section	Graduate Attribute	Description
3.1.1	Knowledge base for Engineering	Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.
3.1.2	Problem Analysis	An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.
3.1.3	Investigation	An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.
3.1.4	Design	An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.
3.1.5	Use of Engineering Tools	An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.
3.1.6	Individual and Team Work	An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
3.1.7	Communication Skills	An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.
3.1.8	Professionalism	An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.
3.1.9	Impact of Engineering on Society and the Environment	An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.
3.1.10	Ethics and Equity	An ability to apply professional ethics, accountability, and equity.
3.1.11	Economics and Project Management	An ability to appropriately incorporate economics and business practices including project, risk, and change management into engineering practice and to understand their limitations.
3.1.12	Life-Long Learning	An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge.