

DIGITS FOR AUDIOLOGISTS

Register No. 8501

*An Independent project submitted as part fulfilment for
First year M.Sc. (Speech and Hearing)
to the University of Mysore.*

All India Institute of Speech & Hearing
MYSORE-570 006.

MAY—1986

"DIGITS FOR AUDIOLOGISTS"

MY DEAREST

AMMA AYYA

CERTIFICATE

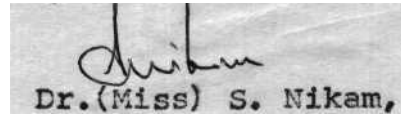
This is to certify that the Independent Project entitled "Digits for Audiologists" is a bonafide work, done in part fulfillment for First year M.Sc, (Speech and Hearing) of the student with Register Number. 8501



**Dr.M.Nithya Seelan
Director
All India Institute of
Speech and Hearing,
Mysore - 570006.**

CERTIFICATE

This is to certify that this Independent Project entitled: "Digits for Audiologists" has been prepared under my supervision and guidance.



Dr. (Miss) S. Nikam,

Prof, and Head,
Department of Audiology
All India Institute of
Speech and Hearing,
Mysore - 570006.

DECLARATION

This Independent Project entitled: "Digits for Audiologists" is the result of my own study under the guidance of Dr.(Miss) S.Nikam, Professor and Head of Department of Audiology, All India Institute of Speech and Hearing, and has not been submitted earlier at any other University for any other Diploma or Degree.

Mysore

Register No.8501.

Dated: April 1986.

ACKNOWLEDGEMENT

I am greatly indebted to Dr.(Miss) S.Nikam, Professor and Head of the Department of Audiology, All India Institute of Speech and Hearing, Mysore for her invaluable guidance, constant help and concern. I am especially thankful for the inspiration given by her, without which this work could not have been completed.

I am also grateful to Dr.M.Nithya Seelan, Director, All India Institute of Speech and Hearing, Mysore-6.

My special thanks to my dearest friends, Sunitha, Hemalatha, Manjula, Sreedevi, Bharathi, Latha, Radhika and Manoj Kumar.

I also extend my thanks to Ms.Malini, M.S., Mrs.Asha Yathiraj, Ms.Nagapoornima, Ms.Sreedevi, N., and Ms.Vanaja for their help.

My special thanks to Ms.Rajalakshmi R Gopal for typing out this project neatly and quickly.

TABLE OF CONTENTS

	<u>Page No.</u>
Introduction	1-2
Instructions	3-4
Subject index	5-81
ABLB	- 12, 22, 34, 50, 54 62, 69, 74.
Acoustical Intensity	- 48
Acoustic Nuclei	- 5, 11, 26
Acoustic reflex	- 23, 55
Adaptation	- 6,15, 23, 36, 62,73
DLB	- 15, 23, 36, 41, 47 64.
SDLB	- 18, 23, 36, 52, 53 57, 60
Afferent Fibres	- 17, 53, 67
Air Conduction	- 60, 64, 74
Amplification System	- 37
Amplifiers	- 23
Annular ligament	- 14
Articulation Index	- 6, 7
Asymptotic localization	- 45
Auditory evoked potential audiometer	- 36

Audiogram	-	19
Auditory placode	-	23
Audiometers	-	28,48,71
Auditory localization	-	10, 15, 18, 27, 28, 40, 49
Auditory fibre	-	12, 74
Auditory pit	-	56
Auditory receptors	-	18
Auditory reception area	-	55, 60, 61
Auditory training system	-	37, 55
Auditory tube	-	33 (See eustachian tube also)
Auditory nerve	-	17, 74
Auditory vesicle	-	33
Auricle	-	11, 53
Aural harmonics	-	63
Auropalpebral reflex	-	69
Average evoked response	-	77
Basilar membrane	-	5, 7, 17, 58, 81
Bekesy audiometry	-	14, 22, 3E, 55, 66, 70, 72
Binaural amplification	-	20, 38, 52
Binaural candidacy	-	20, 46, 52
Binaural hearing aids	-	31, 44
Binaural listening	-	6, 31
Body level hearing aid	-	30, 76
Bone conduction	-	10, 11, 27, 28, 40, 48, 51, 54, 59, 73
B/C Calibration	-	75
B/C Vibrator	-	9, 43, 77

Bony labyrinth	- 17,25
Brief tone audiometry	- 48, 58, 75
Broad Spectrum	- 78
BSERA	- 6, 22, 45, 56
Canal molds	- 21
Carhart notch	- 40, 48, 51, 77
Cell transduction	- 27
Chronic suppurative	
Otitis media patients	- 77
Closed molds	- 30
Cochlear channels	- 59
Cochlear fibres	- 17
Cochlear nuclei	- 26
Cochlear partition	- 25
Cords	- 21, 30, 44
Cartilymph	- 25
Comfortable level	- 44
Compliance	- 72
Compression amplifiers	- 20
Cochlea	- 11, 14, 34, 40, 43, 44, 46, 47, 49, 54 69.
Conduction velocity of neuron.	- 70
Concha	- 9, 14, 78, 79
Contralateral reflex	- 29, 65.
Coupler	- 8, 20, 43, 53
Cranial nerves	- 26, 40
Cristae	- 47
Custom molds	- 37
DAF	- 72
Difference limen Intensity	- 34, 48, 51, 60,61
Difference limen	- 18
DLB	- See adaptation

Diictus reuniens	-	45
Ears	-	16, 17, 18, 34
Earcushions	-	28
Ear level hearing aids	-	30, 16
Earmolds	-	6, 7, 9, 19, 20
Earplugs	-	29
Earphones	-	18, 43, 48, 51, 55, 69, 80
Ear protective devices	-	23, 38
Echo	-	12, 51, 53
Efferent fibre.	-	17, 74
Electroacoustic characteristics	-	31
Electrocochleography	-	13, 35
Electroencephalic response audiometry	-	22, 28, 29, 35, 46, 62, 73, 74
Electroacoustic measurements	-	7, 39
Endolymph	-	40, 66, 71
Epitympanum	-	59
Equal loudness contour	-	76
Eustachian tube	-	12, 14, 50, 16, 53, 59, 61. (see auditory tube also)
External auditory meatus	-	6, 7, 11, 8, 14, 15, 19, 20, 34, 43, 46, 47, 51, 56, 71, 78.
Eye glass hearing aids.	-	30
Fenestration operation	-	54
Fluids of cochlea	-	25
Frequency filtering	-	20
Frequencyrange	-	72, 75
Gain	-	31
Ganglion cells	-	80
Graphic Level Recorder	-	33
Hair cells	-	17, 80

Harmonic distortion	
Head shadow	- 7, 20, 28, 43
Hearingaid test box	- 10, 44
Hearing aid trials	- 72
Hearing loss	- 32, 37, 42
Halicotrema	- 27, 57, 63, 66, 68
High risk	- 5
Impedance	- 45
Impedance audiometry	- 11, 26, 61
Incidence	- 7, 8, 29, 36, 72, 73, 75
Incus	- 37, 43, 48, 61, 63
	- 12, 40, 46, 50, 56, 58, 64
Inner ear	
Inner hair cells	- 17, 24, 39, 53
Inner rods	- 47, 53, 62, 68, 68, 80
Insert receiver	- 79
In the ear transducers	- 18, 55
Interaural attenuation	- 8
Internal auditory artery	- 13, 51, 59
Iptracellular potentials	- 26
Ipsilateral reflex	- 54
Kiniocilium	- 23
Labyrinth	- 14
Ligaments	- 16
Localization	- 16, 39
Loudness balance	- See auditory localization
Loudness	- 23
Maculae	- 19
Malleus	- 17, 47
Masking	- 10, 12, 24, 50, 56, 58, 71
Mastoid	- 40, 51
Mastoid air cells	- 25, 47, 50
Minimum audible angle	- 59
Microphones	- 15, 43, 61
	- 5, 8, 10, 20, 21, 32, 38
	66, 67, 80, 81.

Middle ear	-	9, 15, 16, 39, 43, 50 77.
Middle ear pressure	-	71
Middle meningeal artery	-	25
MLD	-	23, 29, 36, 45
Moving phonton	-	45
Monaural heterophonic	-	75, 80
Narrow band noise	-	15
Noise	-	8, 10, 67, 68, 69, 70, 71, 75, 78
Noise analyzer	-	23
Noise measurement	-	42
Noisiness	-	15, 62
Occlusion effect	-	51
Octave	-	12, 18, 19, 34, 46, 53, 58, 75, 78
Octave interval	-	12
Octave masking	-	63
Open molds	-	21, 30
Organ of corti	-	5, 10, 46, 79, 80, 81
Ossicles	-	6, 14, 24, 62 see Malleus, Incus and Stapes also
Ossicular chain	-	58, 64, 77
Outer hair cells	-	14, 25, 56, 61, 66, 79, 80
Outer rods	-	79
Oval window	-	25
Berilymph	-	47, 54, 71, 73
Permanent threshold shift	-	79
Pink noise	-	78
Pinna	-	33, 42, 50, 65 see auricle also
Place principle	-	18
Pseudohypacusis	-	51
Psychogalvemic skin response	-	18
Pure tone audiometry	-	21, 28, 40, 62, 70
Random incidence corrector	-	80

