Building Acoustics

Name of the Course **:** Building Acoustics
Course Code **:** PH 40015
Credit Value **:** 3
Pre-requisite **:** None

Course Overview:

This course is introduced to impart a clear idea about architectural acoustical services to any built form. The course is broadly divided into two parts. In the beginning, along with physics of sound, the principles of room acoustics are covered. The major emphasis is given to the acoustical design of auditorium, lecture theatre and studios. In the second part Environmental acoustics and noise control is delivered. The sound transmissions in outdoor and noise reduction strategies are framed in the course.

Course Objectives:

1. Explain the physics of sound propagation through materials.
2. Outline the measures or guideline for room acoustics.
3. Adopt the acoustical guidelines for auditorium design.
4. Design a studio with complete acoustical efficiency.
5. Calculate the reverberation time for an enclosed space.
6. Estimate the sound transmission class of a composite wall system.
7. Design a sound proof partition wall for specific use.
8. Develop the environmental noise control design components to reduce urban traffic noise.

Learning and Teaching Approach Used: (3 - 0 - 0)

Lectures	:	3 hours / week
Tutorial	:	Nil
Practical	:	Nil

Course Curriculum:

Acoustical problems in contemporary architectural design. Properties of sound – origin, propagation, reflection, absorption, diffusion, room resonance, echo. Human ear and hearing – Weber Fechner's Law, Intensity, intensity level, sound pressure level, PHON. Reverberation, Sabine's reverberation formula, reverberation time (tR) measurement of tR. Sound absorbing materials – descriptions & characteristics. Choice of absorbers – measurement of absorption - frequency dependence. Acoustical requirements in auditorium design. Acoustical design of rooms for speech, music, studios. Acoustical correction of existing auditoriums. Sound amplification systems. Environmental noise control - noise sources - airborne & structure-borne noise, transmission of noise in buildings' methods of environmental noise control – control of mechanical noise and vibrations. Sound isolation – transmission loss- noise reduction – Speech privacy- construction criteria. Noise control in specific types of buildings like – auditoriums, residential buildings, hotels, school, hospitals, offices, libraries.

Reading List:

1. Moore, J.E., Design for Good Acoustics and Noise Control.
2. Templeton, D., Acoustics in The Built Environment.
3. Wood, A.B., A Text book of sound.
4. Yarwood, T.M., Acoustics.

Lecture Plan:

Lecture No.	Topic
Lecture-1	Introduction to architectural acoustics and its application in ancient and modern architecture,
Lecture-2	Introduction to Sound Physics: Characteristic and measurement of sound, frequency, intensity, decibel scale,
Lecture-3	Introduction to Sound Physics: auditory range, Threshold of audibility and pain, effects of sound on humans, loudness.
Lecture-4	Class Assignment-I on Sound Physics
Lecture-5	Introduction to Room Acoustics: Acoustics and acoustical environment, Behavior of sound in an enclosed space.
Lecture-6	Principle of geometrical acoustics, Different acoustical defects in auditorium and its solution, reverberation, percentage syllable articulation and reverberation time calculations
Lecture-7	Sabine's formula and its interpretation, dead and live room.
Lecture-8	Class Assignment-II on application of Sabine's formula
Lecture-9	General description of acoustical materials - acoustical tiles, fiberboard, resonator absorption unit absorber, carpets, acoustical plaster,
Lecture-10	General description of resilient packing composite materials, etc. – Their use, selection criteria and construction.
Lecture-11	Design of Auditoriums: Size, shape, sitting arrangement design criteria for speech and music,
Lecture-12	Acoustical correction design and modification techniques,
Lecture-13	Design of Broadcasting studio, television studio,
Lecture-14	Design of Classroom, lecture hall,
Lecture-15	Design of Church and Cathedral.
Lecture-16	Class Test-I
Lecture-17	Introduction of Electro-acoustical systems, Unidirectional and Stereophonic sound system,
Lecture-18	Digital and Surround-sound systems, Design criteria for Theatres,
Lecture-19	Design criteria for Motion picture halls, Multiplexes and Multipurpose Auditoriums.
Lecture-20	Introduction to open-air acoustics: Free field propagation of sound, absorption from air and natural elements, effect of barriers, effect of landscape element, thermal and wind gradient.
Lecture-21	Design of Open-Air Theatre and planning of building.
Lecture-22	Outdoor Acoustics: Reduction of noise by screening, Screening by Planting.
Lecture-23	Introduction to Environmental Noise Control: Noise sources, air borne and structure borne sound, NC curve,
Lecture-24	Propagation of noise of mechanical operation and impact noise, sound transmission through wall and partition, Design for STC
Lecture-25	Class Assignment-III on application of Sound Transmission
Lecture-26	Vibration isolation – control of mechanical noise, floor, wall, ceiling treatment. Design Principles- reduction of noise at the source, Reduction of noise near the source.
Lecture-27	Application of sound absorption material, Reduction of noise by Structural Defense. Planning and analysis of problem.
Lecture-28	Design of sound proof partition wall and resilient floor
Lecture-29	Reduction of noise by Town Planning and Regional Planning consideration.
Lecture-30	Class Test-II