Course Syllabus- MUSIC AND APPLIED NEUROSCIENCE

Language of Instruction: English
Professor: Rafael Ramirez
Professor's Contact and Office Hours: Monday-Friday 18-21 hrs
Course Contact Hours: 30 hours
Recommended Credit: 4 ECTS credits
Weeks: 2
Course Prerequisites: None
Language Requirements: English

Course Description:
Brief description of the course.
With the advent of new sophisticated neuroimaging technology providing neurological and biomedical measures of cognitive states, human responses to music are being viewed through a new lens. As a consequence of this, new knowledge is being obtained about how music is able to affect our emotions and psychological states, and how it may produce significant improvements in social, overt and agitated behaviours. This course provides an insight into this fascinating research area focusing on how music can help us to understand brain functioning, as well as how it can be used to improve medical conditions such as post-stroke disabilities, affective disorders, and autism. The topics of the course include an introduction to brain anatomy and organization, followed by a description state-of-the art neuroimaging techniques, music perception and cognition, neural correlates of music and different cognitive functions, music for health and well-being, therapeutic applications of music, brain-computer (music) interfaces, and neurofeedback.

Learning Objectives:
At the end of the course, the student:

· will have acquired survey knowledge of Music Neuroscience

· will poses a solid understanding of
- brain anatomy and organization
- neural correlates of music and emotions
- neuroimaging techniques (e.g., fMRI, EEG, MEG)
- potential therapeutic applications of music
- brain-computer interfaces
- Neurofeedback

Course Workload
Example:
The course is divided into lectures, discussions, and practical sessions. Students should be prepared to read 2 or 3 research papers per week.

Methods of Instruction:
The course consists of theory, discussion sessions, and practical sessions.
- Theory sessions introduce the theory and formal concepts of the course. The concepts analysed in the the theory sessions will be used in the discussion and practical sessions. The student will have to complement this activity with reading of additional material provided by the lecturer.

- Practical sessions develop the practical aspects of the course content. In these sessions, students work on a well-defined practical problem set by the lecturer. At the beginning of a practical session the lecturer will clearly explain the objectives of the session and will give directions on how to accomplish such objectives.
- In the discussion sessions students discuss about course materials (e.g. preselected research papers and book chapters) which they have prepared in advance, and that directly relate to the topics and concepts covered in the theory sessions.

Method of Assessment

Class Participation: 10 percent
Paper presentations: 40 percent
Final Exam: 50 percent

Absence Policy

Attending class is mandatory and will be monitored daily by professors. The impact of absences on the final grade is as follows:

Absences	**Penalization**
Up to one (1) absence	2 points subtracted from final grade (on a 10 point scale).
Two (2) absences	The student receives an INCOMPLETE for the course

The BISS attendance policy does not distinguish between justified or unjustified absences. The student is deemed responsible to manage his/her absences.

Emergency situations (hospitalization, family emergency, etc.) will be analyzed on a case-by-case basis by the Academic Director of the UPF Barcelona International Summer School.

Classroom Norms:

· No food or drink is permitted.
· There will be a ten-minute break during the class.
· Students must come to class fully prepared.

Course Contents:

Please, detail here the course topics distributed on a weekly or daily schedule.

Day	*Classroom activity / activity type*	*Activity out of class / activity type*
Day 1	Theory: Introduction to the brain: neurons, synapses, dendrites, axons	*Reading: (*Koelsch, S. 2014)
Day 2	Theory: the cortex areas and the inner brain functions, music and the limbic system Discussion: music and emotions	*Reading: (Ramirez, R. et al. 2012)*
Day 3	Theory: introduction to neuroimaging Practical session: EEG recording and visualization	*Watch Openvibe video*
Day 4	Practical session: EEG processing and analysis Discussion: non-invasive EEG potential and limitations	*Reading: selected sections of (*Peretz I. and Zatorre, R. J., 2003)

Day 5	Theory: Music perception and cognition Discussion: music cognition	*Reading: (O'kelly, 2015)* *Term paper preparation*
Day 6	Theory: Music therapy	*Reading: (Ramirez et al. 2015)* *Term paper preparation*
Day 7	Practical session: visit to Hospital del Mar, Barcelona	*Quiz for exam preparation*
Day 8	Theory: Brain-computer interfaces and neurofeedback Theory: Exam	

Required Readings: The professor will assemble a course pack/or indicate textbooks.