Recording system	- 64
Refractory period	- 7, 14, 18, 54
Reissner's membrane	- 17
Reverberation time	- 9, 13
Round window	- 16
Sacculle	- 43, 44
SAL	- 33
Scale media	- 66
SDLB	- See adaptation
Sensitivity of cochlea	- 74
Semicircular canals	- 6, 10, 14, 17,25, 58
Shell molds	- 21
SISI	- 13, 14, 22, 40, 49, 54, 57, 60, 62, 65, 66, 73, 74, 76, 78
Skeleton molds	- 30
Social adequacy index	- 58
Sound pressure	- 8, 14, 47
Sound	- 11, 19, 27
Sound level dosimeter	- 33, 49, 76
Sound level meter	- 32, 38, 39, 44, 60, 63, 64, 65,67, 69
SPAR	- 48, 49, 55
Speech audiometer	- 13, 19, 21, 28, 54
Speech discrimination	- 46
Speech frequency	- 74, 76, 77
Speech intelligibility	- 32
Speech receptionthreshold	- 59
Spiral Cochlear tube	- 58
Sondees	- 10
SRT	- 13
Stapes	- 9, 14, 24, 50, 53
Stapes foot plate	- 8, 9*
Stapedius muscle	- 40, 43, 47
Stapedial reflex	- 56, 65, 67
STAT	- 67, 70, 74, 76,77
Standard molds	- 21

Statoconial membrane	-	7
Static compliance	-	6
Stereocilia	-	6
Stria vascularis	-	25
Symbols	-	19
Synaptic cleft	-	5
TDT	-	13, 28, 35, 52 40, 41, 48, 54, 55, 58, 61, 64, 67, 74, 76.77
Tectorial membrane	-	47, 67
Telephonic principle	-	18
Temporal bone	-	39
Temporarythreshold shift	-	52, 64, 78, 79
Tensor tympanic muscle	-	14, 50, 56
Threshold	-	12, 13, 51,
Threshold of discomfort	-	70
Thre-shold of pain	-	71
Time-intensity trade relationship	-	76
Tone bursts	-	5, 56, 58
Tone control	-	30
Tone pips	-	5, 22, 41
Travelling wave	-	7
Tubotympanic recess	-	24
Tuning fork tests	-	34
Tunnel of corti	-	11, 79
Tympanum	-	57
Tympanic antrum	-	47
Tympanic cavity	-	24
Tympanogram	-	22, 29, 57
Tympanic membrane	-	5, 6, 10, 11,12, 16 24, 33, 47, 51, 55, 59, 60, 63, 64, 71, 72
Tympanometry	-	56

Tympanic Ring	- 47, 50
Ultra sound	- 81
Uncomtortable level	- 44, 70
Utricle	- 43, 44
Velocity of sound	- 73, 74
Vestibule	- 46
Vestibulo cochlear division	- 33
Vestibular nuclei	- 26, 33
White noise	- 80
Wave length of sound	- 9, 11
Zwislocki coupler	. 38
Abbreviation	-82
Bibliography	-83-84

INTRODUCTION

In the field of Speech and Hearing, there are training programs in several parts of the country and also at several levels. The major aim of training program is the development of 'Critical skills'. Such skills in the field of Speech and Hearing would include the knowledge of structure and functions of the organs of speech hearing, clinical procedures for testing, digits related to these etc.

There is an exceedingly large number of digits of interest in the various section and subsections of Audiology. It is difficult to know what each one of them signifies and it is also that many aspects may be related to one digit etc. It is therefore felt that a collection of such digits together with their description would prove useful. Such an attempt has been made in the following pages. Digits with different units like centimeters, millimeters, Hertz, c.c, etc. have been covered.

The main objective is to get collective information about different digits which serve as a guide to those appearing for interviews and conducting interviews.

The implications are:-

1. It is expected that this would be useful particularly to students who are new to the course and being exposed to

digits, might find it difficult to appreciate their significance. The ready availability of the explanation for these digits will thus serve useful purpose for reference.

2. The digits included here, are from subject areas, that individuals receiving training in the field of audiology, be familiar with.

3. The set of digits are designed to function as a self-study guide as well as a supplemental text for courses in Audiology and hearing sciences. It covers some aspects of the fundamentals of Audiology.

4. This can be considered as a reference for setting questions.

5. Even for those who are working in this field of audiology, and who are familiar with the technical jargon, this work might be of interest, to be used whenever required for reference.

An indepth study of the implication of the different digits is beyond the scope of this work. What has been attempted is to explain the significance of the digits.

INSTRUCTIONS TO USE THE BOOK

In this book numbers have been arranged in an ascending order. In the initial part, decimels are included which is followed by numbers like 0, 1, 2, 3, etc.

In each number, for e.g., 2, there are different aspects in the same digit. So, here it is arranged as follows: embryology, anatomy, physiology, and testing. All the numbers have been arranged in this order.

Some digits have capital letters in the beginning of sentence and other have lower case letters. They have to be read in the following way:

eg: 2 - Stimuli are used in adaptation. They are:

- Adapting stimulus and
- Comparing stimulus

4.c.c - of air enclosed in the meatus and in the first recess of the auricle.

If the sentence begins with lower case letter, as given above, then number should also be read with the sentence. And in case, where the sentence begins with capital letter, then digit which is present in the beginning should be deleted, it is present in the sentence.

Eg: 4th - During the 4th week of fetal life, the pinna develops.

4 minutes - The adapting stimulus is presented continuously for 4 minutes in adapting ear after preadapted balances, in delayed loudness balance method of adaptation.

DIGITS OF AUDIOLOGISTS

FOLLOW THE INSTRUCTIONS BEFORE STARTING TO READ.

- 0.00005mm² - is the area of the synaptic cleft or synaptic gap (the space between 2 nerve cells)
- 0.0002dynes/cm² - is the reference for common sound measurement.
- 0.0005μF - is the internal capacitance of a sound cell crystal microphone. It ranges upto 0.015μF.
- 0.005389mm² - is the maximum cross-sectional area of the organ of corti.
- 0.03μF - is the internal capacitance of a diaphragm actuated crystal microphone.
- 0.03mm - is the diameter of the largest neurons in the acoustic nuclei.
- 0.08mm² - is the area of helicotrema. It ranges upto 0.04mm² .
- 0.01mm - is the thickness of the tympanic membrane.
- 0.1mm - is the thickness of the basilar membrane at the apex.
- 0.1mmsec - Tone pips are produced by passing a 0.1msec tone, through 1/3rd octave filter.
- 0.1mmsec - Tone bursts are produced by passing 0.1msec tone, through the filters and its spectrum depends on the characteristic of the filters through which it passes.
- 0.2mm - is the thickness of the skin near the tympanic membrane.

- 0.2msec - If interaural latency difference is more than 0.2msecs in BSERA, then retrocochlear pathology can be suspected in the ear which shows increased 5th peak latency.
- 0.2sec - If rest period between stimuli presentation is less than 0.2sec, then recovery is absent in adaptation.
- 0.2dB - is the difference in optimal performance in monaural versus binaural listening, for intensity discrimination.
- 0.28.C.c- If static compliance is lower than 0.28 c.c in impedance audiometry, then it is abnormal, i.e., tympanic membrane is excessively stiff.
- 0.3cm^2 - is the cross sectional area of the external auditory meatus. It ranges upto 0.5cm^2 .
- $0.3\mu\text{m}$ - is the width of the stereocilia on the outermost of the closely - spaced multiple rows on each hair cell.
- 0.3 - Generally an articulation index of less than 0.3 is taken to be unsatisfactory for good communication.
- 0.4mm- is the diameter of the cross-sectional membranous semi circular canals.
- 0.4 to 1.0cm^3 - The volume of the cavity between the end of the earmold and the eardrum is in this range.
- 0.5cm^2 - is the area of the tympanic membrane. It ranges upto 0.9cm^2 .
- 0.5cm^3 - is the volume of ossicles. It ranges upto 0.8cm^3 .

- 0.5mm - is the thickness of the basilar membrane at the first turn.
- 0.5 μ m - is the size of crystals of calcite present in statoconial membrane. It ranges upto 30 μ m.
- 0.5%- The total harmonic distortion of the sound source should not exceed 0.5%, when the system is being used for the measurement of harmonic distortion.
- 0.5dB - The effect of ambient noise or stray electrical or magnetic field in the test result should not be greater than 0.5 dB in electroacoustic measurements.
- 0.5msecs - The travelling wave takes about 0.5 msecs to travel from base to apex of the basilar membrane.
- 0.5msec - is the absolute refractory period of neurons in the cochlea.
- 0.5msec - is the relative refractory period of neurons in the cochlea. It ranges upto 20msecs.
- 0.5 to 0.7 - Generally, an articulation index in the range of 0.5 to 0.7 is considered as satisfactory for good communication.
- 0.6cm³ - is the volume of the cavity between the end of the earmold and the eardrum, for the standard type of earmold.
- 0.6c.c.to 0.8 c.c. - is the C₁ volume in a child, in impedance audiometry
- 0.7cm - is the diameter of the earcanal.
- 0.7 - Generally, an articulation index greater than 0.7 is considered to be very good for good communication.

- 0.8cm - is the volume of the cavity between the earmold tip and the eardrum, (with the eardrum closing one end) in series with an acoustic resistance of about 3500hms (Zwislocki, 1971).
- 0.10 dynes/sq cm - is the sound pressure while whispering.
- 0.25inch - separation should be there between the microphone and the receiver for better feedback in case of In-the-ear transducers.
- 0.50cm³ - volume of the middle ear is occupied by the ossicles. It ranges upto 0.8cm . (Bekesy, 1960).
- 1.00 to 1.5c.c. - is the C₁ volume in an average adult with an intact eardrum, when measured by impedance audiometry.
- 1.08mm - is the width of footplate of stapes. It ranges upto 1.66mm.
- 1.2c.c. - is the size of the coupler used for testing pre-lingual children.
- 1.2mtrs - According in the ISO recommendation for vehicle noise test, the microphone position should be at an height of 1.2mtrs. above the ground.

1.5cms - is the height of the middle ear cavity.

1.7dB - poorer speech threshold is obtained with use of open earmolds compared to closed molds, in subjects with flat conductive loss.

1.7cms - Wavelength of 20KHz is about 1.7cms.

