Washington State University
MAJOR CURRICULAR CHANGE FORM - COURSE
(Submit original signed form and ten copies to the Registrar's Office, zip 1035.)

Future Effective Date: Spring 2014 ☐ New course ☐ Temporary course ☐ Drop service course
(Effective date cannot be retroactive) ☐ There is a course fee associated with this course (see instructions)

☐ Variable credit
☐ Increase credit (former credit ______)
☐ Number (former number ______)
☐ Crosslisting (between WSU departments)
(Must have both departmental signatures)

☐ Cojoint listing (400/500)
☐ Request to meet Writing in the Major [M] requirement (Must have All-University Writing Committee Approval)
☐ Request to meet GER in ______
(Must have GenEd Committee Approval) ☐ Fulfills GER lab (L) requirement
☐ Professional course (Pharmacy & Vet Med only) ☑ Graduate credit (professional programs only)
☐ Other (please list request)

EE 522 High Voltage Engineering

3 3 0 0 Graduate student standing

credit lecture hrs lab hrs studio hrs prerequisite
per week per week per week

Description (20 words or less) High voltage engineering concepts and techniques that facilitate design, research, and development of modern electric power apparatus and interconnected components.

Instructor: Patrick Pedrow Phone number: 5-1749 Email: pedrow@eecs.wsu.edu
Contact: Josh Whiting Phone number: 5-2446 Email: joshwhiting@wsu.edu
Campus Zip Code: 2752

- Please attach rationale for your request, a current and complete syllabus, and explain how this impacts other units in Pullman and other branches (if applicable).
- Secure all required signatures and provide 10 copies to the Registrar's Office.

Chair/date 6/26/13 Dean/date 6/17/13
General Education Com/date

Chair (if crosslisted/interdisciplinary) * Dean (if crosslisted/interdisciplinary) * Graduate Studies Com/date

All-University Writing Com/date Academic Affairs Com/date Senate/date

*If the proposed change impacts or involves collaboration with other units, use the additional signature lines provided for each impacted unit and college.
1. "Please attach rationale for your request"

This course was retired several years ago when there was an insufficient number of electric power engineering faculty members to cover all electric power engineering courses. WSU and the School of Electrical Engineering and Computer Science have invested significant resources over the last two years into its program in electric power engineering. One plan for expanding its graduate program in this area is to offer a Professional Science Masters (PSM) degree in Electric Power Engineering through WSU's Global Campus. This prospective new program will be similar to the PSM presently being offered in the Molecular Biosciences area. Details regarding the existing PSM in Molecular Biosciences can be found at the URL:

http://www.smb.wsu.edu/academic-training/graduate-studies/professional-science-master's-degree

EE 522 has been identified as one of the highly desirable electives for the prospective PSM degree in Electric Power Engineering. In addition, EE522 will likely be a popular elective for Pullman and branch campus electric power engineering graduate students.

2. "Explain how this impacts other units in Pullman and other branches (if applicable)"

As a WSU Online course, students and working professionals throughout the US and the world will have access to this course and as such it will enhance the WSU reputation in electric power engineering. WSU branch campuses will find this to be a very good elective for their electrical engineering graduate students, especially those with an interest in electric power engineering.
Course Overview

This is a 3 credit hour graduate course on high voltage engineering concepts and techniques that facilitate design, research and development of modern electric power apparatus and interconnected components. This will be an online course developed by the WSU School of Electrical Engineering and Computer Science offered through the WSU Global Campus (http://online.wsu.edu) Essential science and engineering fundamentals covered include electrostatics, transient circuit analysis, kinetic theory of gases as well as conduction and dielectric breakdown in gases, liquids and solids. Phenomena such as corona discharge, treeing, dielectrophoresis, power arcs and lighting are covered. Modern high voltage apparatus essential to the electric power grid will be studied. Software packages will be used to gain insight into phenomena such as the processes by which large electric field intensity leads to dielectric breakdown in high voltage apparatus. Techniques used to minimize occurrences of dielectric breakdown (insulation coordination) epitomize the challenges of bringing into practice all of the fundamentals studied earlier in the course. The course will conclude with a study of high voltage laboratory testing and metrology techniques. By the time the course concludes, students will understand the role electric field intensity plays in dielectric failure of high voltage apparatus and they will understand the microscopic nature of dielectric failure, including the transport of charged and neutral chemical species.

