New Graduate Course Approval Cover Form
Montana State University

This four-page form collects basic information about the proposed new course, provides information on the approval process, and includes all required approvals. Additional information (see INFO sheet) is also required as part of the New Course Packet.

Proposed New Course Information

Requested Rubric, Course Number, Core Designation (if needed): ELE 517

Course Title: Acoustics and Audio Engineering
Abbreviated Course Title (≤ 30 chars): Acoustics/Audio Engineering
First Semester to be Offered: Fall 2014
Submitted by: Robert C. Maher
Submitter’s Contact Info: Phone, Email: x2505 rob.maher@montana.edu
Instructor: Robert C. Maher
Department: Electrical & Computer Engineering
College: Engineering

New Graduate Course Approval Process

Instructor completes the New Course Packet.

Department Head’s signature indicates that course has been approved by the process used within the Department.

The Chair of the College Curriculum Committee signs to indicate College academic approval (if required).

The College Dean signs to indicate that adequate resources are available to offer the course. Supporting information (Dean’s Statement) is typically required.

The New Course Packet (as PDF) is submitted to the Graduate School for approval by the Dean.

Provost’s Office reviews the new course request.

Approved new course sent to Registrar for inclusion in the Catalog and Schedule of Classes

APPROVALS

Submitter

Department Head

Chair, College Curriculum Comm.

Graduate School Dean

Assoc. Provost

Note: This diagram illustrates the typical flow path, but at any review step there can be a request for additional information or modifications. Careful review in early steps is the best way to speed the overall process. * Special topics courses (≤91) do not require review by the College Curriculum Committee, but cannot be offered more than two times without committee review.
INFORMATION NEEDED FOR COMMON COURSE NUMBERING

The process for identifying a common course number for a new course is as follows:

1. Course learning outcomes are prepared for the new course.
2. The person submitting the new course request looks at the CCN website to see if a course with similar outcomes already exists in the MUS system.

   www.mus.edu/Qtools/CCN/ccn_default.asp

   - If a course exists with at least 80% of the same outcomes, the course is considered “equivalent” to the proposed new course, and the new course should use the existing rubric and course number.
   - If no “equivalent” course is found, the person submitting the new course request should identify a unique course number that has not been used by any other course in the MUS system.
3. The requested rubric and course number are submitted as part of the new course packet.
4. The Provost’s Office submits the learning outcomes and the requested rubric and course number to the MUS to have a course number assigned to the course. (This will typically be the requested course number, but it could be changed.)
5. The assigned common course number is reported back to the person submitting the new course request.

Requested Rubric, Course Number, Core Designation (if needed):

<table>
<thead>
<tr>
<th>EELE 517</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustics and Audio Engineering</td>
</tr>
<tr>
<td>Acoustics/Audio Engineering</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>Electrical &amp; Computer Engineering</td>
</tr>
<tr>
<td>Engineering</td>
</tr>
</tbody>
</table>

Is this course “equivalent” to a course in the MUS System?:  
☑️ No

Learning Outcomes for the Course:

1) Understand the linear acoustic wave equation and explain the relationship between pressure and particle velocity for plane waves and spherical waves.

2) Calculate and interpret the near-field and far-field response of a circular piston radiator mounted in an infinite baffle.

3) Explain the basic physiology of the human hearing system and elementary psychoacoustical principles (e.g., sensitivity as a function of frequency, simultaneous masking, and difference limens).

4) Use geometrical measurements and material properties to calculate Sabine reverberation time for a room.

5) Explain the basic operation of dynamic (moving-coil) loudspeakers and condenser (capacitive) microphones.

6) Understand the principles of recording studio signal flow.

7) Discuss the strengths and weaknesses of modern perceptual audio coders such as MP3.

8) Describe one or more active areas of research in the acoustics and audio engineering field, and knowledgeably...
**INFORMATION REQUIRED BY THE REGISTRAR**

The data needed to enter the new course into the MSU Catalog and Schedule of Classes is collected on this page. Once the new course has been approved, this page is automatically forwarded to the Registrar for data entry.