2.5cm^3 - is the volume of the concha.

2.5mgms - is the mass of the stapes.

2.5mm - is the length of footplate of the stapes. It ranges upto 3.36 mm.

2.5dB/sec - is the attenuation rate for the signal in Bekesy audiometry.

2.5c.c. - If static compliance exceeds 2.5c.c. in impedance audiometry, then it is abnormal i.e., tympanic membrane has excessive mobility.

2.65mm^2 - is the area of footplate of the stapes. It ranges upto 3.75mm^2 .

3.5mm - is the length of the stapes from its head to its footplate.

3.8secs - is the reverberation time of an echo chamber.

5.5dB - difference in threshold is obtained by forehead and by mastoid placement of boneconduction vibrator at 4000Hz in normals.

- 6.4dB - mean difference In thresholds for spondees between monaural direct and indirect listening conditions.
- 6.44dB - is the effect of head shadow for speech thresholds (Tillman, Hasten and Homer, 1963).
- 6.5mm - is the diameter of the membranous semicircular canals.
- 7.5mm - is the length of the malleus. It ranges upto 0mm.
- 7.5mtrs - According to the ISO recommendations for vehicle noise test, the microphone position should be 7.5mtrs from the vehicle path.
- 7.9sq.mm - is the diameter of the tympanic membrane.
- 8.75cm - is the radius of the spherical head for auditory localization measurement.
- 9.2dB - is the difference between bone conduction thresholds obtained by forehead and mastoid placements in normals, at 1000Hz. !
- 9.5dB - is the difference between bone conduction thresholds obtained by forehead and mastoid placements in normals, at 2000Hz.
- 9.8dB (10dB) - is the difference in threshold obtained, for the tones of 20msecs and 500msecs duration (zwislacki, 1960).
- 14.3dB - is the difference between bone conduction thresholds obtained by horehead and mastoid placements in normals at 500Hz.

14.6dB - is the difference between bone conduction thresholds obtained by forehead and mastoid placements in normals, at 250Hz.

17.2mtrs - wavelength of 20cycles is about 17.2mtrs.

31.52mm - is the length of the tunnel of corti.

42.9mm^2 - is the effective area of the tympanic membrane. It ranges upto 55mm^2 .

98.1mm - is the volume of the cochlea.

99.99% - of energy is reflected back, when sound travels directly from air to fluid media.

3.6×10^{-5} cu.mm - is the volume occupied by the largest neurons in the acoustic nuclei.

1.54×10^5 Ω- is the impedance of water.

2/3rd - The newborn auricle is 2/3rd of the adult sized auricle,

1/3rd - of outer portion of external auditory meatus is formed by cartilage.

2/3rd - of inner portion of external auditory meatus is formed by bone.

$\frac{2}{3}$ rd - area of the tympanic membrane is the effective area.

$\frac{1}{2}$ - Anterior $\frac{1}{2}$ of the middle ear develops from the 1st branchial arch.

$\frac{1}{2}$ - Posterior $\frac{1}{2}$ of the middle ear develops from the 2nd branchial arch.

$\frac{1}{3}$ rd - Upper $\frac{1}{3}$ rd portion of the eustachian tube is formed by bone.

$\frac{2}{3}$ rd - of lower portion of eustachian tube is formed by cartilage.

$\frac{1}{20}$ sec - The reflected sound must be $\frac{1}{20}$ of a second or longer behind the original sound to be an echo.

$\frac{1}{1000}$ sec - is the refractory phase of the auditory fibre.

$\frac{1}{2}$ sec - is the duration of the tone, if presented manually in ABLB technique to each ear.

14:1 - is the ratio between the effective area of the tympanic membrane and the stapes footplate.

17:1 - is the ratio between the area of the tympanic membrane and stapes footplate.

1.3:1 - is the effective ratio between the Malleolar arm and Incudal arm.

2:1 or 1:2 - is the frequency ratio corresponds to an octave interval.

For example, 250Hz and 500Hz are one octave apart, while the difference between 250Hz and 1000Hz is two octaves.

0dB - hearing level represents a statistical average of threshold levels of normal ears.

- 0dB SPL - is the average threshold of the human ear = $0.0002 \text{ dynes/cm}^2 = 0.0002 \text{ microbar} = 10^{-16} \text{ watt/cm}^2$
(freefield in air) = $10^{-13} \text{ watts/ft}^2$.
- 0dB HTL - refers to the threshold of a person at a particular frequency.
- 0dB - At 1000Hz and 2000Hz interaural attenuation in boneconduction varies from 0 to 15dB.
- 0dB - is the magnitude of interaural attenuation for boneconduction at 250 Hz and 500Hz.
- 0dB - The SPL of 0dB SRT varies according to the
- specific test materials employed, and
- the methodology used.
- 0 to 100 dB - According to American National Standard, the speech audiometers should cover, a range of least from 0 to 100dB, in steps of 2.5dB or less.
- 0sec - is the reverberation time of an anechoic chamber.
- 0 to 20% - scores are observed at 250Hz and 500Hz with cochlear disorders, which is low in SISI test (Jerger, 1975).
- 0 to 70% - scores are -ve, indicating normal hearing or a cochlear lesion, in original SISI test. (Jerger and Peterson, 1959).
- 0* - According to Green's modified TCP, the hand should be kept at 0° i.e., to the rest position, if the sound becomes completely inaudible.
- 0 to 5 dB - tone decay indicate normal (Rosenberg, 1958).
- 0 to 4msecs - is the latency of the very early response, which is observed in electrocochleography.

1 - pair of branchial arches are responsible for the development of external auditory meatus.

1st - Tympanic cavity and eustachian (auditory) tube develops from 1st pharyngeal pouch.

1st - Malleus, Incus and Tensor tympanic muscle develops from 1st branchial arch.

1cm - is the diameter of the concha. It ranges upto 2 cms.

1mm - is the thickness of the skin near the concha.

1cm³ - is the volume of the ear canal.

1 - annular ligament is attached to the stapes.

1mm - is the diameter of bony canal of the semi circular canal.

1cm - is the width of the cochlea.

1 - row of inner hair cells is present in the organ of corti.

1 - kinocilium is present in each sensory cell in the vestibular receptor organ.

1msec - is the functional refractory period of nerve fibres,

dyne/sq cm - is the sound pressure of a normal voice.

1dB - increments can be detected by normal hearing subjects at higher frequencies in SISI test.

1dB - increments at sound levels (75 dB HTL) with low scores suggest a retrocochlear lesion in SISI test.

1dB - increments at 20 dB SL with high scores suggests a cochlear lesion in SISI test.

1dB - increments can be detected by cochlear pathology patients, in SISI test, at 20 dB SL.

1dB - Tracking width for the 500msec tones used in Brief tone audiometry is 1dB greater than the width obtained for the 200msec tones used in Bekesy audiometry.

- lsec - If the rest period between successive stimulus presentation is less than lsec, but more than 0.2sec, then recovery is not complete in adaptation.
- lsec - If rest period between successive stimulus presentation exceeds lsec, then recovery is complete in adaptation. (Mathews, 1931).
- lsec - is the duration of comparative stimulus in delayed balance method of adaptation.
- lsec - is the duration of comparative stimulus in single simultaneous dichotic loudness balance method or modified SDLB. (studebaker and Stockinger)
- 1° - is the minimum audible angle for low and high frequencies for auditory localization and for frequencies between 1500 and 2000Hz, it is large.
(Minimum audible angle - The smallest change in azimuth from which the listener could identify the direction of change correctly on 75% of the trials is called minimum audible angle).
- 1NOY - is noisiness experienced when a 40dB SPL narrow band noise centering at 1KHz is presented.
- 2nd - Ossification of the bony part of external auditory meatus is completed by 2nd year of life.
- 2 - germinal layers are responsible for the development of the middle ear. They are L - Mesoderm and
- Endoderm.
- 2nd - branchial arch is responsible for the development of the handle of malleus, lenticular process of the incus and stapes and also stapedius muscle.

2 - Normal human beings have 2 ears.

2 - Portions of the tympanic membrane are:-

- Upper smaller portion (Pars flaccida) and
- Lower larger portion (Pars tensa).

2 - layers are present in Pars flaccida. They are:

- Skinny (Epithelial) layer, and
- Mucous layer.

2 - types of fibers in the medial (fibrous) layer of tympanic membrane are:- Radial fibres and
Circular fibres.

2mm - is the length of the middle ear cavity. It ranges upto 7 or 8

2cm - is the volume of the middle ear cavity.

2 - muscles in the middle ear are:

- Tensor tympani, and
- Stapedius.

2 - ligaments are attached to the Incus. They are:-

- Anterior ligament and
- Posterior ligament.

2mm - is the diameter of the eustachian tube.

2 - windows which are present in the medial wall of the middle ear are:

- Round window and
- Oval window.

2mm² - is the area of the round window.

2 - labyrinths in inner ear are:-

- Bony labyrinth and
- Membranous labyrinth.

- 2cm - is the length of the bony labyrinth.
- 2 - opening of lateral semicircular canal are present in the lateral wall of the utricle.
- 2 - portions of the basilar membrane are:
 - Zona arcuata and
 - Zona pectinata.
- 2 - layers of cells are present in the Reissner's membrane.
- 2 - types of hair cells in the organ of corti are:
 - Outer hair cells and
 - Inner hair cells.
- 2 - types of fibres of hair cells are:
 - Type 1 or afferent fibres and
 - Type 2 or efferent fibres.
- 2 - maculae of each ear are capable of detecting accelerating forces in all planes of space.
- 2nd - shortest nerve among cranial nerves is the Auditory nerve while the 1st shortest nerve is the Olfactory nerve.
- 2 - divisions of the Auditory nerve are:
 - Vestibular division and
 - Cochlear division.
- 2 - branches of all central cochlear fibres are:
 - Anterior branch and
 - Posterior branch.
- 2 - For physiological purposes, the ear is divided into 2 parts.
They are:
 - Conducting apparatus and
 - Perceiving apparatus.
- 2 - functions of inner ear are:
 - Hearing and
 - Balance.

