King Fahd University of Petroleum & Minerals
MECHANICAL ENGINEERING DEPARTMENT
ME 484: Acoustics

Catalogue Description: (3-0-3)
Fundamentals of vibration; Plane and spherical acoustic waves; Radiation, transmission and filters; Loudspeakers and microphones; Speech, hearing, noise and intelligibility; Architectural acoustics; Acoustic measurements and demonstration of measurement apparatus; and Case studies

Status in Curriculum (Required or Elective): Elective

Prerequisites: ME 201, MATH 301

Co-requisites: None

Prerequisites by Topics:
- Kinematics of rigid body (ME201)
- Center of mass and Mass moment of inertia (ME201, CE201)
- Kinetics of rigid body and Newton's second law (ME201)

Textbook: **Fundamentals of Acoustics**, L. Kinsler, A. Fery, A. Coopens, & J. Sanders John Wiley, 4th Edition, 2000

References:
1) **Study Guide**, ME-484 Acoustics, Prepared by Dr. Khulief, ME Department, KFUPM, 2002.
2) **Engineering Principles of Acoustics**, D. Reynolds, Allen & Bacon, Reading, MA, 1981.
3) **Sound and Structural Vibration: Radiation**, *Transmission and response*, F. Fahy, Acad. Press, NY, 1985.

Goals:
This course is intended to teach students the basic principles of acoustics including the theory underlying different acoustic measurements and introductory exposure to noise control. Students shall be provided with techniques for analyzing industrial noise and make them aware of the human and regulatory issues related to noise exposure.

Course Outline (Lecture Topics):

1)	Fundamentals of vibration; The harmonic oscillator; Damped oscillations. Forced oscillations; Mechanical resonance.	(4 Classes)
2)	Vibrating strings and bars; Wave propagation.	(6 Classes)
3)	Acoustic plane waves. Velocity of sound in fluids. Energy density and Acoustic intensity; Specific acoustic intensity; Decibels	(6 Classes)
4)	Spherical waves; General wave equation. Harmonic spherical waves; Spherical radiation and radiation impedance	(6 Classes)
5)	Noise levels and noise criteria.	(3 Classes)
6)	Sound reflection; Resonators and filters and wave-guides; Absorption of sound waves; and acoustic attenuation;	(4 Classes)
7)	Loudspeakers and microphones; Direct-radiator speakers; Horn loud-speakers; Microphones and sound-level meters;	(5 Classes)
8)	Architectural acoustics; Growth and decay of sound in a room; Reverberation time; Sound absorption materials.	(3 Classes)
9)	Case studies in industrial noise.	(8 Classes)

Design Activities/Projects:
As part of the homework assignments, students are required to design noise silencers such as a car muffler and noise attenuators like partitions and barriers.

Computer Usage:
Students are encouraged to use the available engineering software to solve and present their homework assignments.

Laboratory: None

Assessment Tools:

i- Mid-term Examinations
ii- Homework Assignments
iii- Quizzes
iv- Term Project
v- Final Exam

Course Learning Outcomes:

1. Students shall demonstrate knowledge of the fundamental assumptions related to the derivation of the wave equation.
2. Students shall demonstrate knowledge of the basic instruments used to experimentally characterize acoustics fields.
3. Students shall demonstrate ability to represent acoustic parameters in terms of decibel levels for pressure, power, intensity, impedance, equivalent level descriptors, and statistical level descriptors.
4. Students shall demonstrate the ability to characterize treatment effectiveness in terms of insertion loss.
5. Students shall demonstrate ability to select or design simple barrier and enclosure type noise control treatments given performance criteria.
6. Students shall demonstrate knowledge of how noise is being generated in an industrial environment.
7. Students shall demonstrate knowledge of the mechanism of human hearing, and of noise-induced hearing damage.
8. Students shall demonstrate the ability to assess the legality of a noise exposure history under OSHA regulations.
9. Students shall demonstrate the ability to assess the suitability of a given noise environment to accepted usage practices, and noise exposure history under OSHA regulations.

Course Learning Outcomes mapped to Student Outcomes:

Student Outcomes	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*
Course-to-Student outcome mapping	1, 3, 4, 5, 6, 7		5		2, 3, 4, 5, 9			8, 9			2
Emphasis*	**S**		**M**		**M**			**M**			**M**

* **L**:: Little/None **M**: Moderate **S**: Strong

Status of Continuous Improvement review of this Course:

Date reviewed: March 9, 2015 **Reviewed by:** Dr. Saif Al-Kaabi