<table>
<thead>
<tr>
<th>Assigned Rubric, Course Number, Core Designation (if needed):</th>
<th>ELE 517 Acoustics and Audio Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title (for Catalog):</td>
<td>Acoustics/Audio Engineering</td>
</tr>
<tr>
<td>Course Title (for Schedule of Classes, 30 characters, max.):</td>
<td>Fall 2014</td>
</tr>
<tr>
<td>First Semester to be Offered:</td>
<td></td>
</tr>
<tr>
<td>Restricted Entry/Consent of Instructor Required:</td>
<td>☐ Yes ☐ No</td>
</tr>
<tr>
<td>Instructor’s GID (last 4 digits only):</td>
<td>1154</td>
</tr>
<tr>
<td>Department Offering Course:</td>
<td>Electrical &amp; Computer Engineering</td>
</tr>
<tr>
<td>College:</td>
<td>Engineering</td>
</tr>
</tbody>
</table>

Is the requested course number available? (x4155 to check): ☐ Yes ☐ No

Frequency of course offering: ☐ Annually ☐ Alternate Years, starting 2014

Semester(s) offered (check all that apply): ☐ Summer ☐ Fall ☐ Spring

Summer Options (check all that apply): ☐ First 6 weeks ☐ Second 6 weeks ☐ 12 weeks

Credits by mode of instruction:

<table>
<thead>
<tr>
<th>Lecture</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminar</td>
<td>0</td>
</tr>
<tr>
<td>Independent Study</td>
<td>0</td>
</tr>
<tr>
<td>Lab/Studio</td>
<td>0</td>
</tr>
<tr>
<td>Recitation/Discussion</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL CREDITS:</td>
<td>3</td>
</tr>
</tbody>
</table>

Primary Mode(s) of Delivery:

<table>
<thead>
<tr>
<th>☐ Face-to-face</th>
<th>☐ Web-Enhanced (small on-line comp.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ On-Line Only</td>
<td>☐ Blended (significant on-line portion)</td>
</tr>
</tbody>
</table>

**Time and Location** — Call the Registrar’s Office at x4155 to find a time and location for the course.

<table>
<thead>
<tr>
<th>Assigned Day(s):</th>
<th>☑ M ☑ Tu ☑ W ☑ Th ☑ F ☑ Sa ☑ Su</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assigned Time(s):</td>
<td>0800-0850</td>
</tr>
<tr>
<td>Assigned Building:</td>
<td>Roberts Hall</td>
</tr>
<tr>
<td>Assigned Room:</td>
<td>121</td>
</tr>
</tbody>
</table>

Capacity (room capacity, or enrollment "cap"): 30

Co- and Pre-Requisites — Courses numbered 200 and above are normally expected to have prerequisites. When listing multiple prerequisites, please separate courses with “and” if both are required, or “or” if only one is required.

Prerequisite(s): PHYS 222

Co-Requisite(s): Physics 222

**Course Description** — Provide a course description of 40 words or less for the MSU Catalog.

DEAN'S STATEMENT

The reviewing committees are being asked to take a closer look at the resources required for each proposed new course. In many cases new courses will replace existing courses and the new course request is effectively resource neutral, however that is not always the case. For example, a new elective course that would result in distributing an existing student population across a larger number of courses would represent a significant increase in expenditures for the new course, and no increase in total student credit hours. A funding mechanism for such a course would need to be identified. The Dean’s Statement is the place to document how the costs of the proposed new course will be covered.

This course will be co-convened with an undergraduate level 417 course. Offering these courses together will increase faculty efficiency and create an enhanced learning environment for the students. Co-convening these courses will allow the graduate students to fulfill their 500-level course requirements in a timely fashion. The learning outcomes are clearly defined with the additional expectations for graduate students well explained, the instructor will be including an assessment component. The course has previously been taught as a graduate level special topics course, and as EELE 491 in the past, and will not involve a significant increase in resources to teach.
NEW GRADUATE COURSE NARRATIVE
Updated: 12/31/2013

REQUIRED DOCUMENTATION FOR REVIEW OF NEW GRADUATE COURSES

1. Course Description:
   a. What are the special goals or purposes of the course that support a “graduate” level of the course?

