IL016-15 The Science of Music

23/24

Department
Institute for Advanced Teaching and Learning
Level
Undergraduate Level 2
Module leader
Oksana Trushkevych
Credit value
15
Module duration
10 weeks
Assessment
100% coursework
Study locations
University of Warwick main campus, Coventry Primary
Royal Birmingham Conservatoire

Description

Introductory description

This interdisciplinary module introduces students (in all subject areas and with any level of musical, mathematical or scientific expertise) to the relationships between science, music and mathematics. The module will touch on aspects of physiology, and psychology in the perception of music and the inspiration of mathematical and scientific ideas in musical composition.

Module web page

Module aims

To help students develop their appreciation and understanding of the complex interplay of mathematics and physics with technological, cultural and historical factors inherent in the making and appreciation of music.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

The core topics of the syllabus will be used as the basis for the lectured material as well as inspiration for student projects and critiques going beyond this core.

Fundamentals of sound: pressure waves in air, the dB scale, frequency as pitch, standing waves, nodes and anti-nodes, Fourier analysis of waveforms, harmonics and timbre, envelope (attack/decay/sustain/release). [MC]
Perception of sound and music: the ear, the psychophysics of sound, body resonances (e.g. bass perception), wellbeing and music, sound illusions. [E]
The physics of acoustic instruments: air columns (e.g. flute vs. clarinet), string vibrations, resonance and sympathy, tuning, timbre and pitch. [P, M]
The physics of electronic instruments and digital sound processing: stability, digital vs. analogue concepts, filtering, distortion and feedback, history of electronic music. [P]
The human voice: resonance, song vs. speech, physiology, pitch, vocal manipulation. [P, E]
Scales and tuning: mathematical relations, equal temperament, consonance & dissonance, history of scales and pitch standards, non-Western scales. [P]
Music in the environment: orchestral layout, speakers and PA systems, room acoustics, reverberation, the challenge of artificial reverb, impulse response. [P, M]
History of Music and cultural perspectives, interdisciplinary topics [MC, M]
Guest lecture on a specific acoustic or electronic instrument or voice [E]

Legend: lecture led by the MC - Module Convenor, P - Physics, E - External Speaker, M-Musicians

Learning outcomes

By the end of the module, students should be able to:

- Demonstrate a theoretical knowledge base and understanding of some of the key abstract mathematical and physical concepts underlying sound, its generation and perception, and musical structure.
- Demonstrate an ability to synthesise interdisciplinary insights in an artistic, historical and cultural framework.
- Reflect on the relationship between the musical and scientific aspects of sound and their own area of specialism.
- Take responsibility for own learning and development in the contexts of (1) interdisciplinary project work, (2) peer assessment and (3) devising topics for the curriculum itself.
- Communicate their own scholarly and creative work in an interdisciplinary environment.

Indicative reading list

Johnston, I. (2009) Measured tones : the interplay of physics and music, London: CRC Press [e-Book, ML 3805.J6)
BBC Radio 4, The Science of Music (2019), 4 episodes, available online https://www.bbc.co.uk/programmes/b01sk5xs

Further reading:
A. Ross, The rest is noise : listening to the twentieth century (2008), London : Fourth Estate [ML 197.R6]

Roederer, J.G. (2001) The physics and psychophysics of music: an introduction , London: Springer
[e-Book]
Sethares, W.A. (2005) Tuning, timbre, spectrum, scale, London: Springer [e-Book]
Giordano, H.J. (2010) Physics of the piano, Oxford: Oxford University Press [ML3805.G56]
Benson, D.J. (2007) Music : a mathematical offering, Cambridge: Cambridge University Press [ML 3805.B3]
Fletcher, N.H. and Rossing T.D. (1998) The physics of musical instruments, New York: Spinger [ML 3805.F5]
The Oxford handbook of voice studies (2019), edited by Nina Sun Eidsheim and Katherine Meizel, Oxford University Press [E-Book]
The Oxford handbook of music and the brain (2019) edited by Michael H. Thaut and Donald A. Hodges, Oxford University Press, [E-Book]
The future of music: towards a computational musical theory of everything (2020), Guerino Mazzola, Jason Noer, Yan Pang, Shuhui Yao, Jay Afrisando, Christopher Rochester, William Neace, Springer
[E-Book]

Research element

Students taking project options can engage in original work including musical and scientific literature-based research, composition and performance, design and software development. All students research a short musical clip and present their findings and critical reflections.

