WINONA STATE UNIVERSITY
PROPOSAL FOR NEW COURSES

Refer to Regulation 3-4, *Policy for Changing the Curriculum*, for complete information on submitting proposals for curricular changes.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>160</td>
<td>The Science of Music</td>
<td>4</td>
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</table>

This proposal is for a(n)  

_X_ Undergraduate Course  

Graduate Course  

Applies to:  

_X_ Major  

Minor  

_X_ University Studies*  

Not for USP  

Required  

Required  

Elective  

Elective  

Prerequisites  

NONE  

Grading method  

_X_ Grade only  

P/NC only  

Grade and P/NC  

Option  

Frequency of offering  

YEARYL  

*For University Studies Program course approval, the form *Proposal for University Studies Courses* must also be completed and submitted according to the instructions on that form.

Provide the following information:

A. Course Description – See attached Syllabus

1. Catalog description.
2. Course outline of the major topics and subtopics (minimum of two-level outline).
3.a Instructional delivery methods utilized: (Please check all that apply).
  Lecture: Audtorium  
  ITV  
  Online  
  Web Enhanced  
  Web Supplemented  
  Lecture: Classroom  
  Service Learning  
  Travel Study  
  Laboratory XX  
  Internship/Practicum  
  Other: (Please indicate)
3.b. MnSCU Course media codes: (Please check all that apply).

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<tbody>
<tr>
<td>2. CD Rom</td>
<td>5. Broadcast TV</td>
<td>8. ITV Receiving</td>
<td></td>
</tr>
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</table>

4. Course requirements (papers, lab work, projects, etc.) and means of evaluation.
5. Course materials (textbook(s), articles, etc.).
6. Assessment of Outcomes
7. List of references.

B. Rationale – See attached statement

1. Statement of the major focus and objectives of the course.
2. Specify how this new course contributes to the departmental curriculum.
3. Indicate any course(s) which may be dropped if this course is approved.

C. Impact of this Course on other Departments, Programs, Majors, or Minors – See attached statement

Physics 160 – New Course Proposal
1. Does this course increase or decrease the total credits required by a major or minor of any other department? If so, which department(s)?
2. Attach letter(s) of understanding from impacted department(s).

Definitions:

01-Satellite:

02-CD Rom:

03-Internet: Predominately = where all, or nearly all, course activity occurs in an online environment. One to two activities may occur face-to-face in a classroom, with the maximum being two activities.

04 – ITV Sending: a course in which students are in the classroom with the instructor, other students join via interactive television technology from other geographically separate locations

05 – Broadcast TV:

06 – Independent Study: a course in which the teacher develops specialized curriculum for the student(s) based on department guidelines in the University course catalog

07 – Taped: a course in which the teacher records the lessons for playback at a later date

08 – ITV Receiving: a course in which students are not in the classroom with the teacher, other students join via interactive television technology from other geographically separate locations

09 – Web Enhanced- Limited Seat Time: For a course in which students are geographically separate from the teacher and other students for a majority of required activities. However, some on-site attendance is required. The course includes synchronous and/or asynchronous instruction.

10 – Web Supplemented- No Reduced Seat Time: For a course utilizing the web for instructional activities. Use of this code may assist your college/university in tracking courses for “smart classrooms” and/or facility usage.

Attach a Financial and Staffing Data Sheet.

Attach an Approval Form with appropriate signatures.

Department Contact Person for this Proposal:

_________________________   ________________   ______________
Frederick Otto                  X5854                          fotto@winona.edu
Name (please print)                  Phone                          e-mail address

[Revised 7/5/07]
A. **Course Description**

1. Catalog Description: This is a lecture and laboratory course about sound and acoustics, relating music and physics and other associated topics, including environmental noise, room acoustics, and digital audio recording and editing. Prerequisites: None. Offered yearly.

2. See the attached course syllabus.

3. Course delivery is by traditional lecture/discussion and laboratory classes,

4. Course requirements and evaluation are listed in detail in the attached course syllabus.


   Required Software: Logger Pro data collection software – supplied by department for both Windows and Mac OS laptops

6. See the attached course syllabus.

B. **Rationale for this Course**

1. The major focus of this course is to familiarize the student with the principles of physical acoustics with special emphasis on its applications to music. This course was designed at the request of the Music Department to provide their students with background in physical acoustics in the context of musical performance. It is also intended to be a course of general interest for students wishing to learn more about how sound and music are interrelated.

2. This course does not directly contribute to any of the Physics Majors or Minors. It is designed to be a supporting course for the Music degree programs and as a general interest University Studies course in the Natural Science category.