2 - Advantages of having 2 ears are:

- Ease in listening,
- Directional hearing is enhanced,
- Selective listening (or Cocktail party effect)
- Better detection of speech,
- Localization,
- Greater power for auditory discrimination.

2 - Information about the frequency of a sound may be signalled by auditory receptors in 2 ways. They are:

- Place principle, and
- Telephonic principle.

2 to 3dB - is contributed by torso for localization of sounds.

2 - Octaves is the range of voice in males while singing.

2% - is the incidence of hearing loss in Waardenberg's syndrome.

2 - types of refractory period are:

- Absolute refractory period, and
- Relative refractory period.

2 - types of earphones are:

- External earphone, and
- Insert type.

2 - couplers which approximate more closely to the human ear are:

- IEC coupler, and
- Zwislocki coupler.

2 - types of recordings in psychogalvanic skin response are:

- Exogenic, and
- Endogenic.

2 - synonyms for difference limen are:

- Differential threshold, and
- Just noticeable difference.

2 - Important cues for sound localization are:

- Intensity difference, and
- Phase difference of the signals arriving at the 2 ears

- 2 - factors which determine loudness are:
 - Number of activated neural units, and
 - Rate of firing of neurons.

- 2 - types of hearing aids based on the mode of sound conduction are:
 - Air conduction hearing aid, and
 - Bone conduction hearing aid.

- 2 - dimensions on the audiogram are:
 - Frequency along the abscissa, and
 - Intensity along the ordinate.

- 2 - symbols are used to plot the air conduction threshold points. They are:
 - '0' for right ear, and
 - 'X' for left ear.

- 2 - In speech audiometry, speech testing materials may be introduced in 2 ways, either through -
 - microphone (referred to as monitored live-voice testing), or
 - disc or tape recording.

- 2 - In speech audiometry, 2 ways of recording spondee words are:
 - W-1, (consists of lists of 36 spondaic words recorded at a conversation level).
 - W-2, (Spondaic word lists with attenuation at an average of 1dB per word).

- 2KHz to 50megahertz - is the frequency range of sound through water.

- 2 - An octave is the interval between 2 sounds having a basic ratio of 2.

- 2cm³ - is the volume of the cavity between the end of the earmold and the eardrum and the equivalent volume of the eardrum compliance.

- 2 to 3 inches - separation should be there between 2 microphones, especially for children recommended to use binaural amplification, while the ears are separated by 7 or 8 inches.
- 2 - types of amplifier circuits are used in hearing aids. They are:
- Class A or Single ended amplifier, and
 - Class B or Pushpull amplifier.
- 2% - The total harmonic distortion of the sound source should not exceed 2%, when the system is being used for general hearing aid response measurements.
- 2dB - drop will result at low frequencies and at high frequencies, when the volume of the cavity between the end of the earmold and the eardrum is increased by shortening the earmold tip, with other factors remaining constant.
- 2 - types of compression amplifiers used in hearing aids are:
- Limiter (compression limiting) and
 - Compressors..
- 2 - types of output limiting used in hearing aids are:
- Peak clipping, and
 - Compression amplification.
- 2 - types of hearing aids are:
- Individual hearing aid, and
 - Group hearing aid.
- 2c.c. - couplers are used in electroacoustic measurements of hearing aids.
- 2 - There are 2 tests to determine binaural candidacy. They are:
- Determine monaural most comfortable levels,
 - Obtain binaural balance.

(Mercola and Mercola, 1985).

- 2 - types of crystal microphones in general use are:
 - The direct actuated, and
 - The indirectly actuated.

- 2 - There are 2 angles at the extreme ends of cords. They are:
 - Adiflex (The cord emerges from the plug along the same plane as the contact pins)
 - Angleflex (The cord emerges at right angles to the contact pins).

- 2 - The 2 instruments commonly used to measure cord continuity are:
 - Cord and Battery tester, and
 - Multimeter.

- 2 - Types of shell molds are:
 - Shell (with tube)
 - 1/2 shell (without tube)

- 2 - types of canal molds are:
 - Canal (with tube)
 - Canal lock (without tube)

- 2dB - better speech threshold is obtained with standard molds in subjects with gradually sloping sensori-neural loss, (about 7dB per octave across the speech range)

- 2dB - better speech threshold is obtained with the open mold, in subjects with sharply sloping sensorineural loss. (25 dB per octave across the speech range)

- 2 - room set-up is necessary for speech audiometry, and is favourable for pure-tone audiometry.

- 2 - psychophysical methods employed in puretone audiometry are:
 - Method of limits, and
 - Method of adjustments.

- 2 to 5dB - increments at 20 dBSL with low scores suggest a retrocochlear lesion in SISI test.
- 2 - types of tests for loudness balance used clinically are:
 - Alternate binaural loudness balance and
 - Monaural loudness balance method.
- 2 - tones are presented alternately to the 2 ears in ABLB test.
- 2 - reference intensity levels (20 and 40 dBSL) in ABLB test with poorer ear as the reference ear, (Jerger) will result in faster and more accurate establishment of recruitment versus no recruitment.
- 2 - types of test stimuli used in Bekesy audiometry are:
 - Continuous tone, and
 - Interrupted tone.
- 2 - types of frequency tracings in Bekesy audiometry are:
 - Sweep frequency tracings and
 - Fixed frequency tracings.
- 2 - types of very late responses in electroencephalic audiometry are:
 - Expectancy wave, and
 - Contingent negative variation.
- 2 - tones are presented at 2 rates in Brainstem evoked response audiometry. They are:
 - 2K logon stimuli - 5times/sec.
 - 2K logon stimuli - 20times/sec.
- 2 to 3msecs - is the rise decay time for tone pips.
- 2 - approaches to tympanogram interpretation are:
 - Coding system (Jerger, 1970)
 - Descriptive analysis of tympanograms
(Feldman, 1975, 1976a)

- 2 - types of acoustic reflex measurements are;
 - Ipsilateral reflex measurement, and
 - Contralateral reflex measurement.

- 2minutes - 50% of recovery takes place within 2minutes after adaptation.

- 2 - stimuli used in adaptation are:
 - Adapting stimulus, and
 - Comparing stimulus.

- 2 - hypotheses to explain levelling of adaptation in Simultaneous dichotic loudness balance method are:
 - Jerger's hypothesis, and
 - Palva's hypothesis.

- 2 - ways of varying the stimulus in simultaneous dichotic loudness balance method of adaptation are:
 - Fixed intensity steps, and
 - Tracking method.

- 2 - ears (i.e., binaural hearing) are important for masking level difference. (In antiphasic condition, better detection of signal and in homophasic condition, poor detection of signal).

- 2 - Ears protecting devices can be classified into 2 types. They are:
 - Worn by the person (Earplug, Semi-inserts, earmuffs, and helmets)
 - Enclosures (Person being put in enclosure).

- 2 - types of noise analyzers are:
 - Constant band width, and
 - Constant percentage narrow band (Jones, 1967).

- 3rd week - During the 3rd week of fetal life, auditory placode is formed.

3rd week - During the 3rd week of fetal life, tubotympanic recess is formed.

3 - germinal layers are responsible for the development of inner ear. They are:

- Ectoderm,
- Mesoderm, and
- Endoderm.

3 - parts of ear are:

- External ear,
- Middle ear, and
- Inner ear.

3 - layers of Pars tensa in tympanic membrane are:

- Epithelial layer,
- Fibrous layer, and
- Mucosal layer.

3 - Tympanic cavity is divided into 3 portions. They are:

- Epitympanum,
- Mesotympanum, and
- Hypotympanum.

3 - ossicles which are present in the middle ear are:

- Malleus,
- Incus, and
- Stapes.

3 - ligaments are attached to the malleus. They are:

- Anterior ligament,
- Superior ligament, and
- Lateral ligament.

3mm - is the size of the stapes.

- 3 - branches of middle meningeal artery, supplied to the superior region of the middle ear. They are:
 - The superficial petrosal,
 - Superior tympanic arteries, and
 - The ramus nutrica incudomallei.

- 3 - types of mastoid are:
 - Pneumatic,
 - Sclerotic, and
 - Mixed.

- 3 - parts in bony labyrinth are:
 - Vestibule,
 - Semicircular canals, and
 - Cochlea.

- 3mm - Oval window has a depth of 3mm.

- 3 - semicircular canals are present in inner ear. They are:
 - Posterior,
 - Superior, and
 - Lateral.

- 3 - cochlear partition are:
 - Scala vestibuli,
 - Scala media, and
 - Scala tympani.

- 3 - types of fluids are found in the cochlea. They are:
 - v - Perilymph,
 - Endolymph, and
 - Cortilymph.

- 3 - rows of outer hair cells present in the organ of corti in the cochlea.

- 3 - types of cells are present in stria vascularis. They are:
 - Marginal cells,
 - Intermediate cells, and
 - Basal cells.

- 3 - cranial nerves concerned with hearing are:
 - 5th (Trigeminal),
 - 7th (Facial), and
 - 8th (Auditory)
- 3 - branches of internal auditory artery are:
 - Vestibular,
 - Vestibulocochlear, and
 - Cochlear.
- 3 - main primary cochlear nuclei are:
 - The ventral nucleus,
 - The posterior nucleus, and
 - The dorsal nucleus, (often called as tuberculum acusticum).
- 3 - main in vestibular nuclei are:
 - Lateral (Deiter's)
 - Superior ^Bechterew's)
 - Medial (schwalbe's)
- 3 or 4 m - is the diameter of smaller cell bodies which are present in acoustic nuclei.
- 3 - main pathways leave the primary acoustic nuclei. They are:
 - Dorsal stria (of Von monakow)
 - The intermediate stria(of Held) } called as
 - Trapezoidbody. Acousticstria
- 3 - inherent characteristics of Impedance interact in a complex manner to determine the mobility of a mechanical system. They are:
 - Mass,
 - Resistance, and
 - Stiffness.

