Indian Institute of Technology, Kharagpur

Centre for Educational Technology

**End Semester Examination 2013 (Spring)**

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

Time: 3:00 Hours Full Marks =50

***PART-A***

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

1. Draw the equivalent electrical circuit of the Mechanical system given in Fig.1

m

Rm

S2

S1

F

Fig-1

1. An earth quake wave was traveling through the earth and the intensity detected *50 Km* from source was *5.0x 106 W/m2*. What is the intensity of the earth quake wave at a distance *200 km* from the source?

1. If the input voltage of a loud speaker is raised by *40%* how many *dB* will be increase the acoustic pressure
2. A sound source producing *60 dBm* power and the sound is propagated as a spherical wave. What will be the sound intensity for a person hearing it from *30 m* away?
3. 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.
4. A plan wave whose surfaces of constant phase are parallel to *z* axis and inclined with an angle of *θ* with the *x* axis. Derive the expression of the acoustic pressure wave.

1. If the intensity of a sound in air at *1 kHz* is *10-12W/m2*. Find out the value of root mean square pressure? Where density of air is *ρ0 =1.21 kg/m3* and sound velocity is *c=350 m/s*
2. During the testing, a microphone produced an open circuit voltage *E0=0.002 V*, at 100 dB sound pressure level (SPL) find out the sensitivity (Sv) of the microphone.
3. An acoustic signal is reflected from a surface that is *80%* absorptive. The reflected signal will drop by how many *dB*.
4. Following specifications are given for an acoustic studio. Calculate the total number of possible reflection if *RT60=15.72 Sec*. [Volume (V) = 500,000 m3, Surface area (S) =40000m2]

**PART-B**

*Answer any five questions (5x6=30)*

1. Draw the schematic of the construction of an electrostatic transducer (Reciprocal). Draw its equivalent electrical circuit. Prove that the turns ratio Ф of the above transducer is as in equation -1

*=C0V0/x0------(1)*

Where C0 is capacitance of the transducer when plats are rest position and V0 is the equilibrium voltage and x0 is the equilibrium spacing of the plates 2+1+3

1. A damped oscillator whose general solution *is x=Aexp(-βt)cos(ωd+Ф)* start at rest with a positive speed U0. Find the expression of A? Show that for a damped oscillator the expression of relaxation time *τ=2m/Rm*. where m is the mass and Rm is the mechanical resistance of the oscillator 3+3
2. An acoustic speech studio is design using the following specification. Find out its Reverberation time (RT60), Mean free path (MFP) and number of reflection per second (RPS). Is the volume is sufficient for large room acoustic provide reason? 4+2
3. Prove that when a microphone operates in an open-circuit condition (Rin > R0) the overall SNR can improve by *3dB*, compared to the situation when *Rin=R0*. A microphone has *R0 = 200 Ω* & *Sv = - 60dB* calculate the *LAIP. 4+2*
4. What are the basic components of microphone? Describe the operational procedure of a piezoelectric microphone. Write *4* main properties of piezoelectric microphone. 1+3+2
5. From the linear wave equation derive the Spherical wave equation. What will be the particle speed corresponding to very low acoustic pressures for very small distances from a point source.

5+1



Linear wave equation

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