3. No existing courses will be dropped with the implementation of this course.

C. **Impact on Other Departments**

1. This course will not compete with any other courses in other departments.

2. Currently, this course has no effect on any major or minor programs in any other department.

3. No other physics courses will be dropped. One section of another course offering, such as Conceptual Physics (115) may be eliminated in order to provide faculty resources for teaching this class without requiring additional staff.
PHYSICS 160 – The Science of Music

Instructor: Dr. Fred Otto  
Phone: 457-5854

Office: Pasteur 144  
e-mail: fotto@winona.edu


Course Web Site: http://course1.winona.edu/fotto/

I. COURSE DESCRIPTION

This is a lecture and laboratory course about sound and acoustics, relating music and physics and other associated topics, including environmental noise, room acoustics, and digital audio recording and editing. Prerequisites: None. Offered yearly.

II. MAJOR FOCUS

Physics and music have always been closely connected, from the time of Ancient Greek civilization to the present. As the understanding of science advanced, so did the theory of music. This course will trace the development of music, while highlighting the underlying concurrent developments in science. Numerous in-class demonstrations of both physics and music will be used to show the physical principles of sound. Various families of musical instruments will be analyzed, including electronic instruments. Concert hall acoustics, sound recording, and digital sound will also be examined.

III. TEACHING AND LEARNING STYLE

The instructor will post the suggested reading and problem assignments for the following week on the course web site. The student should look over the assigned materials and practice concepts covered in class by doing the assigned problems. The answers to all assigned problems will be given on the due date for the assignment. The instructor will use class time to (1) demonstrate concepts covered in the reading material, (2) show the historical connections and development of the concepts discussed (3) provide demonstrations illustrating the principles being studied, and (4) answering questions from class. Laboratory exercises will be used to test the principles discussed in class and to acquaint the student with measurement techniques, apparatus and software.

IV. EVALUATION

The student's grade is determined by scores on two midterm exams, homework, laboratory exercises, a research paper and a final exam. The last of these exams will be a comprehensive final exam containing material covered during the entire semester. The weighting of the various scores is as follows:

<table>
<thead>
<tr>
<th>Component</th>
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<tr>
<td>2 midterm exams</td>
<td>30%</td>
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<tr>
<td>Homework</td>
<td>10%</td>
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Physics 160 – New Course Proposal
<table>
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<tr>
<th>Component</th>
<th>Weight (%)</th>
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<tbody>
<tr>
<td>Laboratory</td>
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</tr>
<tr>
<td>Research Paper</td>
<td>15%</td>
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<tr>
<td>Final Exam</td>
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<tr>
<td><strong>TOTAL:</strong></td>
<td><strong>100%</strong></td>
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</table>

V. **POLICIES**

Students are expected to attend and participate in class. Class exams are announced well in advance and students are obliged to take tests at the scheduled times. The obvious reasons for the exam policy are for fairness to the entire class. A penalty of a *10% per day deduction from the score* will be given to those who have an unexcused absence.

Examples of unexcused absences include, but are not limited to: attendance at weddings, convenient rides home, oversleeping, unpreparedness. Examples of excusable absences include verifiable illness, and family emergency. Prior notice may be given by calling the Physics Department office at 457-5260, or the instructor at 457-5854, or by sending e-mail to the instructor at the e-mail address listed above. If you are in doubt of the status of a pending absence, discuss the matter with the instructor prior to the test date.
VI. Course Outline:

1. What are Sound Waves?
   A. Periodic pressure waves
      i) Longitudinal Waves: Sound
      ii) Transverse Waves; Strings
   B. Speed of Sound
      i) Increases with temperature
      ii) Changes with molecular weight of gas
      iii) Speed in liquids and solids
   C. Frequency
      i) Determines musical pitch
      ii) Equal to 1/(period of vibration)
   D. Amplitude
      i) The size of the wave
      ii) Relationship to loudness and energy of wave
   E. Timbre (Quality of a musical note)
      i) Harmonics of a fundamental frequency
      ii) Most notes are a mixture of harmonics
      iii) The exact mixture and phase of the harmonics determines the timbre
   F. \((\text{Frequency} \times \text{Wavelength}) = \text{Wave Velocity}\)
      i) Usually, the velocity is fixed, so the frequency and wavelength are inversely related
   G. Application: Why does helium change one’s voice?
   H. The Doppler Effect
      i) A moving source changes frequency heard
      ii) A moving observer changes the frequency heard
   I. Shock Waves
      i) Caused by a source of waves moving at a speed greater than or equal to the speed of the waves
      ii) Examples: Sonic booms, boat wakes