- 3 - general classifications of hearing losses are:
 - conductive,
 - sensorineural, and
 - Mixed.

- 3 - factors important for localization are:
 - Azimuth, (0° , 90° , 180°),
 - Distance,
 - Elevation*

- 3 - Sound can be transmitted to the inner ear in 3 ways.
They are:
 - By way of the ossicular chain, across the middle ear from the vibrating tympanic membrane to the oval window.
 - Directly across the middle ear, when waves fall in the round window membrane. This may occur when there is a large perforation of the drum-head.
 - By bone conduction, sound energy is taken up and transmitted to the inner ear through the bones of the skull.

- 3 - modes of vibration in bone conduction are:
 - Inertial,
 - Compression, and
 - Osseous tympanic.

- 3 - modes of sound energy transformation in ear are:
 - Air conduction,
 - Bone conduction,
 - Tissue conducted.

- 3 - There are 3 steps in hair cell transduction. They are:
 - Mechanical deflection of hairs,
 - Transmission at the synapse,
 - Setting up of discharge in the afferent nerve fibres.

3dB - is contributed by pinna for localization of sounds.

3dB - Audiometers should be in calibration within + 3dB from 125 to 4000Hz if it is new.

3% - is the maximum permissible total harmonic distortion in B/c vibrator, (except at 250 Hz).

+3% - is the allowable tolerance for frequency from a fixed frequency pure tone audiometer.

3 - requirements for measurement of hearing impairment for speech are:

- Adequate test materials,
- Suitable equipment and
- A baseline of speech thresholds for a group of normal listeners.

(Hudgins et al., 1947).

3 - types of earcushions are:

- Supra aural,
- Circum aural, and
- Combination of above 2.

3 - synonyms for frequency filtering are:

- frequency selectivity,
- frequency analysis, and
- frequency resolution.

3 - major tone decay types (Owens, 1964) are:

- Type I
- Type II
- Type III

3 - electrodes used in electroencephalic response audiometry are:

- Vertex electrode,
- Reference electrode,
- Ground electrode.

- 3 - Electrodes and recording sites used in electrocochleography fall into 3 categories. They are:
 - Transtympanic membrane needle electrodes,
 - Intrameatal electrodes, and
 - Surface electrodes which are attached outside of the ear canal.

- 3 - measures obtained in Impedance audiometry are:
 - Tympanogram,
 - Static compliance, and
 - Acoustic reflex.

- 3 - features are described in descriptive analysis of tympanograms. They are:
 - Pressure,
 - Amplitude, and
 - Shape.

- 3 to 12dB - lower sensation level is necessary to obtain ipsilateral reflex than contralateral reflex threshold.
(Moller, 1962).

- 3 - stages in adaptation measurement are:
 - Preadapted balances,
 - Adapted balances, and
 - Postadapted balances

- 3 - models to explain masking level difference are:
 - O model (or Vector model) by Jeffress
 - Laterization model by Hafter
 - Equalization - Cancellation model by Durlach
(or Black - box model).

- 3 - types of earplugs are:
 - Premolded,
 - Custom made, and
 - Formable.

3 - types of skeleton molds are:

- Full skeleton,
- 1/2 skeleton, and
- 3/4 skeleton.

3 - essential controls and accessories in each hearing aid are:

- Volume control,
- Earmold, and
- 'Tubing' in case of behind the ear hearing aids, or 'cord' - in case of body level hearing aids.

3 - types of classification of cords on the basis of -

- length-3ft, 2½ft, 2ft, 1½ft.
- Configuration-V, Y, Single.
- Plugs-angleflex I, angleflex II.

3 - markings on tone control are:

- H (High frequency emphasis)
- N (Normal response)
- L (Low frequency emphasis)

3 - additional electronic circuits available on most body and many ear-level and eyeglass models are:

- Tone control,
- Telecoll, and
- Output limiting control.

3 - types of ear level hearing aids are:

- All in the ear,
- Behind the ear,
- Eye glass.

3dB - In subjects with high frequency loss (had an average slope of about 20 dB per octave across the speech range) 3 dB better speech threshold is obtained with closed molds compared to open molds.

- 3% - is the difference in optimal performance in monaural
Versus binaural listening for frequency discrimination.
- 3dB - improvement in threshold is obtained with binaural
hearing aids than monaural hearing aids.
- 3 - procedures are there for the selection of binaural aids.
They are:
- Based on discrimination tests,
 - Localization testing, and
 - Split-band technique.
- 3 - interaural differences occur in binaural hearing. They are:
- Time or phase differences,
 - Intensity differences, and
 - Spectral differences.
- 3 - The electroacoustic characteristics of a hearing aid can
be graphically represented through 3 curves.
They are:
- Gain Versus frequency curve,
 - SPL 90 Versus frequency curve, and
 - Intermodulation Versus frequency curve.
- 3 - types of hearing aids on the basis of Gain according to
ISI are:
- Strong gain,
 - Median gain, and
 - Low gain.
- 3 - types of hearing aids on the basis of gain are:
- Mild gain,
 - Moderate gain, and
 - Higher gain.

- 3 - different methods of carrying out hearing aid trials are:
 - Prescriptive procedure,
 - Selective procedure, and
 - Combined.

- 3 - types of microphones based on polarity are:
 - Unidirectional
 - Bidirectional, and
 - Omnidirectional.

- 3 - types of microphones used in different modern hearing aids, either
 - Magnetic, or
 - Ceramic, or
 - Electret.

- 3 - basic types of microphones used in noise measurements are:
 - Piezoelectric mic,
 - Dynamic mic, and
 - Condenser mic.

- 3 - major types of microphone that are currently available are:
 - Pressure microphone,
 - Velocity or pressure gradient microphone, and
 - Microphones that are the combination of the above 2 classes.

- 3 - methods used to measure speech intelligibility in the presence of noise are:
 - Articulation index,
 - Speech interference level, and
 - Preferred speech interference level.

- 3 - frequency weighting networks are present in general purpose sound level meters. They are:
 - A,
 - B, and
 - C.

3 - different types of Sound level dosimeters are:

- Stationary noise dosimeter,
- Earborne dosimeter, and
- Pocket size personal noise dosimeter.

3 - parameters measured in Graphic level recorder are:

- Frequency Versus Intensity,
- Intensity Versus Time,
- Directional.

4th - During the 4th week of fetal life, auditory vesicle is formed.

4th - During the 4th week of fetal life, the pinna develops.

4th to 5th - During 4th to 5th week of fetal life, primary tympanic membrane is present.

4th - During the 4th week of fetal life, vestibulo cochlear division is formed.

4 - quadrants of the tympanic membrane are:

- Posterior superior,
- Anterior superior,
- Posterior inferior,
- Anterior inferior.

4 - sections of the auditory (eustachian) tube are:

- The osseous
- The cartilaginous,
- The membranous portion, and
- The isthmus.

4 - main vestibular nuclei are:

- The superior (also known as the angular or Bechterew) nucleus.
The lateral (Nucleus of Deiter),
- The medial (Nucleus triangularis of schwalbe)
- The descending (Spinal vestibular).

- 4 - Only 4 parts of the ear are accessible to visual inspection. They are:
 - Auricle,
 - External auditory meatus,
 - Tympanic membrane, and
 - Eustachian tube.
- 4.5mm - shift in the points of maximum stimulation is observed for a change of an octave (doubling) in the sound frequency in the human cochlea.
- 4 to 10 Hz - Greater sensitivity to vibration occurs in this frequency range.
- 4 - octaves is the range in female human voice while singing.
- 4c.c - of air enclosed in the meatus and in the first recess of the auricle.
- 4 - common tuning fork tests for the assessment of hearing acuity are:
 - Rinne test,
 - Weber test,
 - Bing test, and
 - Schwabach test.
- 4dB SL - tone is presented in Denes and Naunton's ('50) DLI test.
- 4 - categories in interpreting ABLB results are:
 - No recruitment,
 - Partial recruitment,
 - Complete recruitment, and
 - Decruitment (abnormally slow loudness growth).
- 4 - distinct types of loudness growth in ABLB method are;
 - Asymptotic,
 - Straight line,
 - Delayed, and
 - Delayed asymptotic.

(Harris, Haines and Myers 1952).

- 4 - type of classification system to indicate increasing amounts and rates of tone decay used by Morales, Garcia and Hood (1972) are
- Type-I,
 - Type-II
 - Type-III,
 - Type-IV.
- 4 - types of tracings based on the criterion of reduced tracking amplitude in Bekesy audiometry are: (Lundborg, 1952).
- Type-I seen in normal hearing and in middle ear lesions,
 - Type-II seen in cochlear pathology,
 - Type-III seen in retrocochlear pathology,
 - Type-IV seen in retrocochlear pathology.
- 4 - types of electroencephalic responses are:
- Early response,
 - Middle response,
 - Late response,
 - Very late response.
- 4msecs - is the latency of early response in electroencephalic response audiometry. It ranges upto 8msecs.
- 4 - features of the evoked response must be considered, while interpreting electrocochleograph findings. They are:
- Response threshold,
 - Response wave form,
 - Rate of change of the response amplitude, and
 - Rate of change of the response latency.