Interdisciplinary

The module aims to explore as many facets of music and musical experience as possible – by using tools from a variety of disciplines. The module is taught by physicists and professional musicians with guest contributions from a neuroscientist, violin maker and singers. In more detail, we focus on understanding some basic physics behind what the sound is, how musical instruments work (acoustic and electronic), how different acoustic venues are designed and why. At the same time we have professional musicians giving input from their point of view and discuss student’s own experiences of listening and performing. We learn about how our hearing works (anatomy and physics), and what happens next when the signals get to the brain -– the neuroscience and perception of music. Professional singers perform and help discuss how vocals work.

Students do a project of their choice in interdisciplinary teams. Interdisciplinary interaction is also fostered through group work in class.

Overall, students get a better understanding of how other disciplines work and learn to communicate with peers specialising in other fields.

Subject specific skills

Knowledge of musical theory and practice.
Interdisciplinary scientific knowledge around sound and music.

Reasoning skills.
Critical skills.
"Close-listening" skills.

Transferable skills

Time management and interdisciplinary team working (projects).
Cross-discipline communication skills: writing, verbal and visual presentation, group discussion.
Problem-solving and analytical skills.
Self-study and critical reflection.
Peer assessment.

Study

Teaching split

Provider	Weighting
School of Engineering	60%
Psychology	5%

Study time

Type	Required	Optional
External visits	(0%)	1 session of 3 hours
Other activity	20 hours (13%)	
Private study	50 hours (33%)	
Assessment	80 hours (53%)	
Total	150 hours	

Private study description

Private study individually and in small groups

Other activity description

Nine 2-hour sessions will incorporate lectured material, listening, discussion, demonstrations and work in small groups. External academics and musicians contribute to these sessions alongside the module leader and Warwick academics. The sessions will be a mix of face to face and online participation, with flexible timing of activities where possible, to allow for timetable clashes.

One further session, making a total of ten, will be devoted to project presentations and peer assessment.

Project groups will have meetings within the group and also with their project supervisors. These could be a mix of face to face and online meetings, or entirely online. The number of meetings with supervisors will be 5 or more, so that their project can progress effectively.

Supervised time in studio/workshop may be required for student mini-projects.

Costs

Category	Description	Funded by	Cost to student
Field trips, placements and study abroad	Day trip to a music venue with variable acoustics (e.g. Birmingham Conservatoire) for the Acoustics in the Environment session. Train cost between £5 to £10 per student depending on route taken.	Student	£10.00

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group A2

	Weighting	Study time	Eligible for self-certification
Project	80%	70 hours	Yes (extension)

Project consists of both (i) a peer-reviewed group presentation or group performance (20% weight), (ii) individual project report (60% weight) and work done (20% weight).
The report comprises an academic research and critique of background literature and detailed account of the work done by the student and the group, and conclusions are drawn (3500 words).

Continuous Assessment	20%	10 hours	No

The continuous assessment includes 10 parts, one for each session.
Session one requires bringing an introductory music clip and providing a commentary.
Sessions 2-9 will have an online quiz to consolidate learning.
Session 10, the project presentations, requires every student to take part in assessing their peers.

Feedback on assessment

Written and/or verbal feedback from peers on peer-reviewed presentation/performance. Optional audio/video recording of presentation/performance.
Written feedback on project report.

Availability

Courses

This module is Optional for:

- Year 4 of UFIA-QW25 Undergraduate Film and Literature

This module is Unusual option for:

- Year 2 of UMDA-B990 Undergraduate Health and Medical Sciences

This module is Unusual option for:

- Year 2 of UFRA-R101 Undergraduate French Studies