Course Goals

Upon completion of this course, students can competently:

- Employ the science and engineering fundamentals most important to high voltage engineering.
- Analyze natural phenomena associated with dielectric breakdown failure of high voltage apparatus.
• Assess the high voltage engineering issues that are essential to the various pieces of high voltage apparatus that are interconnected to make the electric power grid.
• Design insulation coordination schemes and utilize associated engineering standards.
• Synthesize high voltage laboratory testing and metrology circuits and procedures.

Course Work

Overview:

This course is subdivided into 5 primary sections of material. The length of time spent on each section varies. Abbreviated section titles and approximate class time per section are: I) Science and Engineering Models will require about 4 weeks; II) Natural Phenomena will require about 3 weeks; III) High Voltage Apparatus will require about 3 weeks; IV) Insulation Coordination and Standards will require about 2 weeks; and V) High Voltage Laboratory Techniques will require about 3 weeks. Students should monitor the course website closely and utilize the course resources and complete the course activities to prepare themselves for the assessments shown below.

Assignments:

This is a general breakdown and basic description of assignments. Full descriptions of the assignments are at the online course space. Percentage weighting for grade calculations are shown as typical values that will vary from semester to semester, depending on results from the previous offering of the class.

Software Simulation Reports (≈15%):

There will be two graded software simulation assignments. The first simulation will be an electrostatics simulation designed to re-acquaint the student with parameters that determine the electric field intensity found in and around high voltage apparatus. The approach will be to use readily available freeware student versions of a commercial or open source software package that each student will download to their own computer. The second simulation will relate to transient circuits and will be designed to show the student how they can easily simulate the transient voltages that cause failure of high voltage apparatus. Similar to the electrostatics simulation project, the software will be readily available freeware student versions of commercial or open source software that each student will download to their own computer. For both software simulation projects, the precise commercial package will vary from semester to semester so that students are always using up to date products. Typical software packages available as of the writing of this syllabus are FEMM (http://www.femm.info) and LTspice (http://www.linear.com/design/tools/software/) for electrostatics and transient circuits, respectively. Reports will be uploaded by the student to the course website as electronic files in PDF format. One rubric will be written (and posted for student inspection) for grading both of these reports.
Writing Assignments (≈25%):

There will be five short writing assignments (600-1,200 words each) for this course. Each writing assignment will review a refereed journal article or a standards document (IEEE, CIGRE, etc.) The student will select a document that is of interest to them; however the instructor must be consulted on the choice and instructor approval is required before the writing assignment begins. Instructor approval is required so that applicable topics and sufficiently challenging documents are covered by the written reports. These five written papers will be coupled in a one-to-one fashion to the five major topics in the course: 1) Science and Engineering Fundamentals; 2) Natural Phenomena Associated with High Voltage; 3) Electric Power Grid High Voltage Apparatus; 4) Insulation Coordination and Engineering Standards; and 5) High Voltage Laboratory Testing and Metrology. Due dates will match the rate at which these topics are covered. Reports will be uploaded by the student to the course website as electronic files in PDF format. One rubric will be written (and posted for student inspection) for grading all 5 of these writing assignments.

Online Discussion (≈15%):

There will be five discussion topics that will map in a one to one fashion with the five major topics in the course: 1) Science and Engineering Fundamentals; 2) Natural Phenomena Associated with High Voltage; 3) Electric Power Grid High Voltage Apparatus; 4) Insulation Coordination and Engineering Standards; and 5) High Voltage Laboratory Testing and Metrology. A student must participate in all five discussion topics to receive full credit for this activity. A single rubric will be used to grade all five discussion topics. The rubric will utilize performance indicators such as A) posts that respond in a timely manner to instructor prompts and fellow student comments; B) posts that are of a high quality and are insightful; C) a reasonable number and volume (word count) of posts; D) posts that reflect a professional attitude; E) ability to start new meaningful threads but also to comment on threads started by colleagues; and F) ability to integrate course material into the discussions.