2. How Do We Hear? The Physics of Hearing
   A. Human Hearing Frequency Range
      i) Normal = 20 to 20,000 Hz
      ii) High frequency limit decreases with age
      iii) Range can be reduce by hearing damage
   B. Loudness: Decibels
      i) Logarithmic response in perceived loudness
      ii) Examples from everyday life
      iii) Hazardous sound levels and hearing loss
   C. Interference of sound waves
      i) Superposition of waves
      ii) Waves of different frequencies produce beats
      iii) Equal waves in opposite directions produce standing waves
D. Pitch Perception
   i) Differentiation of different frequencies
   ii) Tuning instruments
E. Spatial Location and Phase
   i) Binaural hearing is necessary to determine the location of a sound source
   ii) Phase relationship of sounds received by each ear.
      a) very high and very low frequencies are hard to localize
      b) sonar in bats

A. Musical Scales: Why these notes?
   i) The harmonic series
   ii) Mathematical harmony
   iii) Dissonance
B. Timing
   i) Rhythm
   ii) Tempo
D. Dynamics
   i) Loudness
   ii) Attack and decay of notes
E. Tone Quality
   i) The mixture of harmonics is influenced by technique
   ii) Resonances and natural frequencies
   iii) Variation between similar instruments

4. How Do Musical Instruments Work?
A. Strings
   i) Standing waves on a string
   ii) Bowed string instruments: The Violin Family
   iii) Plucked string instruments: Harp, Guitar and others
   iv) Hammered string instruments: Piano, Hammered Dulcimer
   v) What influences tone quality?
B. Woodwinds
   i) Single and Double Reeds
      a) Clarinet family: cylindrical bore instruments
      b) Saxophone family: conical bore instruments
   ii) Flutes, piccolos and fifes
   iii) Whistles
C. Brass Instruments
   i) Valve mechanisms and notes
   ii) Tone quality
   iii) Mutes
D. Voice
   i) The vocal apparatus
   ii) Resonant cavities
   iii) Vocal Formants
   iv) Vocal injuries and their prevention
E. Percussion
   i) Drums
   ii) Tuned bars: Glockenspiels, etc
F. Miscellaneous Instruments

5. **Reflection and Absorption of Sound Waves**
   A. Tuned Pipes
      i) Both ends open
      ii) One end open
   B. Echoes
      i) Under what circumstances do echoes occur?
      ii) What determines the “echo time”?

6. **Diffraction of Sound Waves**
   A. Diffraction of sound from a source
      i) Waves coming from a source that is small compared their wavelength spread out in all directions
      ii) In general, high frequencies spread out less, since their wavelengths are smaller, low frequencies spread out more
   B. Dispersion angle of sounds

7. **Acoustics: Concert Hall Design**
   A. Acoustical Paths: Reflections
      i) There are multiple paths for sound
      ii) These sounds arrive at different times
   B. Reverberation
      i) The sum of all the sound paths causes the sound amplitude build up over time.
      ii) When the sound source is cut off, sound levels decay over time
      iii) Definition of Reverberation Time
   C. “Live” and “Dead” spots
      i) Constructive and destructive interference
      ii) Resonances
   D. Sound Absorption and Soundproofing
      i) Reducing the reverberation time in large halls
      ii) Eliminating unwanted sounds from outside

8. **Electronic Instruments**
   A. Electric Organs
   B. Electric Pianos
   C. Electric Guitars

9. **Electronic Systems**
   A. Recording and Reproduction of Sound
      i) Microphones
      ii) Speakers and Earphones
      iii) Recording media, from wax cylinders to magnetic tape
      iv) Digital recording and editing
   B. Digital Music: Producing Sound
      i) Synthesizers
      ii) Garage Band, and others
C. Filtering and Equalization
   i) What filters do
   ii) Equalizers: trying to fix imperfect speakers and listening environments
   iii) Feedback prevention

10. New Media
   A. Music on the Web
      i) Digital file formats
      ii) How your computer turns the files into sound
   B. CD music
      i) Digitization and recording
      ii) Why there is no noise
   C. MP3 Players
      i) Making the music data files smaller: compression
      ii) Decoding and playing the files: the nuts and bolts

Additional Resources:


Laboratory Schedule:

Week 1: Introduction and Software Installation
Week 2: Speed of Sound
Week 3: Standing Waves on a String – Overtones
Week 4: Loudness – Decibels
Week 5: Resonance
Week 6: Standing Waves in Tubes – Open and Closed Ends
Week 7: Frequencies of the Musical Scales
Week 8: Interference of Sound
Week 9: Doppler Effect
Week 10: Echoes, Reverberation Time of a Room
Week 11: Harmonic Analysis
Week 12: Formants and the Human Voice
Week 13: Overtones of Woodwinds
Week 14: Overtones of the Violin Family
Week 15: Digital Sound recording and Editing
Include a Financial and Staffing Data Sheet with any proposal for a new course, new program, or revised program.

