

Course guide

200252 - MUS - Music and Mathematics

Last modified: 21/06/2023

Unit in charge: School of Mathematics and Statistics
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN MATHEMATICS (Syllabus 2009). (Optional subject).

Academic year: 2023 **ECTS Credits:** 3.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: FRANCESC XAVIER GRACIA SABATE

Others: Segon quadrimestre:
FRANCESC XAVIER GRACIA SABATE - M-A

PRIOR SKILLS

Generic mathematical knowledge such as that acquired in the first two years of a science or engineering degree is required. More particularly, you need to be familiar with differential equations and solving boundary value problems for partial differential equations. It is also necessary to have studied music at an intermediate level, without which the subject has little motivation.

REQUIREMENTS

Having studied a subject where partial differential equations are explained at a basic level.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

GM-CE1. CE-1. Propose, analyze, validate and interpret simple models of real situations, using the mathematical tools most appropriate to the goals to be achieved.
GM-CE3. CE-3. Have the knowledge of specific programming languages and software.
GM-CE5. Knowing how to use search tools of bibliographic resources in Mathematics.
GM-CE6. Ability to solve problems from academic, technical, financial and social fields through mathematical methods.

Generical:

GM-CB2. CB-2. Know how to apply their mathematical knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader or multidisciplinary contexts related to Mathematics.
GM-CB4. CB-4. Have the ability to communicate their conclusions, and the knowledge and rationale underpinning these to specialist and non-specialist audiences clearly and unambiguously.
GM-CB5. To have developed those learning skills necessary to undertake further interdisciplinary studies with a high degree of autonomy in scientific disciplines in which Mathematics have a significant role.

Transversal:

04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

TEACHING METHODOLOGY

Theoretical expository classes, supplemented with listenings or videos, and the completion of exercises.



LEARNING OBJECTIVES OF THE SUBJECT

To study some of the many connections between music and mathematics, such as the description of the sound produced by musical instruments, the building of scales and tuning systems, and the description of the patterns that appear in musical compositions.

STUDY LOAD

Type	Hours	Percentage
Hours large group	15,0	20.00
Hours small group	15,0	20.00
Self study	45,0	60.00

Total learning time: 75 h

CONTENTS

Introduction

Description:

Music, the art of sound.

Full-or-part-time: 1h

Theory classes: 1h

Spectra of musical instruments

Description:

Classification of musical instruments. The wave equation. Vibrating string. Air tubes. Membranes. Bars, plates...

Full-or-part-time: 6h

Theory classes: 6h

Perception of sound and the concept of dissonance

Description:

The ear. Characteristics of sound. Theory of dissonance. Relationship between spectra and scales.

Full-or-part-time: 5h

Theory classes: 5h

Scales and tuning systems

Description:

Intervals and scales. Pythagorean tuning. Just intonation. Mesotonic temperaments. Irregular temperaments. Other scales. Scales generated by an interval.

Full-or-part-time: 10h

Theory classes: 10h



Symmetries and mathematical structures in music

Description:

Musical divertimentos. Transformations and symmetries in musical space. Composition methods; dodecaphonism. Combinatorics of scales and chords. Rhythms.

Full-or-part-time: 8h

Theory classes: 8h

GRADING SYSTEM

15%: participation in the classroom and work done throughout the course;

15%: short final exam, on basic concepts;

70%: completion and presentation of a final work.

BIBLIOGRAPHY

Basic:

- Rossing, Thomas D.; Wheeler, Paul A.; Moore, F. Richard. The science of sound. 3rd ed. San Francisco: Addison Wesley, cop. 2002. ISBN 0805385657.
- Benson, David J. Music : a mathematical offering. Cambridge University Press, 2006. ISBN 0521619998.
- Fletcher, Neville H.; Rossing, Thomas D. The physics of musical instruments. 2nd ed. New York: Springer-Verlag, 1999. ISBN 0387983740.
- William A. Sethares. Tuning, timbre, spectrum, scale [on line]. 2nd ed. London: Springer, 2004 [Consultation: 15/06/2023]. Available on: <https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/b138848>. ISBN 9786610337293.
- Goldáraz Gaínza, J. Javier. Afinación y temperamentos históricos. Madrid: Alianza, 2004. ISBN 8420665460.

RESOURCES

Other resources:

For more information see <https://web.mat.upc.edu/xavier.gracia/musmat> (in Catalan).