Indian Institute of Technology, Kharagpur

Centre for Educational Technology

**End Semester Examination 2015 (Spring)**

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

Time: 3:00 Hours Full Marks = 100

***PART-A***

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

1. An oscillating block-spring system has a mechanical energy of ***1.0 J***, amplitude of ***0.10 m***, and a maximum speed of ***1.2 m/s***. calculate the value of spring constant.
2. A sound system gain is increased by ***15dB***. What is the % power increase
3. What is the meaning of just noticeable difference of Fundamental frequency (F0) of speech signal is ***0.3-0.5%.***
4. What is equal loudness curve or phone curve? Draw an equal loudness curve for ***10 dB***.
5. Write four factors which effecting Acoustic Environment.
6. An acoustic speech auditorium is design and it is observed that the Reverberation time (RT60) of the auditorium is ***1.6s***. What should be the minimum acoustic volume required for the auditorium such that it support large room acoustic.
7. 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 the liquid is ***1000 m/s*** find the value of the critical angle.
8. During the testing, a microphone produced an open circuit voltage ***E0=0.008*** ***V***, the sensitivity (Sv) of the microphone is ***-60dB***. Calculate the sound pressure level (SPL) of the testing condition.
9. What is critical distance of an acoustic studio? Why the critical distance important for an acoustic studio?
10. What is Initial signal delay gap (ISD)? What should be the value of ***ISD*** in case of small room acoustic?

**PART-B**

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

1. (a) Draw the schematic construction of an electrostatic transducer. (b) Draw its equivalent electrical circuit. (c) Prove that in case electrostatic transducer ***Tem=Tme***

[4+8+4]

[4+4+8]

1. (a) Draw the schematic construction of Moving – Coil Loudspeaker. (b) A Moving – Coil Loudspeaker have the following specification. Calculate the lowest and highest frequency of the Loudspeaker. (c) What will be the maximum surface velocity of the diaphragm?

*Mass of the speaker diaphragm and voice coil, m=10g*

*Radius of the diaphragm, a=0.05m*

*Stiffness of the speakers s=2000N/m*

*Mechanical resistance of the speaker Rm=1N.s/m*

*Inductance of the voice coil L0=0.2H*

*Resistance of the voice coil R0=5 Ω*

*Length of the voice coil l=5m*

*Magnetic field B=0.9T*



Where short circuit mechanical impedance

*And* ***φm=Bl***

1. An auditorium (live room acoustic) has the dimensions are******. (a) Calculate the value of mean free path of the sound in the auditorium (b) when steady state condition are reached in the auditorium the sound pressure level is ***74dB*** re ***20 μPa***. if the average absorptivity of the walls is ***0.05***, calculate the rate at which sound energy is being absorbed per square meter of wall. (c) If ***200*** people are present, each adding  to its total absorption, calculate the new reverberation time? [*where* ***ρ0 = 1.21 kg/m3*** *and* ***c=343 m/s***]

[4+4+4+4]

[8+4+4]

[4+6+6]

1. (a) A microphone is connected to an amplifier and the specification of microphone and amplifier as in given below. If the microphone is placed in a speech studio and the average sound pressure level (SPL) is ***-70dB*** at silence condition find out the signal to noise ratio at output of the amplifier at ***25o C*** temperature. (b) Calculate the ***LAIP*** of the given microphone (c) if the microphone is Unidirectional plot it directivity pattern.

**Microphone specification**

**Amplifier specification**



V=RMS value of the noise voltage; K=1.38x10-23 J/K



1. A room has dimensions ***8 m x 16 m x 10 m*** and average absorptivity of the surfaces is **a = 0.5.** If a ***5x10-2*** W average output acoustic source is placed in the junction of the front wall and the roof find the (a) The reverberant level in dB (b) The total dB at a distance of ***5 m*** from the source and (c) The critical distance. (d) If the room absorptivity Change to ***500 Sabin’s***. What is the change in reverberant sound in dB?

End