



**Australian Acoustical Society
Queensland Division**

ACOUSTICS BURSARY QUEENSLAND SCIENCE CONTEST 2013

The Bursary

The Australian Acoustical Society, Queensland Division will present a **\$600** bursary for the best project in the field of acoustics; open to students in all Divisions. At the discretion of the judges, this bursary may be split among a number of deserving entries (maximum of five).

The Society

The Australian Acoustical Society is a learned society formed in 1971 to advance the science and practice of acoustics. Members practise or study acoustics in areas such as architectural acoustics, underwater acoustics, engineering noise and vibration, ultrasonics, environmental and occupational noise management, bioacoustics, hearing and speech physiology, audiology and music acoustics.

Project Areas

Acoustics pertains to the study of sound and hearing in air, water and other fluids and the interactions of sound with solid materials. Acoustics is a broad field and impinges on many aspects of the physical and biological sciences.

Project areas include:

- Architectural acoustics
- Acoustical and vibration transducers
- Bioacoustics
- Engineering noise and vibration control
- Environmental noise and vibration
- Hearing and speech physiology
- Music acoustics
- Occupational noise and vibration
- Physical acoustics
- Seismology
- Ultrasonics
- Underwater acoustics

Descriptions of the above areas of acoustical science and practice are given below.

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Architectural acoustics: involves the study and design of building spaces to determine those attributes which make them acoustically “fit for purpose”. For example, to be “fit for purpose” an auditorium, lecture theatre or classroom must provide an environment which allows a person standing in front of the audience to be heard clearly. A bedroom must be quiet enough for sleep. A musical venue must provide satisfactory acoustical conditions for musicians and audience while limiting the emission of “music noise” to the environment.

Acoustical and vibration transducers: Transducers convert one form of energy into another. Mechanical, electro/magnetic, optical and hydraulic components and phenomena are used to pick-up or generate sound and vibration. Examples of “pick-up” transducers include microphones, hydrophones, geophones and accelerometers. A loudspeaker is a familiar example of a transducer which converts an electrical signal into sound.

Bioacoustics: Animals use sound (and vibration) to explore their environment and communicate. Bioacoustics involves the study of the uses and mechanisms of hearing and vocalisation in mammals, birds, reptiles, amphibians, fish, insects, crustaceans, molluscs and other animals. It includes the study of other effects of sound on biological systems. Acoustical techniques are used to identify and track individuals or groups of animals and to study their interactions with other species and the environment in which they live and move.

Engineering noise and vibration control: applies acoustical science to the control of unwanted sound (noise) and mechanical vibrations. Mufflers employ the acoustic effect of a series of passages and chambers to attenuate engine noise. Building materials are used to encompass a noise source within a “box” which is more or less opaque to the sound produced within. Sound absorptive materials are used to control reverberation and other unwanted effects. Springs are used to isolate vibration from areas sensitive to its effects. “Active” noise and vibration control seeks to cancel noise or vibration by introducing a signal which is equal in amplitude and frequency but opposite in phase to one or more of the major components comprising the disturbance.

Environmental noise and vibration: Industrial, mining and construction processes, road, rail and air transport, sporting and musical activities and home appliances such as air-conditioners, lawnmowers, vacuum cleaners and food blenders, produce noise. While such noise (and vibration) is often little noticed by those involved in the activity or using the appliance, it may cause intense annoyance to “the neighbours”. To ameliorate such unwanted effects, many techniques are available, from good land use planning, which would separate residential areas from industry and transportation, to expensive “after-the-fact” treatments to reduce noise and vibration at source, at the receiver or in between.

Hearing and speech physiology: The physiology behind the sense of hearing and ability to speak has been the subject of inquiry since ancient times. From the 1500’s on increasingly detailed knowledge was acquired as to the mechanisms involved. Today, with the many tools available to medicine and science, our knowledge of the mechanisms of hearing and speech and the processes behind the diseases which affect them, has greatly advanced. This has led to the development of devices and other interventions to assist and protect hearing and speech, including most recently, the “cochlear implant” to provide a partial restoration of hearing in the profoundly deaf.



Music acoustics: is the study of the physical, physiological and psychological mechanisms behind music and musical instruments. Vibrating strings, membranes, plates and columns of air are used in different ways in the various families of musical instruments. Similar mechanisms apply in the anatomy which supports the human voice. Music acoustics began with Pythagoras and other ancients and continues to be investigated and applied today.

Occupational noise and vibration: Exposure to loud noise can cause hearing loss. If the noise is loud enough and persists long enough, the person is rendered deaf. Thus in any occupation where high sound levels are involved, workers must be protected from its effects. Similarly, high levels of vibration over long periods can cause injury, for example through the hands when manipulating a vibrating tool. Occupational noise and vibration is concerned with managing and minimising such exposure so that the deleterious effects of loud noise and excessive vibration can be avoided.

Physical acoustics: concerns the fundamental properties of sound. Phenomena such as sound transmission, absorption, reflection, refraction, diffraction, interference, scattering and dispersion and the mechanisms of sound propagation through gases, liquids and solids and through the fluid filled pores of rocks and other materials are relevant to the area. Physical acoustics also includes the interactions of sound with light and other electromagnetic radiation (for example, sonoluminescence), the use of sound to investigate the structural properties of materials (including at atomic level) and to modify those properties (for example, through the methods of sonochemistry).

Seismology: uses ground vibrations to “sound-out” structures within the earth. Seismic techniques are used to investigate the processes behind earthquakes and to prospect for oil and gas. In ancient times, groundborne noise was used to detect tunnelling activities in siege warfare. Today directional seismic arrays can be used to detect artillery emplacements. Groundborne noise and vibration from underground trains, other transport and construction activities, is a topic of current interest in many cities around the globe.

Ultrasonics: Sound at frequencies above 16 to 20 kHz is “ultrasonic” and unheard by people. Animals such as bats and dolphins use ultrasound, to detect prey and avoid obstacles. Prey animals such as moths have evolved the ability to hear these frequencies (and sometimes, to produce them). Ultrasonic imaging is used in medicine. Ultrasound is used to detect flaws in large mining machines, in prestressed concrete structures and in the lightweight composites used in racing cars, aircraft and wind-turbines. Intense ultrasound can be used to clean and sterilise, induce chemical reactions and drill through materials which are too hard for mechanical tools to process efficiently.

Underwater acoustics: Underwater, sound is everywhere. Most fishes, marine mammals, reptiles and invertebrates have a well developed sense of hearing and many employ vocalisations to communicate. Whales and dolphins are known for their “singing” and echolocation abilities. Sonar was developed to track submarines underwater and similar methods are used in applications such as fish finding, depth sounding and investigation of submerged sediments. Underwater acoustic arrays have been deployed to detect nuclear explosions. Similar systems detect earthquakes and warn of tsunamis.