- 4 - An auditory evoked potential audiometer must accomplish four things. It must:
- generate an acoustic stimulus,
 - amplify the very small electrical signal from the patient,
 - numerically process the signal from the patient to obtain the averaged waveform and
 - display and/or plot the averaged waveform.
- 4c.c. or 5.0c.c - is the C_1 volume in an adult patient if the tympanic membrane is not intact (due to perforation or if the ventilating tube is not intact).
- 4minutes - The adapting stimulus is presented continuously for 4 minutes in adapting ear after preadapted balances, in delayed loudness balance method.
- 4 minutes - The tone is presented continuously for 4minutes to the adapting ear for adaptation only once in single SDLB. (Studebaker, and Stockinger)
- 4 - There are 4 methods of adaptation depending upon the methodology used according to Ward. They are:
- Monaural concomitant. Eg., TDT.
 - Monaural Residual, Eg., TTS study.
 - Binaural concomitant. Eg., SDLB.
 - Binaural Residual, Eg., ABLB.
- 4minutes - is the maximum recovery time after adaptation of the ear. It ranges upto 5minutes.
- 4dB - Masking level differences(MLD) for speech intelligibility thresholds is about 4dB for monosyllabic words. When both signal and noise are in phase at the 2 ears, MLD is greater. (Carhart et al., 1967).

4% - is the incidence of hearing loss in Von Recklinghausen's syndrome.

4 - different types of custom molds are:

- Regular molds,
- Skeleton molds,
- Shell molds,
- Canal molds.

4 - basic components in every hearing aids are:

- Microphone,
- Amplifier,
- Receiver, and
- Power supply (Battery)

4 - types of classroom amplification systems are:

- Hard wire system,
- Induction loop system,
- Frequency modulation system,
- Modular and mobile group hearing aid system.

4 - methods of hearing aid trial under selective procedure are:

- Carhart's method,
- Jerger and Haye's method,
- Zerlin's paired comparison procedure, and
- Jeffer's paired quality judgement.

4 - basic considerations during the preselection of hearing aids in children include:

- the type of instrument,
- the frequency response,
- the arrangement of wearable amplification, and
- the maximum power output.

4 inches - is the optimal distance between the microphone and the teacher's lips to improve S/N ratio, in classroom auditory training system. It ranges upto 6 inches.

- 4 - factors are responsible for non candidates of binaural amplification. They are:
- Asymmetrical losses,
 - Degradation effect (cochlear pathology),
 - Fusion problems (8th nerve pathology and central auditory disorders), and
 - Diplacusis.
- 4dB - SPL (Sound pressure level) developed in a Zwislocki coupler is about 4dB higher than in 2c.c. coupler for frequencies upto 800Hz.
- 4 - types of ear protecting devices based on the mode of wearing are:
- Earplugs,
 - Semi inserts,
 - Ear muffs and
 - Helmets.
- 4 - types of microphones belong to the pressure type are:
- Carbon microphone,
 - Condenser microphone,
 - Dynamic microphone, and
 - Piezoelectric microphone.
- 4 - types of microphones depending on their size (i.e., with respect to diameter) are:
- 1 inch
 - $\frac{1}{2}$ inch
 - $\frac{1}{4}$ inch
 - $\frac{1}{8}$ inch.
- 4 - types of SLMs according to IEC standard are:
- 0
 - 1
 - 2
 - 3

4 - Weighting networks in precision sound level meter are:

- A,
- B,
- C,
- D.

4 - types of sound level meter according to ANSI 1971, are:

- Precision SLM,
- SLM with octave filter set,
- SLM with its output terminals, and
- Impulses precision SLM.

5months - At the end of 5 months of fetal life, inner ear reaches adult size.

5th month - *the inception of hearing starts at 5th fetal month.

5 - Temporal bone is divided into 5 parts. They are:

- Squamous portion,
- Mastoid portion,
- Petrous portion,
- Tympanic portion, and
- Styloid process

5 - major parts in the middle ear are:

- Cavity and mastoid air space,
- Tympanic membrane,
- Auditory ossicles,
- Middle ear muscles, and
- Eustachian tube.

5 - major suspensory ligaments in the middle ear cavity hold the entire ossicular chain. They are:

- Anterior malleolar ligament,
- Posterior malleolar ligament,
- Lateral malleolar ligament,
- Anterior incudal ligament,
- Posterior incudal ligament.

- 5mm - is the length of short process of the incus (Glattke, T.J)
- 5th - Stapedius muscle is innervated by the 5th cranial nerve.
- 5mm - is the axial height of the cochlea.
- 5mEq/litre - is the sodium concentration in the endolymph.
- 5dB - At high frequency ranges, 5dB, improvement in localization is seen because of contribution of head.
- 5dB - Hearing level dial graduated in 5dB steps in most of the audiometers.
- 5dB - improvement in bone conduction threshold is seen when ear is occluded. It ranges upto 25 dB.
- 5dB - Audiometers should be in calibration within 5dB at 6000Hz and 8000Hz, as long as audiometers are used.
- 5dB - is the value for central masking at all frequencies in conventional audiometers. It ranges upto 10 dB.
- 5dB - Threshold shift as a result of central masking does not exceed about 5dB (Zwislocki, 1953). Liden et al., 1959 say it as 15 dB.
- 5dB - The carhart notch introduces an artifact of 5dB in Bone conduction threshold at 500Hz and 4000Hz.
- 5dB - improvement in bone conduction threshold is observed in postoperative otosclerotic patients at 500Hz and 4000Hz.
- 5dB - increments are used first in SISI test, as practice events.
- 5secs - is the interval between the successive increments in SISI test.
- 5dB - increments are made in the level of the signal, without interrupting, until the subject responds continuously for 60 sec in Carhart's tone decay test.

- 5dB - In Carhart's tone decay test, the test is administered 5dB below the established threshold.
- 5dB - increments at successive levels the test should be repeated, until an intensity is reached which produces a sensation of tone "indefinitely" in Hood TDT.
- 5dB SL - tone is presented in Schubert tone decay test, until the tone disappears.
- 5 dB - SL - tone is presented in Hood TDT, until the tone is inaudible.
- 5dB or less - threshold difference between 500 and 20msecs tones is seen with cochlear involvement, either with or without a conductive component.
- 5 to 10 clicks or tone pips/sec - is the rate of presentation of the acoustic signals used in electrocochleography.
- 5dB - In delayed loudness balance method of adaptation, 5dB adaptation was observed when 50dB adapting stimulus was used (Studebaker and Stocking)
- 5 - sound test given by Ling. 5 sounds are:
- /a/,
 - /i/,
 - /u/,
 - /s/, and
 - / / . which is used in screening.
- 5 - essential steps to consider when procuring a hearing aid for a young child are:
- Otologic management,
 - Audiologic evaluation,
 - Preselection of hearing aids to be used for the clinical evaluation,
 - Actual hearing aid selection, and
 - Hearing aid recheck.

5 - methods of hearing aid trial under Prescriptive procedure are:

- Mirroring the audiogram,
- Equal loudness procedure,
- Most comfortable level for speech,
- Severe high frequency or sloped hearing loss,
- Bisection of dynamic range.

5 - microphone characteristics which are necessary for the purpose of noise measurements are:

- Sensitivity,
- Variation of response with frequency and the ambient conditions,
- Directional properties,
- Nonlinear distortion, and
- Impedance.

5 - instruments used for noise measurement and analysis are grouped under:

- Transducer,
- signal conditioner,
- Data storage,
- signal processor, and
- Display.

(Crockshire, 1972)

5dB - rule is given by Occupational Safety and Health Act (i.e. if the intensity of noise is increased 5dB, then the permissible duration must be reduced by ½%)

6th - During the 6th week of fetal life, 6 hillocks are present which is responsible for the development of pinna.

6th - During the 6th week of fetal life, utricle and saccule are present, and the semicircular canals begin to develop.

6 - walls in the middle ear are:

- Lateral wall,
- Medial wall,
- Anterior wall,
- Posterior wall,
- Roof, and
- Floor.

6mm - is the length of the Incus.

6mm - is the length of the Stapedius muscle.

6 to 8 - Near the base of the cochlea, each hair cell receives 6 to 8 terminals and near the apex, rather fewer,

6 μ m - is the diameter of each outer hair cell at its base.
Range upto 7 μ m.

6c.c. - of air is enclosed between earphone and the tympanic membrane.

6c.c. - couplers are used in calibrating audiometer earphones.

6months - During first 6 months after birth, assessment of hearing is generally qualitative.

6dB - Minimum audible field (hearing in free field) is on average about 6dB more sensitive than minimum audible pressure (hearing under earphones).

6% - is the maximum permissible total harmonic distortion, for bone conduction vibrator. Ranges upto 12% at 250Hz.

6% - is the incidence of sex-linked hearing loss. Range upto 8%.

6months - The life of the hearing aid cord is about 6months when handled carefully.

6 - subjective advantages of binaural hearing aids are:

- superior to one aid,
- easier to listen,
- easier to use,
- better spatial orientation,
- better overall hearing, and
- require less gain and volume setting.

6dB - The difference in comfortable level between the ears, should be within 6dB for the client to be a candidate for binaural hearing aids.

6dB - The difference in uncomfortable level of the 2 ears should be within 6dB+ If difference is greater than 6dB, signal is lateralized to the ear with the higher uncomfortable level, when the hearing aid selected with a higher SSPL has been fitted.

6dB - overall reduction in the intensity of speech is caused by the head-shadow.

6 - parts of sound level meter are:

- Microphone,
- Input amplifier,
- Weighting networks (A,B,C)
- Output amplifier,
- Indicating meter, and
- Power supply.

7th - During the 7th week of fetal life, one coil is present in the cochlea, utricle and saccule get the otolith.