Recommended bibliography:
Students are encouraged to consult the following sources on their own.

- Peretz I. and Zatorre, R. J. (eds.) (2003). The Cognitive Neuroscience of Music. Oxford and New York: Oxford University Press, 2003, 452 pp., ISBN 0-19-852520-6
- Bruscia, K. E. (2016). Defining music therapy (2nd ed.). ISBN-13: 978-1891278075
- Barbara L. Wheeler (2015). Music Therapy Handbook. Guildford Press, ISBN 9781462529728
- Perani, D. et al. Functional specializations for music processing in the human newborn brain. Proc. Natl Acad. Sci. USA 107, 4758–4763 (2010).
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- Kropotov, IU. D., Quantitative EEG, event-related potentials and neurotherapy, (IUrii Dmitrievich) Amsterdam: Academic Press, cop. 2009, RC386.6.E43 K76 2009
- Wheaton, Clinical EEG and neuroscience, EEG and Clinical Neuroscience Society, 2004
- Gandhi, Vaibhav, Brain-computer interfacing for assistive robotics: electroencephalograms, recurrent quantum neural networks and user-centric graphical interfaces, Amsterdam: Academic Press, [2014]
- Electroencephalography and clinical neurophysiology. [Recurs electrònic], New York, NY: Elsevier Science Pub. Co., 1998
- Openvibe, http://openvibe.inria.fr/
- Todd, N. P. M., Paillard, A. C., Kluk, K., Whittle, E. & Colebatch, J. G. Vestibular receptors contribute to cortical auditory evoked potentials. Hearing Res. 309, 63–74 (2014).
- Todd, N. P. M. & Cody, F. W. Vestibular responses to loud dance music: a physiological basis of the "rock and roll threshold"? J. Acoust. Soc. Amer. 107, 496–500 (2000).
- Balaban, C. D. & Thayer, J. F. Neurological bases for balance–anxiety links. J. Anxiety Disord. 15, 53–79 (2001).
- Blood, A. J., Zatorre, R., Bermudez, P. & Evans, A. C. Emotional responses to pleasant and unpleasant music correlate with activity in paralimbic brain regions. Nature Neurosci. 2, 382–387 (1999).
- Koelsch, S. (2014), Brain correlates of music-evoked emotions, volume 15, Nature Neuroscience
- Ramirez R, Palencia-Lefler M, Giraldo S and Vamvakousis Z (2015) Musical neurofeedback for treating depression in elderly people. Front. Neurosci. 9:354. doi: 10.3389/fnins.2015.00354
- Ramirez, R. and Vamvakousis Z. (2012). Detecting Emotion from EEG Signals Using the Emotive Epoc Device, Brain Informatics, LNCS 7670, pp. 175–184.
- Paul A, Sharda M, Menon S, Arora I, Kansal N, Arora K and Singh NC (2015) The effect of sung speech on socio-communicative responsiveness in children

with autism spectrum disorders. Front. Hum. Neurosci. 9:555. doi: 10.3389/fnhum.2015.00555

- Menon, V. & Levitin, D. J. The rewards of music listening response and physiological connectivity of the mesolimbic system. Neuroimage 28, 175–184 (2005).
- Keeler JR, Roth EA, Neuser BL, Spitsbergen JM, Waters DJM and Vianney J-M (2015) The neurochemistry and social flow of singing: bonding and oxytocin. *Front. Hum. Neurosci.* 9:518. doi: 10.3389/fnhum.2015.00518

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