SPPH 569: Industrial and Environmental Acoustics & Vibration Syllabus

ACKNOWLEDGEMENT

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xwməθkwəy̓əm (Musqueam) people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on their culture, history, and traditions from one generation to the next on this site.

COURSE INFORMATION

Course Title	Course Code Number	Credit Value
Occupational and Environmental Acoustics and Vibration	SPPH 569	3 Credits

PREREQUISITES AND COREQUISITES

None

CONTACTS

Course Instructors	Contact Details	Office Location	Office Hours
Hugh Davies	For most course-related enquiries, please use Canvas discussion board "Administration" thread. For personal issues or private matters, email: hugh.davies@ubc.ca. In an emergency, you can call my office: +1 (604) 822 6777	SPPH 360A	By Appointment
Robin Van Driel	For most course-related enquiries, please use Canvas discussion board "Administration" thread. For personal issues or private matters, email: robin.vandriel@ubc.ca	SPPH 366C	TBA

OTHER INSTRUCTIONAL STAFF

Course TA: Drew Lichty
Email: alichty@student.ubc.ca

Lab Manager: Matty Jeronimo
Email: matty.jeronimo@gmail.com

COURSE STRUCTURE

All materials and instructions are provided on the UBC Canvas learning management system.

There is one Canvas module for each week. Students are responsible for:

- assigned required readings,
- watching video-lecture,
- completing quizzes, and
- undertaking other activities, assignment and discussions

We will meet as a class three times per week – 2 lectures and 1 lab. The lectures are held on Tuesday and Wednesday mornings at 0900, and the labs are held on Thursday mornings at 0900.

During lecture session periods, we will review and discuss topics assigned for that week, including:

- begin with review of weekly quiz
- active discussion of readings and short lectures
- individual and small group activity
- broader discussion integrating course material into the occupational hygiene professional practice

Students should expect to work 8 hours per week (inclusive). Some activities may include use of laboratory equipment that will be supplied to the student. Supplementary readings offer alternative approaches to topics or more in-depth coverage.

LEARNING OUTCOMES

The objective of this course is to give occupational hygiene students the basic knowledge required to measure, assess, analyze and solve noise and vibration problems in (mostly) industrial situations, and to discuss such problems and their solutions with specialists in the field.

Students will acquire a knowledge of acoustical and vibration concepts, quantities and terminology and measurement techniques. They should achieve a basic understanding, and some hands-on experience, of the characteristics of sound waves and of how sound propagates, of the effects of sound and vibration on humans and how to mediate these effects.

They should acquire a general understanding of measures available to control noise and vibration problems and of their cost- effectiveness. They should be capable of doing basic calculations to predict noise and vibration levels and reductions.

See also Schedule of Topics, below.

ASSESSMENTS OF LEARNING

Your mark in this course will comprise the following parts:

- 12 Weekly quizzes 40%
- 6 Labs assignments 40%
    - SLM – Intro and propagation and frequency analysis (Lab 2 and Lab 3) - 5%
    - SLM – mapping – 7%
    - Dosimeter – 8%
    - Vibration – 5%
    - Engineering Controls – 5%
    - Hearing protection – 10%
- Mid-term Evaluation 10%
- Final 10%

Quizzes (40%): Weekly quizzes will test your grasp of the material covered in the assigned required readings and the taped video lectures. These will be graded automatically and reviewed in the first of two weekly lecture sessions.

Labs (40%): You will be assigned a hands-on activities to complete. We will tell you how to summarize your activity and submit for grading. These “labs” will be conducted both in the SPPH building and in the field.

Midterm Evaluation (10%): an in-class exam will cover material in the first half of the course.

Final Exam (10%): an in-class exam will cover material in the second half of the course.

General Grading Rubric (from the UBC Department of Educational Studies, Graduate Course Grading Policy):

A Level (80% to 100%)

A+ is from 90% to 100%: *It is reserved for exceptional work that greatly exceeds course expectations.* In addition, achievement must satisfy all the conditions below.

A is from 85% to 89%: A mark of this order suggests *a very high level of performance on all criteria* used for evaluation. Contributions deserving an A are distinguished in virtually every aspect. They show that the individual (or group) significantly shows initiative, creativity, insight, and probing analysis where appropriate. Further, the achievement must show careful attention to course requirements as established by the instructor.

A- Is from 80% to 84%: It is awarded for generally high quality of performance, no problems of any significance, and fulfillment of all course requirements.

B Level (68% to 79%)

This category of achievement is typified by *adequate but unexceptional performance* when the criteria of assessment are considered. It is distinguished from A level work by problems such as: One of more significant errors in understanding, superficial representation or analysis of key concepts, absence of any special initiatives, or lack of coherent organization or explanation of ideas.

The level of B work is judged in accordance with the severity of the difficulties demonstrated. B+ is from 76% to 79%, B is from 72% to 75%, and B- is from 68% to 71%.