This is a graduate-level version of the existing undergraduate course EELE 417 Acoustics & Audio Engineering. EELE 417 has been taught alternate years in the fall semester since 2006 as a senior-level elective primarily for students in electrical engineering, computer engineering, mechanical engineering, and physics. This proposal is to co-convene a graduate-level course that will be a superset of the material contained in EELE 417. Students enrolled for graduate credit in EELE 517 will be required to do additional problem sets, and to engage in assigned readings in the research literature. Grad students will also write a scholarly review paper, in consultation with the course instructor, on a topic relevant to the course material.

b. Is this course intended to be a required part of a new degree curriculum option, major, or minor?

No, the course is not part of a new option, major or minor.

c. Provide a course syllabus containing all major topics to be covered.

Please see the attached syllabus.

d. List required texts or other required references.


Other reference material: Handouts and reprints (in class)

2. Level of Offering:
   a. Has the course been offered previously as a 591?
      i. If so, when?
      ii. What was the enrollment?
      iii. What level of students took the course?
      iv. What were the evaluations?

The course has not previously been offered as a graduate special topics course, but as noted above, the undergraduate version EELE 417 has been taught four times previously with enrollments 32, 32, 23, 24.
b. Does the course represent an upgraded version of an undergraduate level course?
   i. If so, how has the course been changed to justify offering it at the graduate level? (Be specific)

Yes, the proposed course is a superset of the co-convened undergraduate course EELE 417. Students taking this course for graduate credit will cover the same basic learning objectives as the undergraduate students, but will be required to go into greater depth in the current research literature. While the undergraduate student expectations are primarily based on textbook and assigned handout readings and regular homework problems, the graduate course expectations will include additional problem sets and assigned readings in the research literature. Grad students will also write a scholarly review paper, in consultation with the course instructor, on a topic relevant to the course material.

c. What are the prerequisites for this graduate course? (List exact MSU courses - e.g. ESCI XXX or equivalent)

The course prerequisite is the waves and electromagnetics physics course, PHSX 222 (physics II), and graduate standing.

d. What performance requirements are placed on students which make this a graduate course?
   i. Specifically state the written requirements or products of this course.

   The expectation for graduate-level performance in the course encompasses the same basic material as the undergraduate course, but then focuses on the current research and discovery going on in the acoustics and audio engineering fields. In other words, while the undergraduates are expected to learn what is already in the acoustics fundamental body of knowledge, the graduate students are expected to study what is happening in the emerging areas of active research and scholarly publication.

   ii. How will the student’s learning be assessed and graded?

   For graduate students, the learning assessment and grading is based on (1) homework and quizzes, acoustic event attendance, and written report preparation (35%); (2) midterm exam 1 (20%); (3) midterm exam 2 (20%); and (4) final exam (25%).

3. Relationship to other courses, curricula, and Departments:
   a. Does this course build on or interrelate with other courses in your curriculum or related curricula? If so, which one(s)?

This course fits into the electronics and into the signals & systems area of electrical and computer engineering. Related undergraduate courses include EELE 308 Signals &

b. Does this course replace one or more courses that will not be offered? If so, which one(s)?

No, this is not a replacement for another course.

c. Will this course be co-convened with an undergraduate course? If so, what additional requirements will students enrolled in the graduate course be expected to fulfill?

This course will be co-convened with the existing course EELE 417. The expectation for graduate-level performance in the course encompasses the same basic material as the undergraduate course, but then focuses on the current research and discovery going on in the acoustics and audio engineering fields. In other words, while the undergraduates are expected to learn what is already in the acoustics fundamental body of knowledge, the graduate students are expected to study what is happening in the emerging areas of active research and scholarly publication. The graduate course expectations will include additional problem sets and assigned readings in the research literature. Grad students will also write a scholarly review paper, in consultation with the course instructor, on a topic relevant to the course material.

d. Do the topics in the proposed course duplicate or reiterate those in other courses in this or any other department? If so, how do the coverages and education experiences differ, and how are these duplications or reiterations justified?