Homework (≈20%):

There will be online homework problems that will be drawn randomly from a larger pool of problems. Students will be shown solution keys for problems they miss. Problems will be related to reading and lecture material. These homework problems will be designed to allow students to learn the various engineering models associated with high voltage engineering. Homework sets will also prepare students for the exams. There will be about 10 homework sets distributed so there are about two sets for each of the five major topics in the course: 1) Science and Engineering Fundamentals; 2) Natural Phenomena Associated with High Voltage; 3) Electric Power Grid High Voltage Apparatus; 4) Insulation Coordination and Engineering Standards; and 5) High Voltage Laboratory Testing and Metrology.
Exams (≈25%):

There will be online exams whose questions will be drawn randomly from a larger pool of questions. Students will be shown solution keys for problems they miss. Exam problems will be related to homework problem which will in turn relate to reading and lecture material. These exam questions will be designed to measure a student’s knowledge about high voltage engineering concepts taught in the class. There will be about 5 exams, one for each of the five major topics in the course: 1) Science and Engineering Fundamentals; 2) Natural Phenomena Associated with High Voltage; 3) Electric Power Grid High Voltage Apparatus; 4) Insulation Coordination and Engineering Standards; and 5) High Voltage Laboratory Testing and Metrology.

Instructor Interaction

The instructor will attend to the course online space at least 3 times each week (Mon-Fri), and respond to email and questions posted to the Questions for the Instructor discussion board within 48 hours (Mon-Fri). Homework and exams will be computer graded (with instructor oversight) and those scores will be posted for the student within 48 hours (Mon-Fri). Reports and writing assignments may take as long as 7 working days to be graded via the posted rubric.

Grading

Midterm grades for this course will be based on the number of points accumulated by the student at midterm (expressed as a percentage of the total number of points possible as of midterm.) Midterm assessment should not be interpreted as a formal grade, but rather as an indication of the student’s progress to date. Midterm grades are advisory and do not appear on the student’s permanent record, the WSU transcript.
Final grades will be calculated as follows:

<table>
<thead>
<tr>
<th>Course Work</th>
<th>Percent of Final Grade</th>
<th>Grading Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software Simulation Report #1: Electrostatics</td>
<td>10%</td>
<td>Instructor &amp; Rubric</td>
</tr>
<tr>
<td>Software Simulation Report #2: Transient Voltages</td>
<td>5%</td>
<td>Instructor &amp; Rubric</td>
</tr>
<tr>
<td>Writing Assignment #1</td>
<td>5%</td>
<td>Instructor &amp; Rubric</td>
</tr>
<tr>
<td>Writing Assignment #2</td>
<td>5%</td>
<td>Instructor &amp; Rubric</td>
</tr>
<tr>
<td>Writing Assignment #3</td>
<td>5%</td>
<td>Instructor &amp; Rubric</td>
</tr>
<tr>
<td>Writing Assignment #4</td>
<td>5%</td>
<td>Instructor &amp; Rubric</td>
</tr>
<tr>
<td>Writing Assignment #5</td>
<td>5%</td>
<td>Instructor &amp; Rubric</td>
</tr>
<tr>
<td>Online Discussion</td>
<td>15%</td>
<td>Instructor &amp; Rubric</td>
</tr>
<tr>
<td>HW #1</td>
<td>2%</td>
<td>Computer</td>
</tr>
<tr>
<td>HW #2</td>
<td>2%</td>
<td>Computer</td>
</tr>
<tr>
<td>HW #3</td>
<td>2%</td>
<td>Computer</td>
</tr>
<tr>
<td>HW #4</td>
<td>2%</td>
<td>Computer</td>
</tr>
<tr>
<td>HW #5</td>
<td>2%</td>
<td>Computer</td>
</tr>
<tr>
<td>HW #6</td>
<td>2%</td>
<td>Computer</td>
</tr>
<tr>
<td>HW #7</td>
<td>2%</td>
<td>Computer</td>
</tr>
<tr>
<td>HW #8</td>
<td>2%</td>
<td>Computer</td>
</tr>
<tr>
<td>HW #9</td>
<td>2%</td>
<td>Computer</td>
</tr>
<tr>
<td>HW #10</td>
<td>2%</td>
<td>Computer</td>
</tr>
<tr>
<td>Exam #1</td>
<td>5%</td>
<td>Computer</td>
</tr>
<tr>
<td>Exam #2</td>
<td>5%</td>
<td>Computer</td>
</tr>
<tr>
<td>Exam #3</td>
<td>5%</td>
<td>Computer</td>
</tr>
<tr>
<td>Exam #4</td>
<td>5%</td>
<td>Computer</td>
</tr>
<tr>
<td>Exam #5</td>
<td>5%</td>
<td>Computer</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100%</strong></td>
<td></td>
</tr>
<tr>
<td>Grade</td>
<td>Percent of Final Grade</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------------------------</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>93–100%</td>
<td></td>
</tr>
<tr>
<td>A−</td>
<td>90–92%</td>
<td></td>
</tr>
<tr>
<td>B+</td>
<td>87–89%</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>83–86%</td>
<td></td>
</tr>
<tr>
<td>B−</td>
<td>80–82%</td>
<td></td>
</tr>
<tr>
<td>C+</td>
<td>77–79%</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>70–76%</td>
<td></td>
</tr>
<tr>
<td>C−</td>
<td>63–69%</td>
<td></td>
</tr>
<tr>
<td>D+</td>
<td>57–62%</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>50–56%</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>49% &amp; Below</td>
<td></td>
</tr>
</tbody>
</table>