- 7th - The ventilating function of the eustachian tube is better at 7th year.
- 7th - The Stapedius muscle is innervated by 7th cranial nerve.
- 7mm - is the length of the mastoid from side to side.
- 7 - peaks are observed in early response or Brainstem response.
They are:
- 1st peak originates from Cochlear nerve,
 - 2nd peak originates from Cochlear nucleus,
 - 3rd peak originates from Superior olivary nucleus,
 - 4th peak originates from Lateral laminiscus.
 - 5th peak originates from Inferior colliculus,
 - 6th peak originates from Median geniculate body,
 - 7th peak originates from Auditory radiations.
- 7minutes - In moving phantom method of adaptation (given by Wright?, adapting stimulus is presented to the adapting ear continuously for 7minutes.
- 7minutes - In asymptotic localization (given by Wright), the adapting ear is adapted for 7 minutes continuously
- 7dB - is the Masking level difference for speech intelligibility thresholds (for spondees). When both signal and noise are in phase, it is greater, (Carhart et al. 1967).
- 7 - most important points for high risk are:
- Familial deafness,
 - Rubella during pregnancy,
 - Birth weight 1500gss or less,
 - Congenital malformations: external ear? cleft lip and/or palateymultiple anomalies.
 - Apnea and cyanosis (APGAR score 1 to 4)
 - Hyperbilirubinemia: 20mg/100ml and over,
 - Severe infections (neonatal).

8th - During the 8th week of fetal life, primary meatus is formed; Incus and malleus are present in the form of cartilage, tower half of the tympanic cavity is also formed; Fluid in the vestibule and cochlea are connected by means of ductus reuniens.

8 - different types of supporting cells in the organ of corti are:

- Inner border cells,
- Pillar cells, inner and outer (rods or corti),
- Deiter cells,
- Claudius cells,
- Boettcher cells,
- Inner phalyngeal cells,
- Hensen cells, and
- Sulcus cells.

8 - notes of a musical scale is an octave.

8msecs - is the latency of middle response in electroencephalic response audiometry. Ranges upto 50msecs.

8% - speech discrimination between the two ears should not vary by more than 8%, for the client to be a candidate for binaural hearing aids.

8 - factors with a possible effect on binaural hearing aid candi dacy are:

- degree of hearing impairment,
- patterns of hearing impairment,
- minimum stimulation in terms of speech intensity required for an ear to contribute to binaural heating or speech,
- cause of deafness,
- previous experience with binaural hearing aids,
- speech audiometry measurements,
- diplacusic,
- reverberation.

9th - During the 9th week of fetal life, 3 tissue layers at the tympanic membrane are present (3 layers are epithelial, fibrous and mucosal layers).

9th - During the 9th week of fetal life, tympanic ring is formed as a membranous bone.

9yrs - External auditory meatus reaches adult size around 9yrs.

9mm - is the length of mastoid from top to bottom.

9mm - is the base width of the cochlea.

9dB - In delayed loudness balance method of adaptation, 9dB adaptation was observed when 80 dB adapting stimulus was used. (Studebaker and Stockinger)

10 mm - is the height of the tympanic membrane.

10mm - is the diameter of the tympanic antrum.

10mEq/litre - is the potassium concentration in the perilymph.

10% - of the tectorial membrane contains gel like substance.

10 μ m - is the diameter of each inner hair cell at the widest point. (Smith, 1968).

10 msec - is the latency of stapedius muscle in response to acoustic stimulus.

10 to 20/sec - is the spontaneous discharge rate of sensory fibres of cristae or maculae in resting state.

10 to 40millionths of an inch - is the average deflection of the human ear drum for sounds of different intensities.

10dynes/sq cm - is the sound pressure for a shout (i.e. speaking shoutly).

10minutes - is the warm up time for audiometer. Ranges upto 15minutes.

100hms - is the impedance value for TDH-39 earphone.

10dB or more - If the bone conduction vibrator is displaced away from the mastoid process, there will be changes in bone conduction threshold by 10dB or more (Bekesy, 1932).

10dB - improvement in bone conduction threshold at 1000Hz is observed in postoperative otosclerotic patients.

10% - is the incidence of hearing Ices in metabolic abnormalities.

10dB - The carhart notch introduces an artifact of 10dB in B/C threshold at 1000Hz.

10^{-16} watts/sq cm - is the unit of acoustical intensity.

10dB SL - is used by Jerger (1953) in his DLI test.

10 to 15dB - is mild tone decay indicating cochlear pathology.
(Rosenberg, 1969)

10msecs - is the rise decay time in brief toneaudiometry.

10dB - threshold difference for the tones of duration 500 and 20msecs is seen with normal hearing, conductive hearing loss, or nerve VIII dysfunction.

10msecs - rise -fall time is sufficient to avoid contamination of threshold results by switching artifacts in Brief tone audiometry.

10 to 20dB - If the difference in reflex threshold for pure tones and broad band noise is 10 to 20 dB, then mild to moderate hearing loss can be suspected (SPAR test given by Jerger et al., 1974).

10dB - If the difference in reflex threshold for puretones and broad band noise is less than 10dB, then severe sensorineural hearing loss can be suspected. (SPAR test given by Jerger et al., 1974).

10 - equipment necessary for electroacoustic measurements of hearing.

- Microphone,
- Hearing aid,
- Condenser microphone,
- Hearing aid test box,
- Loud speaker,
- Measuring amplifier,
- Beat frequency oscillator,
- 2.C.C coupler,
- Distortion factor meter, and
- Graphic level recorder.

10dB - Minimum sensation level of 10dB is required, in order for an impaired ear to participate in localization (according to Markides).

10secs - The dosimeter accumulate a weighted sound energy over durations of 10secs.

11 - During the 11th week of fetal life, 2½ coils of the cochlea is present and 8th nerve attaches to the cochlear duct.

11 - increments are used in screening SISI test.

12th - During the 12th week of fetal life, sensory cells of the cochlea are formed; ossification of the otic capsule takes place.

- 12mm - is the length of the osseous portion of the eustachian tube. Ranges upto 14mm.
- 12mm - is the length of the tensor tympani muscle during normal conditions.
- 14mgms - is the mass of the tympanic membrane.
- 14mm - is the length of mastoid from front to back.
- 14msecs - is the latency for contraction of muscle to sudden onset of a tone. Ranges upto 16msecs.
- 14% - When poorer ear is taken as reference ear and the normal ear as variable ear (Jerger's criteria), 14% of neural lesions showed complete recruitment in ABLB technique.
- 14dB - adaptation was observed when an adapting stimulus of 50dB was used in single SDLB method of adaptation (studebaker and Stockinger).
- 15th - During the 15th week of fetal life, tympanic ring gets ossified.
- 15th to 16th - During the 15th to 16th week of fetal life, malleus and incus begins to ossify.
- 15th -During the 15th week of fetal life, stapes is present in the form of cartilage.
- 15° - Is the angle at which pinna is attached to the side of the head.
- 15mm - is the height of the middle ear cavity.

- 15 to 16dB - increase in sound pressure level at the drum membrane, due to resonance and head effects.
- 15dB - sound pressure gain by the tympanic membrane is seen at 2.5KHz. Ranges upto 20dB. Because 2.5KHz is the resonance of the external auditory meatus near the tympanic membrane.
(Wiever and Ross, 1946).
- 15dB - is the occlusion effect at 1000Hz.
- 15dB - is the interaural attenuation in B/C at 2000Hz and 4000Hz.
- 15dB or more - threshold variation is seen clinically as a result of poor earphone placement.
- 15dB - improvement in bone conduction threshold at 2000Hz is observed, In postoperative otosclerotic patients.
- 15 to 30 dB - Audiometric air - boBme gaps from collapsed canals ranges from 15 to 30 dB for the speech frequencies (Ventry et al., 1961).
- 15feet - is the interior width of an echo chamber.
- 15dB - The carhart notch introduces an artifact of 15 dB in B/6 thresholds at 2KHz.
- 15dB or more - is the threshold difference between 500 and 20msec tone durations, seen with temporal lobe dysfunction or pseudohypacusis.
- 15dB - Threshold shift as a result of central masking is about 15dB. (Liden et al., 1959). Zwislocki, 1953 says it as 5dB.
- 15dB SL - tone is used by Jerger, in modification of the Luscher-Zwislocki's DLI test.

15dB - If the tone decay is more than 15dB in Rosenberg's TDT, then complete TDT should be administered.

15 - There are 15 factors which affect temporary threshold shift internally. They are:

- Interactive effects,
- Hearing level,
- Vibration,
- Residual effects,
- Vitamin A deficiency,
- Oxygen content,
- Drugs,
- Consciousness,
- Sex,
- Ear difference,
- Age,
- Central factors,
- Colour of eyes,
- Articulation, and
- Binaural Vs Monaural

15secs - is the duration of comparative stimulus in original SDLB method of adaptation. (Hood; 1950).

15secs - is the duration of adapting stimulus before preadaptation in original SDLB method of adaptation. (Hood, 1950)

15dB - is the diminished sensitivity during sustained threshold stimulation. (Hallpike et al., 1951).

15dB - If the difference between 2 ears is less than 15dB for pure tones in sensorineural hearing loss cases, then they are considered as candidates for binaural hearing aids (i.e., symmetrical SN loss patients).

15dB - If the difference between 2 ears is more than 15dB, then binaural amplification may adversely affect the functioning of the better ear.

- 16 to 32Hz - Frequencies between this range are called the first octave.
- 16dB - adaptation was observed, when an adapting stimulus of 80dB was used in single SDLB method of adaptation (studebaker and Stockinger).
- 17mm - is the length of the eustachian tube at birth. Ranges upto 18mm.
- 17dB - Sound pressure level developed in Zwislocki coupler is about 17dB higher than in a 2c.c. coupler at 8KHz.
- 18th - During the 18th week of fetal life, stapes begins to ossify.
- 18mm - is the length of the cartilaginous portion of the eustachian tube. Ranges upto 24 mm.
- 18feet - is the interior length of an echo chamber.
- 18 incnes - separation should be there between the receiver and the microphone, in case of a body level hearing aid for better feedback.
- 20th - During the 20th week of fetal life, auricle acquires adult configuration, but continuous to grow until age 9.
- 20th - During the 20th week of fetal life, maturation of inner ear takes place inner ear reaches adult size.
- 20 - Each inner hair cell receives about 20 afferent fibres.

