AUBURN UNIVERSITY

Date: 08/01/2014 *(MM/DD/YYYY)*

Proposal Form For Addition And Revision Of Courses

1. Proposing College / School: Samuel Ginn College of Engineering

Department: Aerospace Engineering

2. Course Prefix and Number: AERO 6410/6416

3. Effective Term: Fall 2015

4. Course Title: Aeroacoustics

Abbreviated Title (30 characters or less): Aeroacoustics

5. Requested Action:

- ○ Renumber a Course — Current Course Number:
- ◉ Add a Course — Proposed Course Number:
- ○ Revise a Course — Type of Revision:

6. Course Credit:

Contact/Group Hours	Scheduled Type (e.g.: Lab, Lecture, Practicum, Directed Study)	Weekly or Per Term?	Credit Hours	Anticipated Enrollment
3	Lecture	3	3	25

Maximum Hours (Repeatability): 3

Total Credit Hours: 3

7. Grading Type: ◉ Regular (ABCDF) ○ Satisfactory/Unsatisfactory (S/U) ○ Audit

8. Prerequisites/Corequisites:

Use "P:" to indicate a prerequisite, "C:" to indicate a corequisite, and "P/C:" to indicate a prerequisite with concurrency.

P AERO 4140 or departmental approval

9. Restrictions: *List specific restriction in space above.* ☒ College ☐ Major ☐ Standing ☐ Degree

10. Course Description:

(20 Words or Less; exactly as it should appear in the Bulletin)

Fundamental concepts in acoustics: decibel scales, sound propagation and measurement, plane and spherical waves, room acoustics, transmission and reflection, reverberant fields and noise assessment.

11. May Count Either: AERO 5410/3 **or** AERO 6410/6 *(Indicate if this particular course cannot be counted for credit in addition to another)*

12. Affected Program(s): *(Respond "N/A" if not included in any program; attach memorandum if more space is required)*

Program Type (e.g.: minor, major, etc.)	Program Title (e.g.: MS in Chemistry, Performance Option, Minor in Art)	Requirement or Elective? (required or optional?)
Graduate	Master in Aerospace Engineering	Elective
Graduate	PhD in Aerospace Engineering	Elective

13. Overlapping or Duplication of Other Units' Offerings:

(If course is included in any other degree program, is used as an elective frequently by other unit(s), or is in an area similar to that covered by another college/school, attach correspondence with relevant unit)

◉ Applicable ○ Not Applicable

14. Justification:

An aeroacoustical analysis is an increasing important phase of the design process for many ground-based vehicles and flight vehicles. Safe and acceptable designs for automobiles, aircraft, launch vehicles, etc., require that the aeroacoustical environment surrounding these vehicles be defined and examined as part of the design process. Students need to be introduced to the basics of aeroacoustics as part of their engineering education.

(Include a concise, yet adequate rationale for the addition/revision of the course, citing accreditation, assessments (faculty, graduate, and/or external) where applicable)

15. Resources:

No additional resources are required.

(Indicate whether existing resources such as library materials, classroom/laboratory space, and faculty appointments are adequate to support the proposed addition/revision; if additional resources are required, indicate how such needs will be met, referencing the appropriate level of authorization -- i.e.: Dean -- where necessary; if no additional resources or shifting of resources will be necessary, respond "Not Applicable")

16. Student Learning Outcomes:

1. an understanding of the fundamentals of the theory and measurement of acoustics and noise control
2. an understanding of the physical principles associated the production of sound from vibrations and waves
3. an understanding of acoustical devices
4. an understanding of the behavior of sound waves in enclosed spaces
5. an understanding of interaction between acoustical waves and structural vibration.

The first four learning outcomes pertain to both undergraduate and graduate students. The last learning outcome is one where the undergraduates would be expected to demonstrate understanding of very simple acoustic-structure interactions. The graduate students are expected to explore a much more complicated acoustic-structure interaction environment for their Graduate Project (see grading info)

(State in measurable terms (reflective of course level) what students should be able to do when they have completed this course)

17. Course Content Outline:

Textbook: Bose, T, Aerodynamic Noise: An Introduction for Physicists and Engineers, Springer, 2012

References

1. Temkin, Samuel, Elements of Acoustics, Wiley, 1981.
2. Pierce, Allan D., Acoustics: An Introduction to its Physical Principles and Applications, McGraw, 1981.
3. Lord, H., Gatley, W. S. and Evensen, H.A., Noise Control for Engineers, McGraw, 1980.
4. Diehl, G. M., Machinery Acoustics, Wiley, 1973.

Topics: One dimensional wave equation: modal solution (separation of variables) and traveling wave solutions (D'Alembert's solution). Concepts of work, power, energy density and intensity for harmonic plane and spherical waves; acoustical impedance in near and far fields. Introduction to aeroacoustics: monopoles, dipoles, quadropoles, subsonic and supersonic flows, pressure, velocity and intensity fields; Lighthill's theory. Frequency spectra: periodicity, Fourier series, Fourier integrals and the discrete Fourier transform. Acoustics of enclosures: absorption, reflection and transmission of sound; sound levels in rooms, reverberation rooms and anechoic chambers.