The new course does not duplicate nor reiterate material from other courses at MSU.

e. When the course is to be co-sponsored, taught by faculty from more than one department, or when content overlaps areas of common concern, the concurrence of all department heads and deans involved must be indicated. What liaison has been conducted with other departments? State reactions, both favorable and unfavorable.

We know of no overlap or concurrence.

4. Students Served:
   a. Does the proposed course serve:
      i. Majors only?
      ii. Non-majors only? State area(s) or discipline(s) to be served.
      iii. Both majors and non-majors? Indicate what specific efforts will be made to make the course materials relevant to all disciplines served. How are faculty and students in the other areas to be served being made aware of this course?
The course is intended for graduate majors in Electrical Engineering, although it is possible that some students from Physics or Mechanical Engineering might choose to take the class. Since the basic prerequisite is fundamental physics knowledge at the level of PHSX 222, no particular extraordinary effort or support for non-majors is expected to be necessary.

5. What is the anticipated course enrollment?

Because the course is co-convened we expect the total enrollment to be 25-30 students. Of these, approximately 5 are expected to be graduate students.

6. Resources (including instructor):
   a. Are department financial resources sufficient for offering this course?

   Yes, as a co-convened elective course the incremental resources required are amortized already.

   b. Does the instructor have the requisite academic training to offer this course?
      i. Describe these qualifications briefly and include a vita (if the instructor is non-tenured).

   The course is to be taught by Rob Maher, tenured full professor and department head. Dr. Maher is a fellow of the Audio Engineering Society and well-qualified to design and teach the course.

   c. Are the library holdings adequate to support this course?

   For the most part the standard material is available and accessible. Grad students will utilize interlibrary loan (ILL) for material that is not stacked at MSU.

7. Course Evaluation:
   a. How will the students evaluate the course and instructor?

   The course will be included in the standard instructor evaluation process and in our ABET-accreditation processes. The instructor also provides a mid-term assessment survey that is tabulated and then discussed with the students.

   b. How will the department evaluate the course and instructor?

   In addition to an assessment based on the process outlined above for student feedback, the graduate courses in the ECE Department are subject to regular review by the ECE Graduate/Research Committee to determine if the course is meeting its learning outcomes and supporting the goals of the graduate program.

8. Other Supporting Material: Include any additional information you feel is needed to support this request.
EELE 517: Acoustics and Audio Engineering

Fall Semester 2014
LECTURE: Section 1 (CRN xxxx), MWF 0800--08:50PM, Roberts Hall 121

Instructor
Prof. Robert C. Maher
| Office: 610 Cobreigh Hall (northeast corner of 6th floor inside the ECE main office) |
| Phone: Office: 994-2505 |
| Home: 587-5925 (but please do not call me at home) |
| Email: rob.maher@montana.edu |
| Class Page: TBD |
| Office hours: Drop-in questions are always OK if I'm not busy with some other appointment. |

Prerequisite:
PHSX 222 PHYSICS II (2nd semester calculus-based physics)

Textbooks and Materials
2. Handouts and reprints (in class)

Class Objective
The students obtain sufficient background and technical knowledge to understand contemporary issues in audio engineering.

Course Outcomes
At the conclusion of EELE 517, students will be able to:

- Understand the linear acoustic wave equation and explain the relationship between pressure and particle velocity for plane waves and spherical waves.
- Calculate and interpret the near-field and far-field response of a circular piston radiator mounted in an infinite baffle.
- Explain the basic physiology of the human hearing system and elementary psychoacoustical principles (e.g., sensitivity as a function of frequency, simultaneous masking, and difference limens).
- Use geometrical measurements and material properties to calculate Sabine reverberation time for a room.
- Explain the basic operation of dynamic (moving-coil) loudspeakers and condenser (capacitive) microphones.
- Understand the principles of recording studio signal flow.
- Discuss the strengths and weaknesses of modern perceptual audio coders such as MP3.
- Describe one or more active areas of research in the acoustics and audio engineering field, and knowledgeably explain the applications and expectations of that work.