C Level (55% to 67%)

Although a C+, C, or C- grade may be given in a graduate course, the Faculty of Graduate Studies considers 68% as a minimum passing grade for doctoral graduate students.

UBC POLICIES

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available on the UBC Senate website.

ACADEMIC RESOURCES AND INTEGRITY

See the UBC website "Academic Resources" for a list of many useful academic resources, including:

- Writing skills
- Library and research
- Relevant school and university policies

Academic integrity "means being an honest, diligent, and responsible scholar" ("Understanding Academic Integrity"). One important aspect of this is avoiding plagiarism. Fortunately, this is simple to do! See "Avoiding Plagiarism".

OTHER COURSE POLICIES

Safety Equipment:

Many MSc(OEH) courses require field trips where PPE (**CSA-approved** safety shoes/boots, safety glasses, hearing protection, hardhat and hi-visibility vests) are required.

Late assignments:

All assignments, and lab reports are due **at the beginning of class on the day they are due**. NO EXCEPTION: Late assignments will be deducted 10% of maximum score per day they are late (1-24 hours, 10% off, 25-48 hours, 20% off, etc.).

SCHEDULE OF TOPICS

Note, due to orientation activities, and university and statutory holidays, there are no classes on the following dates: **Sept 6th, and Nov 9th, 10th.** The last day of class in this term is December 7th.

WEEK 1: INTRODUCTION TO THE COURSE AND TO THE FIELD OF OCCUPATIONAL HYGIENE

Learning objectives:

- Orienting students to this course and the MSc(OEH) program
- Describe the field of occupational hygiene through lens of occupational noise exposure and noise-induced hearing loss
- Use the OH paradigm of "recognition, evaluation and control" appropriately in the context of occupational noise hazard
- Discuss noise-induced hearing loss as an "occupational" disease
- Reflect upon, and measure the world of noise around us

Required Reading	**Supplementary Reading**	**Video Lectures**	**Activities**	**Evaluation**
Course syllabus Meinke et al. Ch 1	Dembe, 1996	Introduction: "Noise and the occupational hygienist"		None

WEEK 2: PHYSICS OF NOISE

Learning objectives:

- Introduce soundwaves, as pure tones and as broadband sound
- Compare sound pressure, power, intensity
- Describe sound propagation
- Define the decibel

Required Reading	**Supplementary Reading**	**Video Lecture**	**In class activities, labs**	**Evaluation**
Meinke et al. Ch 2, pp 11-20	Hansen, CH "Fundamentals of Acoustics", pp 23-40	The Physics of Sound	1. Worksheet: logarithms 2. Lab 1 Ice-breaker activities	1. Quiz 1

WEEK 3: BASICS OF NOISE MEASUREMENT

Learning objectives:

- Explain the setup and use of the sound level meter to measure sound
- Use decibel arithmetic to construct noise metrics

Required Reading	**Supplementary Reading**	**Video Lecture**	**In class activities, labs**	**Evaluation**
Earshen, 2003	Meinke et al. Ch 3, pp 11-20 Malchaire, 2001	Basis of noise measurement	1. SLM operations 2. Worksheet: logarithms 3. Worksheet: decibel	1. Quiz 2 2. Lab 2

WEEK 4: PSYCHOACOUSTICS AND FREQUENCY WEIGHTING

Learning objectives:

- Describe psychoacoustic phenomena such as loudness
- Define a “phon”, equal loudness curves
- Calculate weighted sound pressure levels
- Discuss common noise *exposure* metrics (L_{eq}, L_{ex}, etc.)

Required Reading	**Supplementary Reading**	**Video Lecture**	**Activities**	**Evaluation**
Suter Chapter 9 WorkSafeBC, 2007 WorkSafeBC, 2019 (Part 1 & 2)	Hansen, CH “Fundamentals of Acoustics”, pp 40-48 Meinke et al. Ch 2, pp 21-24	Broadband noise and frequency weighting	1. Worksheet: decibels 2. Calculating weighted SPL	1. Quiz 3 2. Lab 3

WEEK 5: NOISE DOSE, REGULATION OF NOISE EXPOSURE

Learning objectives:

- Define exposure "dosimetry"
- Explain the setup and use of the noise dosimeter
- Use noise dosimetry to estimate long-term noise exposure
- Assess compliance using dosimetry techniques
- Discuss difference in noise regulations across Canadian and international jurisdictions

Required Reading	**Supplementary Reading**	**Video Lecture**	**Activities**	**Evaluation**
Meinke et al., Ch 9, pp 175-186 CSA 104-57 (2013) WorkSafeBC, 2019 (Part 3 & 4)	Noise Calculations ANSI S1.25-1991 / CSA Z107.56-18 ACGIH TLV for audible sound	Assessing regulatory compliance	1. Worksheet: Dosimetry	1. Quiz 4 2. Lab 4

WEEK 6: THE AUDITORY SYSTEM

Learning objectives:

- Describe the basic anatomy and physiology of the normal human auditory system
- Describe the functioning of the inner ear
- Interpret simple audiometry data