Lecture Subject (45 lectures based on a MWF format)

1 Introduction
2 Math - Complex numbers
3 Wave equation
4 Plane waves
5 Plane waves
6 Fourier analysis
7 Fourier analysis
8 Acoustic energy
9 Decibel Scales

10 The ear and human hearing
11 Reflection
12 Reflection
13 Transmission
14 Transmission
15 Variable area
16 Exam I
17 Spherical waves
18 Spherical waves
19 Simple sources
20 Simple sources
21 Other sources
22 Piston sources
23 Forces and dipoles
24 Quadrupoles
25 Room acoustics
26 Room acoustics
27 Room acoustics
28 Room acoustics
29 Semireverberant fields
30 Semireverberant fields
31 Noise control approaches
32 Exam II
33 Acoustic-structure interactions
34 Acoustic-structure interactions
35 Acoustic-structure interactions
36 Acoustic-structure interactions
37 Acoustic-structure interactions
38 Acoustic-structure interactions
39 Noise standards
40 Community noise
41 Aircraft noise
42 Traffic noise
43 Indoor noise
44 Materials
45 Review
Final Exam (Final Graduate Project Due)

(Provide a comprehensive, week-by-week breakdown of course content, including assignment due dates)

18. Assignments / Projects:

Homework: 40% contributes to all learning objectives
Exam I: 15% contributes to learning objectives #1 thru #4
Exam II: 15% contributes to learning objectives #1 thru #4
Undergraduate students –Final Exam: 30% - contributes to all learning objectives
Graduate students –Final Project: 30%- contributes to all learning objectives, but with special emphasis on Learning Outcome #5
The Final Project for the graduate students will involve the solution of a problem related to the individual student's area of interest within engineering using the methods developed in the course. This Final Project for the graduate students will replace an in-class final exam. The undergraduate students will not complete a project, but will have to complete an in-class final exam.
The course instructor will work with the Engineering Graduate Outreach Program office to conduct lectures in a video studio classroom. Engineering Outreach will deliver video content to distance learning students. The instructor will use Canvas to communicate with students, provide learning materials, and post assignments and grades. Engineering Outreach will arrange exam proctoring services.

(List all quizzes, projects, reports, activities and other components of the course grade -- including a brief description of each assignment that clarifies its contribution to the course's learning objectives)

19. Rubric and Grading Scale:

Assessment Contribution to Course Grade

Homework: 40%
Exams (2@25%): 30%
Final Exam/Final Project: 30%
Course Grading Scale:
90-100% - A
80-89% - B
70-79% - C
60-69% - D
Below 60% - F

(List all components of the course grade -- including attendance and/or participation if relevant -- with point totals for each; indicate point totals and ranges or percentages for grading scale; for S/U grading, detail performance expectations for a passing grade)

20. Justification for Graduate Credit:

The course material is taught at the graduate level by our peer institutions. Understanding the course material will require a high degree of critical thinking and a knowledge base that can only be obtained outside of the course lecture material by reading the current research literature (peer-reviewed journals). The department has taught this course as a AERO 7970: Special Topics course during the past year and the students found it to be a very challenging course.

(Include a brief statement explaining how the course meets graduate educational standards (i.e.: rigorous standards for evaluation, development of critical thinking and analytical skills, etc.))

(Included below are standard statements regarding course policies. If necessary, a statement may be altered to reflect the academic policies of individual faculty members and/or the academic unit or department, provided that there is no conflict with the Student Policy eHandbook, Faculty Handbook, *or any existing university policy.)*

POLICY STATEMENTS

Attendance: Although attendance is not required, students are expected to attend all classes, and will be held responsible for any content covered in the event of an absence.

Excused Absences: Students are granted excused absences from class for the following reasons: illness of the student or serious illness of a member of the student's immediate family, the death of a member of the student's immediate family, trips for student organizations sponsored by an academic unit, trips for university classes, trips for participation in intercollegiate athletic events, subpoena for a court appearance, and religious holidays. Students who wish to have an excused absence from class for any other reason must contact the instructor in advance of the absence to request permission. The instructor will weigh the merits of the request, and render a decision. When feasible, the student must notify the instructor prior to the occurrence of any excused absences, but in no case shall such notification occur more than one week after the absence. Appropriate documentation for all excused absences is required. Please consult the **Student Policy eHandbook** for more information on excused absences.

Make-Up Policy: Arrangement to make up a missed major examination (e.g.:hour exams, mid-term exams) due to properly authorized excused absences must be initiated by the student within one week of the end of the period of the excused absence(s). Except in unusual circumstances, such as the continued absence of the student or the advent of university holidays, a make-up exam will take place within two weeks of the date that the student initiates arrangements for it. Except in extraordinary circumstances, no make-up exams will be arranged during the last three days before the final exam period begins.

Academic Honesty Policy: All portions of the Auburn University student academic honesty code (Title XII) found in the **Student Policy eHandbook** will apply to university courses. All academic honesty violations or alleged violations of the SGA Code of Laws will be reported to the Office of the Provost, which will then refer the case to the Academic Honesty Committee.

Disability Accommodations: Students who need accommodations are asked to electronically submit their approved accommodations through AU Access and to arrange a meeting during office hours the first week of classes, or as soon as possible if accommodations are needed immediately. If you have a conflict with my office hours, an alternate time can be arranged. To set up this meeting, please contact me by e-mail. If you have not established accommodations through the Office of Accessibility, but need accommodations, make an appointment with the Office of Accessibility, 1228 Haley Center, 844-2096 (V/TT).

Approvals

Joe Majdalani — Department Chair / Head — 1/13/15 — Date

Steve R. Dahl — College / School Curriculum Committee — 1/22/15 — Date

College / School Dean — 1/22/15 — Date

Dean of the Graduate School *(for Graduate Courses)* — Date

Assoc. Provost for Undergraduate Studies *(for Undergraduate Courses)* — Date

Contact Person:	Steve Gross	**Telephone:**	4-6846
E-Mail Address:	grossrs@auburn.edu	**Fax:**	