**Class Outline (subject to change)**

**Week 1:**
- Intro, audio and acoustics subdisciplines, survey
- Fundamental quantities, Fourier review, mass and vibration
- Damping, complex exponential solutions, forced oscillation

**Week 2:**
- Resonance, electrical circuit analogies
- Acoustic wave equation

**Week 3:**
- Harmonic plane waves, intensity, impedance
- Spherical waves, sound level, dB examples
- Radiation from small sources

**Week 4:**
- Baffled simple source, piston radiation
- Near field, far field
- Radiation impedance

**Week 5:**
- Recap and review
- Demos, speed of sound measurement
- EXAM #1
- Return exam, continue ear/hearing

**Week 6:**
- The ear, hearing, etc.
- Demos, hearing and detection

**Week 7:**
- Environmental acoustics and noise criteria
- OSHA, architectural isolation
- Guest Lecture TBD

**Week 8:**
- Example calculations
- Architectural acoustics, reverb
Absorbing materials, direct-reverberant ratio

**Week 9:**
Relationships among music, audio, acoustics, and electronics
Audio engineering introduction
Audio engineering, units, concepts

**Week 10:**
Microphones
Studio electronics

**Week 11:**
Studio electronics
Analog storage history (tape, phonograph, LP)
Loudspeakers

**Week 12:**
Loudspeakers
EXAM #2

**Week 13:**
Digital audio
THANKSGIVING

**Week 14:**
Digital coding principles
Audio DSP
Multimedia audio, MP3, etc.

**Week 15:**
SMPTE and synchronization
MIDI
Final review

**Course Grading:**

| D2L quizzes, Concerts, and Written Report | 35% | → Homework and D2L quizzes will be required periodically. Assignments are due on the due date at the BEGINNING of class. No late submissions will be accepted.
| → Students must attend at least FOUR formal music concerts during the semester, with verification by turning in the concert program.
| → A WRITTEN REPORT based on a scholarly research review will also be assigned during the semester. |
| **Exam 1:** | 20% | → Written in-class exam given late in September. |
| **Exam 2:** | 20% | → Written in-class exam given in mid-November. |
| **Final Exam:** | 25% | → The final exam is at the scheduled date and time during finals week. |
| **100%** | | |

Grade guarantee: course letter grade cutoffs will not be higher than indicated by the following scale:
A- = 90%
B- = 80%
C- = 70%
D = 60%
F = 59%

NOTE: Regardless of the student's aggregate score total, a grade of F will be given automatically if a written paper, midterm exam or the final exam is not taken.

Policies

- All students must have D2L (Desire To Learn) web access and an electronic mail address listed with the MSU Student Email System. Announcements and reminders for EELE 517 will be sent occasionally via email.
- You are responsible for all material covered in class and in the textbook reading assignments.
- Late submissions of assignments (D2L, homework and reports) will not be accepted. Plan ahead and notify the instructor prior to justifiable absences, or if a bona fide emergency prevented you from attending class.
- Homework problems will sometimes require Matlab or an equivalent computer tool. Matlab is available in the ECE computer labs.
- There will probably be several guest lectures, field trips, and out-of-class presentations scheduled during the semester. Although it is not reasonable for me to make out-of-class events mandatory, I do expect the students to take advantage of all learning opportunities provided in the course.
- Among other details, Section 310.00 in the MSU Conduct Guidelines states that students must be prompt and regular in attending classes, be well prepared for classes, take exams when scheduled, and act in a respectful manner toward other students and the instructor.
- **Academic Misconduct:** Unless group work is explicitly assigned, homework and exams must be prepared individually. Submitting the work of others is dishonest, constitutes academic misconduct, and is grounds for dismissal from the course. Paraphrasing or quoting another's work without citing the source is also academic misconduct. Even inadvertent or unintentional misuse or appropriation of another's work (such as relying heavily on source material that is not expressly acknowledged) is plagiarism. If you have any questions about using and citing sources, you are expected to ask for clarification.
- If you have a documented disability for which you are or may be requesting accommodations, please know that you are welcome and encouraged to participate fully in this class!! Simply contact the instructor and Disabled Student Services (994-2824) as soon as possible.
- All records related to this course are confidential and will not be shared with anyone, including parents, without a signed, written release from the MSU Dean of Students. For more information contact the Dean of Students office at 994-2826.