Please answer the following questions completely. Provide supporting data.

1. Would this course or program be taught with existing staff or with new or additional staff? If this course would be taught by adjunct faculty, include a rationale.

   This course would be taught by existing staff – Dr. Frederick Otto

2. What impact would approval of this course/program have on current course offerings? Please discuss number of sections of current offerings, dropping of courses, etc.

   The department would offer one less University Studies course (chosen from Physics 115 – Conceptual Physics or Physics 140 – Energy) to allow us to reallocate staff for this offering. Physics 160 – The Science of Music will be submitted for University Studies approval as Natural Science course with laboratory, so the department’s number of University Studies offerings per year will be unchanged.

3. What effect would approval of this course/program have on the department supplies? Include data to support expenditures for staffing, equipment, supplies, instructional resources, etc.

   The impact will be minimal – the laboratories have no consumable supplies. Additional equipment to support labs and demonstrations will be allocated from the department’s annual equipment budget, as needed. The department already has most of the apparatus necessary for the labs and lecture demonstrations.

[Revised 9-05]
**WINONA STATE UNIVERSITY**  
**NEW AND REVISED COURSE AND PROGRAM APPROVAL FORM**

Routing form for new and revised courses and programs.  
Course or Program: Physics 160

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<th>Department Recommendation</th>
<th>10-14-09</th>
<th><a href="mailto:fetto@winon.edu">fetto@winon.edu</a></th>
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<td>Department Chair</td>
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<tr>
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<td>President</td>
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Please forward to Registrar.  
Registrar: Date entered: Please notify department chair via e-mail that curricular change has been recorded.

[Revised 7-5-07]

**Physics 160 – New Course Proposal**
WINONA STATE UNIVERSITY
REQUIRED CHECKLIST FOR ALL CURRICULAR PROPOSALS

Course or Program: Physics 160

This checklist enables A2C2 representatives to endorse that their departments have accurately followed the Process for Accomplishing Curricular Change. For each course or program proposal submitted to A2C2, this checklist must be completed, signed by the submitting department's A2C2 representative, and included with the proposal when forwarded for approval. Peer review of proposals is also strongly advised, e.g., departments should discuss and vote on the proposals as submitted to A2C2, rather than on just the ideas proposed or drafts of proposals.

If a proposal fails to follow or complete any aspect of the process, the Course and Program Proposal Subcommittee will postpone consideration of the proposal and return it to the department's A2C2 representative for completion and resubmission. Resubmitted proposals have the same status as newly submitted proposals.

Note: This form need not be completed for notifications.

1. The appropriate forms and the “Approval Form” have been completed in full for this proposal. All necessary or relevant descriptions, rationales, and notifications have been provided.
   ✔ Completed

2a. The “Financial and Staffing Data Sheet” has been completed and is enclosed in this proposal, if applicable.
   ✔ Completed

2b. For departments that have claimed that “existing staff” would be teaching the course proposed, an explanation has been enclosed in this proposal as to how existing staff will do this, e.g., what enrollment limits can be accommodated by existing staff. If no such explanation is enclosed, the department's representative is prepared to address A2C2’s questions on this matter.
   ✔ Completed

3. Arrangements have been made so that a department representative knowledgeable of this proposal will be attending both the Course and Program Proposal Subcommittee meeting and the full A2C2 meeting at which this proposal is considered.
   ✔ Completed

   Name and office phone number of proposal's representative: Frederick Ott, 585-4

4. Reasonable attempts have been made to notify and reach agreements with all university units affected by this proposal. Units still opposing a proposal must submit their objections in writing before or during the Course and Program Proposal Subcommittee meeting at which this proposal is considered.
   ✔ Completed

5. The course name and number is listed for each prerequisite involved in this proposal.
   ✔ Completed

6. In this proposal for a new or revised program (major, minor, concentration, etc.), the list of prerequisites provided includes all the prerequisites of any proposed prerequisites. All such prerequisites of prerequisites are included in the total credit hour calculations.
   ✔ Completed

7. In this proposal for a new or revised program, the following information for each required or elective course is provided:
   a. The course name and number.
   b. A brief course description.
   c. A brief statement explaining why the program should include the course.
   ✔ Completed

8. This course or program revision proposal:
   a. Clearly identifies each proposed change.
   b. Displays the current requirements next to the proposed new requirements, for clear, easy comparison.
   ✔ Completed

9. This course proposal provides publication dates for all works listed as course textbooks or references using a standard form of citation. Accessibility of the cited publications for use in this proposed course has been confirmed.
   ✔ Completed

Department's A2C2 Representative or Alternate: [Signature]

Date: 14 Oct 2009

[Revised 9-03]