**Late Assignment/Exam Policy**

This is a graduate level class and students must have commensurate discipline and work ethic. Thus all writing assignments, discussions, and exams should be submitted on time according to the course schedule. Items graded by computer will have strict start/stop times. Items graded by the instructor must be submitted on or before the due date. Late assignments will be accepted and graded without penalty only if instructor approval is obtained on or before the due date. Student work not fitting within these guidelines will receive zero credit, other than the important learning experience associated with the work.

**Academic Integrity**

WSU’s Academic Integrity Statement can be found at the following web site:
(http://www.gradschool.wsu.edu/facultystaff/Committee/Documents/AcademicDishonesty.pdf) and it reads:

“As an institution of higher education, Washington State University is committed to principles of truth and academic honesty. All members of the University community share the responsibility for maintaining and supporting these principles. When a student enrolls in Washington State University, the student assumes an obligation to pursue academic endeavors in a manner consistent with the standards of academic integrity adopted by the University. To maintain the academic integrity of the community, the University cannot tolerate acts of academic dishonesty including any forms of cheating, plagiarism, or fabrication. Washington State University
reserves the right and the power to discipline or to exclude students who engage in academic dishonesty.”

Each student must turn in original work and properly cite ideas and materials that are not the student’s intellectual property. No copying will be accepted. Students who violate WSU’s Standards of Conduct for Students will receive an F as a final grade in this course, will not have the option to withdraw from the course and will be reported to the WSU School of EECS Graduate Studies Committee and the WSU Office Student Standards and Accountability. Cheating is defined in the Standards for Student Conduct WAC 504-26-010 (3). Each student should read and understand those materials. Additional related materials are at the following website: (http://academicintegrity.wsu.edu/).

Academic integrity is the cornerstone of the university. Students assume full responsibility for the content and integrity of the academic work they submit. Students may discuss engineering issues and problem solving strategies with colleagues and with fellow classmates; however, the guiding principle of academic honesty is that a student’s submitted work, examinations, reports, and projects must be their own work and their own intellectual property. Course-related materials, presentations, lectures, etc. are the intellectual property of the instructor and/or WSU and are protected by copyright. The use of WSU electronic resources (e.g., Angel) for commercial purposes, including advertising to other students to buy notes, is a violation of WSU’s computer abuses and theft policy (WAC 504-26-218).

Students enrolled in online courses are subject to the same University academic regulations as students on the Pullman, WA campus (see the online search function at http://wsu.edu/).

Course Schedule

For course work due dates, please view and follow the posted course schedule. Review the current Academic Calendar to become familiar with critical deadlines on your campus. Visit the WSU Academic Calendar web page at (http://www.registrar.wsu.edu/Registrar/Apps/AcadCal.ASPX) and select your home campus from the drop down menu.