Required Reading	**Supplementary Reading**	**Video Lecture**	**Activities**	**Evaluation**
Meinke et al., Ch 4 Walker, 2013	Alberti, 2001, Ch 2 Meinke, et al. Ch 13	Overview of human auditory system	1. Worksheet: Interpreting audiograms	1. Quiz 5 2. Lab 5

WEEK 7: NOISE-INDUCED HEARING LOSS (NIHL)

Learning objectives:

- Describe work-related disease processes that impact hearing
- Discuss health impact of NIHL
- Discuss social burden of noise-related disease

Required Reading	Supplementary Reading	Video Lecture	Activities	Evaluation
Meinke et al., Ch 5, pp 79-85 Sliwinska-Kowalska, 2012 Hallberg, 2009	Alberti, 2001, Ch 3 Axelson, 2009 Tak, 2009 Masterson, 2013	Hearing pathologies	1. Worksheet: Dosimetry	1. Quiz 6 2. Lab 6 (field work 1)

WEEK 8 NOISE AND NON-AUDITORY DISEASE, OTOTOXICITY

Learning objectives:

- Describe the community response to noise, annoyance, and stress
- Explain non-auditory disease mechanisms of noise
- Discuss role of noise in heart disease and other chronic disease
- Describe chemical noise interaction on auditory toxicity
- Explain mechanisms of ototoxicity

Required Reading	Supplementary Reading	Video Lecture	Activities	Evaluation
Meinke et al., Ch 5, pp 85-91 Meinke et al. Ch 7 TLV for Audible Sound (Ototoxicity Section)	Gan, 2012 Clark, 2005 European Night Noise Guidelines, 2009 Community Noise Guidelines for EU WHO Burden of Disease from Environmental Noise Morata, 1993, 2003 TLV's: Ultrasound, Infrasound	Non-hearing pathologies related to noise	1. Worksheet: Describing the acoustic space	1. Quiz 7 2. Lab 7 (field work 2)

WEEK 9: HEARING CONSERVATION PROGRAMS

Learning objectives:

- Explain the components of the "hearing conservation program" (HCP)
- Discuss how the HCP relates to the "controls hierarchy"
- Describe the administrative control aspects of HCP's
- Discuss challenges and limitations of HCP's

Required Reading	**Supplementary Reading**	**Video Lecture**	**Activities**	**Evaluation**
Meinke et al., Ch 8 WorkSafeBC Sound Advice Hetu, 1994	WorkSafeBC 2019 Suter, 2009 Davies, 2012 Meinke et al., Ch 14 Meinke et al., Ch 15	Introduction to the hearing conservation program	1. Worksheet: Describing the acoustic space	1. Quiz 8 2. Lab 8 (Field work 3)

MID-EXAM (Nov. 8th) / Reading Week

WEEK 11: ENGINEERED NOISE CONTROLS

Learning objectives:

- Describe how sound propagates through air
- Estimate sound absorption properties of rooms
- Describe room acoustic characters based on geometry and absorption
- Describe common sound control strategies
- Discuss design and challenges of sound control

Required Reading	**Supplementary Reading**	**Video Lecture**	**Activities**	**Evaluation**
Meinke et al., Ch 10 OSHA Guide	Owens Corning "Noise Control" booklet	Foundations of noise control engineering	1. Worksheet: Noise control calculations	1. Quiz 9 2. Lab 9

WEEK 12: HEARING PROTECTION DEVICES

Learning objectives:

- Discuss hearing protection device (HPD) design types
- Explain HPD fit and fit testing
- Describe problems and limitations associated with HPD

Required Reading	**Supplementary Reading**	**Video Lecture**	**Activities**	**Evaluation**
Meinke et al., Ch 11 Meinke et al., Ch 12 E-A-R LOG 5, 8, 9, 10, 20	Other E-A-R LOG's	Basics of hearing protection	1. Worksheet: Effective hearing protection	1. Quiz 10 2. Lab 10

WEEK 13: HUMAN RESPONSE TO VIBRATION

Learning objectives:

- Calculate human vibration exposure level
- Evaluate risk from vibration exposures
- Discuss vibration mitigation approaches

Required Reading	Supplementary Reading	Video Lecture	Activities	Evaluation
B&K Human Vibration ISO 2631 Standard		Vibration and human health	1. Worksheet: Vibration metrics	1. Quiz 11 2. Lab 11

WEEK 14: VIBRATION MEASUREMENT AND CONTROL

Learning objectives:

- Describe hand arm and whole-body vibration sources
- Explain disease mechanisms associated with vibration

Required Reading	Supplementary Reading	Video Lecture	Activities	Evaluation
B&K Human Vibration	Hand-Arm Vibration TLV Whole-Body Vibration TLV EU Good practices Guide to WBV Burstrom et al., 2015 Nilsson et al., 2017	Vibration measurement and control	1. Worksheet: Vibration metrics	1. Quiz 12

FINAL EXAM (Week of Dec 12th)