Indian Institute of Technology, Kharagpur

Centre for Educational Technology

**End Semester Examination 2017 (Spring)**

**Subject: Audio System Engineering Code: ET60006**

**Time: 3:00 Hours** **Full Marks = 100**

***PART-A***

*Answer all the questions (****10x2=20)***

1. An acoustic pressure wave with an amplitude ***P*** is incident on a surface of a liquid from air. If the velocity of sound ***c1*** in air is **350 m/s** and ***c2*** liquid is **1000 m/s** find the value of the critical angle.
2. An earth quake wave passes across a boundary in rock where its velocity increases from ***6km/s*** to ***8km/s*** if it strikes this boundary at ***300*** calculate the angle of refraction.
3. In an outdoor acoustic the ambient noise level is ***70dB*** and a sound system generate SPL of ***110dB*** at ***4ft***. How far the sound will travel before it submerged with noise.
4. Plane wave in water of ***100 Pa*** effective (rms) pressure are incident normally on a sand bottom. The sand bottom is characterized by ***ρ2=2000kg/m3and c2=1600m/s***. Where speed of sound in water ***c1= 1450 m/s*** and density ***ρ1=1000kg/ m3***. Calculate the effective pressure of the wave reflected back into water and the effective pressure of the wave transmitted into sand.
5. A ***100*** Watt amplifier has gain of ***64 dB***. What input level in dB will drive the amplifier in full power?
6. A ***1 kHz*** small source of spherical waves in air has produce sound pressure amplitude of ***100 dB*** (Pref = 20μPa), at a radial distance ***1 m*** from the source. Find the absolute magnitude of the specific acoustic impedance. Where density of air ***ρ0=1.21kg/m3*** and speed of sound in air ***c=343m/s***.
7. During the testing If a given microphone produced an open circuit voltage ***E0=0.001*** V, find out the sensitivity of the microphone.
8. Two liquids are separated using a very thin solid membrane. If a sound source is producing a sound in the 1st liquid what will be the effect of the solid membrane in case of transmission of sound from one liquid to other.
9. If a loudspeaker mounted in the following manner. Find out the Directivity factor (Q) for each cases
10. Mounted at centre of ceiling or wall surface
11. Mounted at intersection of any two wall
12. If an acoustic room has the dimension ***12 m x 14 m x 6 m*** find out lowest ***2*** standing wave frequencies?

**PART-B**

*Answer all the questions (5x16=80)*

1. A room has dimensions ***12 m x 24 m x 16 m*** and average absorptivity of the surfaces is ***a = 0.4***. **(a)** Determine whether the room volume support large room acoustic for speech system? **(b)** Calculate the reverberation time (*RT60*) and total number of reflection during *RT60* **(c)** If two loudspeakers is placed in the corner of the front wall and two side walls find out the *%ALCONS*. **(d)** Write your opinion regarding the Speech intelligibility of the room.

[3+4+7+2]

**R->**Distance from speaker to listener

**Tr ->** Reverb time

**Q->** directivity factor

**V->** room volume

**n->** number of reinforcing loudspeakers

Where



1. **(a)** Draw the schematic construction of a Moving – Coil Microphone. **(b)** Prove that Moving – Coil Microphone is an anti-reciprocal transducer **(c)** What is Pressure gradient (velocity) microphone?

**(d)** Give one example uses of Pressure gradient (velocity) microphone.

[4+7+3+2]

1. An auditorium is observed to have a reverberation time of ***1.5s***. Its dimensions are ***10m x 16m x 24m*** are. **(a)** What acoustic power is required to produce a steady-state sound pressure level of****? **(b)** What is the average absorptivity of the surfaces in the auditorium? **(c)** If ***200*** people are present, each adding  to its total absorption, what is the new reverberation time? **[*where ρ0 = 1.21 kg/m3 and c=343 m/s*]**

[6+6+4]

[5+4+5+2]

[8+4+4]

1. During the testing, a microphone of the following specification produced an open circuit voltage ***E0=0.008*** ***V***. **(a)** Calculate the sound pressure level (SPL) of the testing condition. **(b)** Calculate Available Input Power (LAIP) of the microphone. **(c)** If a talker produce 80dB near the microphone find out the signal to noise ratio of the microphone output at 25° C **(d)** if the above microphone is unidirectional microphone draw its directivity pattern

**Microphone specification**

Sensitivity (Sv)= ***-60dB***

***R0=200Ω***

Frequency of operation=***100 Hz to 10 kHz***

1. **(a)** What is critical distance of an acoustic studio? Why the critical distance important for an acoustic studio? **(b)** If an acoustic studio has dimensions of ***12mx14mx8m*** and average absorptivity ***a=0.2*** find the critical distance and reverberant noise sound level for a noise source of ***30dB***. **(c)** If the average absorptivity change to ***0.5*** calculate the reduce reverberant noise sound level