Student Privacy

As a WSU student, you have legal rights under the Family Educational Rights and Privacy Act (FERPA) for protection of your academic records. For a complete explanation of these rights, visit the URL (http://www.registrar.wsu.edu/Registrar/Apps/FERPA.ASPX).

Online Discussions

The essence of a graduate level engineering course is exposure to diverse ways to analyze and solve engineering problems. In your threaded discussion posts you’ll meet students with broad interdisciplinary backgrounds. When you see a new way to analyze an engineering problem
consider if the new technique is more efficient than your approach and then engage in a professional discussion. Always write your discussion comments with an active sense of respect for one another, and without losing focus on the topic at hand. Unprofessional comments do not have a place in academic discourse.

Your instructor will promote high-quality academic discussions by removing any posts they view as disruptive of the educational process and alerting students whose posts have been removed that they have violated course expectations. Students who continue to misuse the discussion boards after a warning may be subject to removal of access rights, course failure, and referral to the Office of Student Conduct. Postings must comply with University policy on use of computing resources, including those regarding harassment and discrimination, as well as conform to the Standards of Conduct for Students. Students are encouraged to review the Standards, particularly WAC 504-26-218, 504-26-220, and 504-26-222. The rubric used to grade the online discussions will be posted and should be used as a guide to engaging in the online discussions.

Disability Accommodations

Reasonable accommodations are available in online classes for students with a documented disability. All accommodations must be approved through the WSU Disability Services office. If you have a disability and need accommodations begin the process as soon as possible. For more information contact a disability specialist at the WSU Access Center (509-335-3417; http://accesscenter.wsu.edu).

Technical Support

If you need technical assistance, please expand the Content folder in the Map menu on the left by clicking the plus sign (+), then select Technical Support.

WSU Online Student Support

The WSU Online Web site (http://online.wsu.edu) has all the non-content and administrative related information you need to be a successful online learner. Login using your WSU Network ID and password to access your personalized information.

- Student Services information is available to provide assistance with any non-advising administrative questions
- Study tips and resources give you a good head start in assuring success with your course are also located on the Web site.

Library Support

All students enrolled in Washington State University online courses can use the WSU Libraries online databases and receive reference and research assistance. Students can also borrow books
and other circulating material and access full text journal articles. To access any WSU library resource start at the website (http://www.wsulibs.wsu.edu/electric). Review the Libraries’ online information for more guidance.

**eTutoring**

WSU students have **FREE unlimited** access to eTutoring.org, a tutoring platform that enables students and tutors to collaborate in an online environment. This is not a course requirement, but simply an available resource that you may utilize as needed. With three ways to access a tutor you can choose the one that best fits your needs.

- Writing Lab tutors will respond to papers in ANY academic subject, including history, anthropology, sociology, and everything else. If you're working on a paper for ANY of your courses our tutors can help you. Just submit your paper, ask specific questions on the submission form and a tutor will respond within 24-48 hours.
- eChat rooms allow students to meet with tutors in one-on-one tutoring sessions via a fully interactive, virtual online environment.
- Students can also leave specific questions for an eTutor in any of our subjects by taking advantage of our eQuestions option. Our tutors will respond to your question within 24-48 hours.

The list of available tutoring subjects can be found on the website (http://etutoring.org/login.cfm?institutionid=176). Current subjects applicable to this course are calculus, chemistry, electrical engineering circuits, physics, statistics and writing.

**On Campus Safety**

Washington State University is committed to maintaining a safe environment for its faculty, staff, and students on all campuses. Safety is the responsibility of every member of the campus community and individuals should know the appropriate actions to take when an emergency arises. In support of our commitment to the safety of the campus community the University has developed a Campus Safety Plan. It is highly recommended that you visit this web site http://oem.wsu.edu/ to become familiar with the information provided as well as the site for your specific campus if applicable.

- WSU Pullman: http://safetyplan.wsu.edu
- WSU Spokane: http://spokane.safetyplan.wsu.edu/
- WSU Tri-Cities: http://www.tricity.wsu.edu/safetyplan/
- WSU Vancouver: http://www.vancouver.wsu.edu/safety-plan

Prepared by: Patrick Pedrow          Date: October 25, 2013