-20 to -80mvolts - The intracellular potentials within the cochlea are -20 to -80millivolts, with respect to the perilymph within the scala tympani.

20 to 20,000Hz - is the frequency range of human hearing.

20 to 20,000Hz - Between this range, cochlea is sensitive to pressure variations.

20msecs - Relative refractory period of neurons in the cochlea ranges from 0.5 to 20msecs.

20MPascals - is the reference for common sound measurements*

20dB - According to ANSI, 1969, the sound pressure level for speech audiometric zero is 20dB.

20dB - is the difference between bone conduction thresholds obtained by forehead and mastoid placements in normals, at 2000Hz.

20Hz - Infra sound is arbitrarily defined as low frequency non audible sound and normally encompasses all frequencies below 20Hz.

20dB - hearing is restored through fenestration operation.
Ranges upto 30dB.

20 to 30dB - improvement in hearing is seen by administration of thyroid medication, with hypothyroid patient at most of the frequencies, (presenting pure 'inner ear', mixed and otosclerotic hearing loss).

20 - Totally 20, 1dB increments are used in original SISI test (Jerger, 1959).

20dB SL - tone is presented in original SISI test (Jerger, 1959).

20dB - successive intervals at which ABLB test is administered.

20dB SL - at which TDT (Olsen and Noffsinger, 1974) is administered

- 20secs - is the rest period between stimulus presentations in TDT (Owen, 1964).
- 20 to 25dB - is moderate tone decay indicating cochlear pathology (Rosenberg, 1969).
- 20msecs - Greater intensity of tone is required to get threshold response for 20msecs duration 6f tone in Bekesy audiometer.
- 20dB - reduction in sound transmission as a function of the acoustic reflex. It ranges upto 30dB at low frequencies.
- 20 to 30dB - is the difference in reflex thresholds for puretones and broad band noise in normals (SPAR test given by Jerger at al., 1964).
- +20dB - signal to noise ratio is required for hearing impaired listeners to reach maximum intelligibility in classroom auditory training system. It ranges upto +30dB.
- 20dB - is the threshold variation between insert receivers and earphones, (i.e., 20 dB gain will be observed using insert receivers than earphones).
- 21st - During the 21st week of fetal life, 3 layers of tympanic membrane are exposed by disintegration of meatal plug.
- 22 - is the area number of auditory reception in the brain, (according to Broadman)
- 22dB SPL - Speech audiometric zero was established at 22dB SPL for 2 reasons:
- the average of levels reported from laboratory studies of normal hearing subjects.

- the assumption was made that the threshold of intelligibility for spondee words should be about 6dB higher than the normal threshold hearing level for 1000Hz.

22dB - adaptation was observed when an adapting stimulus of 50dB was used, in Repeated SDLB method of adaptation (Studebaker and Stockinger).

23rd - During the 23rd day of fetal life, auditory pit is formed

23mgms - is the weight of the malleus. It ranges up to 27mgms.

25mm - is the length of the external auditory meatus in adults.

25mgms - is the weight of the Incus. It ranges up to 32mgms.

25mms - is the length of the tensor tympanic muscle.

25 μ m - is the length of each outer hair cell in the basal turn while 45 μ m is the length of each outer hair cell in the apical turn.

25msecs - is the latency of the stapedial reflex - "dead" time between the onset of stimulus and onset of muscle contraction. It ranges up to 160msecs.

25msecs - is the rise-decay time for tone bursts.

25msecs - is the optimal rise time in average evoked response audiometry. It ranges up to 30msecs.

+25mm H₂O - is the normal pressure in the middle ear.

+25mm H₂O - is the maximum flow setting in normal ears, when measuring through manual tympanometry.

+25mm H₂O - If the tympanogram peak deviates beyond this range, eustachian tube malfunction is indicated.

25dB - If the hearing loss is within 25dB, then the person does not require hearing aid.

26dB - The 'low fence' is an average hearing level through the speech frequencies. (AAO method)
0 to 26dB is the normal hearing limits.

26% - of sound intensity must be increased, in order for the ear to register a change in the loudness sensation produced.

26dB - adaptation wets observed when an adapting stimulus of 80dB was used in Repeated SDLB method of adaptation (studebaker and Stockinger),

26 to 40dB - If the hearing loss is between 26 to 40dB, the person can use the hearing aid whenever necessary.

28 - increments are used in original SISI test (Jerger, 1959).

29 μ sec - If a source of sound is to one side of the head, the sound reaches the farther ear about 29 μ sec later.

30th - During the 30th week of fetal life, pneumatization of tympanum occurs.

30ms - is the length of the spiral cochlear tube.

30° - Lateral semicircular canal makes a 30° angle with the horizontal plane.

30dB - loss in energy results, when sound travels from air to fluid media directly (i.e., from external to inner ear directly).

30 to 40dB - loss results with the perforation of the drum along with interrupted ossicular chain.

30dB SL - above which the test should be terminated in Carhart's TDT.

30dB or more - is marked tone decay, indicating retrocochlear pathology. (Rosenberg, 1969).

30dB - The difference between SPL of fundamental frequency and harmonics should be atleast 30dB.

30 to 50msecs - is the duration of tone bursts.

30dB - error in threshold results because of sidebands in Brief tone audiometry.

32nd - During the 32nd week of fetal life, malleus and incus are completely developed.

32mm - is the length of the basilar membrane.

32 to 512Hz - Frequencies between this range are referred to as the 2nd, 3rd, 4th and 5th octaves.

33 - If social adequacy index is 33 or below, the patient is considered to have excessive difficulty in communication (conversation).

34th - During the 34th week of fetal life, mastoid air cells develops.

34th to 35th - During the 34th to 35th week of fetal life, epitympanum is pneumatized.

35° - is the angle at which the eustachian tube is situated with respect to the horizontal plane.

35µ m - is the length of each inner hair cell.

35mm - is the length of the cochlear channels.

35mg/100ml - is the concentration of protein in cerebrospinal fluid.

37mm - is the length of the eustachian tube in adults.

40° - is the angle at which the tympanic membrane is situated, with respect to the lower wall of the external auditory meatus.

40dB - is the interaural attenuation for airconducted signal.

40dB - Speech discrimination scores are got at a level of 40dB above the subject's speech reception threshold.

40dB HL - For puretones, the bone conduction output calibration measurements are done at 40dBHL.

40 or 50dB - interaural attenuation is provided by the mass of the head for air conduction measurements, when earphones encased in supra-aural cushions are used.

- 40dB - In air conduction testing, the non-test-ear should be masked whenever the signal presented to the test ear exceeds bone conduction sensitivity in the non-test-ear by more than 40dB.
- 40dB - loss is resulted by retraction of the tympanic membrane.
- 40dB SL - tone is presented in Luscher and Zwislock's (1949) DLI test.
- 40dB SL - tone is used by Jerger (1953) in DLI test, similar to Denes and Naunton's DLI test.
- 40 to 60% - scores observed with cochlear disorders at 1000Hz, which is questionable in SISI test (Jerger, 1973).
- 40secs - rest is given between presentations of adapting stimulus before adaptation, in SDLB method of adaptation.
- 40dB - 'A' weighted network of SLM approximates the 30dB phon contour.
- 40 - The loudness of a tone of 40dB at 1000Hz is said to be 40 phoney. $l_{sone} = 40 \text{ phon}^{\wedge}$.
- 40PNdB=1 noy, PNdB and noys are noisiness measures.
- 40PNdB- is noisiness experienced, when a 40 dB SPL narrow band noise centering at 1KHz is presented. (40SNdB=1 noy)
- 41 - is the number of primary auditory reception area in the brain (Broadmann's classification).
- 41 to 55dB - If the hearing loss is between 41 to 55dB, the person has to use the hearing aid continuously, and may not benefit from hearing aid in noisy environment.

42 - is the number of secondary auditory association area in the brain.

42ohms - is the impedance of air.

44dB SL - tone is presented in Denes and Naunton's (1950) DLI test.

45 μ m - is the length of each outer hair cell in apical turn while the length of each outer hair cell in the basal turn is approximately 25 μ m.

45° - is the angle at which the auditory (eustachian) tube is situated, with respect to the sagittal plane.

45 - line between ordinate (better ear tone) and abscissa (poorer ear tone) represents equal loudness growth for two normal ears.

45% - of the genetic hearing loss is associated with renal disease in females.

45° - According to Green's modified TDT, the hand should be kept at 45° to the arm rest, if the stimulus loses tonality but remains audible.

45° - In the evaluation of CROS - type hearing aids, loudspeaker is located at an azimuth of 45° from midline of the subject's head.

45° - For tones between 1500 and 2000Hz, the minimum audible angle is 45° for auditory localization, (refer also).

- 50mgms - is the physical mass of the ossicles (when they are functioning in physical terms).
- 50 - hairs are present on each inner hair cell.
- 50dB - maximum hearing level in bone conduction is available, in most of the pure tone audiometers.
- 50% of tone detection by the patient at particular intensity is the patient's threshold.
- 50 to 60dB HTL - False air conduction thresholds at the 50 to 60 dB HTL can be obtained in a "dead" ear, when there is a conductive loss of equal severity in the better ear.
- 50% - The threshold of intelligibility is the level (in dB) at which the listener is able to identify approximately 50% of spondaic words.
- 50msecs - is the on-off time of the signal in SISI test.
- 50% - At 50% duty cycle with a period of 1sec, the tones alternate in ABLB technique. (Jerger, 1962).
Duty cycle: The duty cycle of a device which normally runs in an intermittent mode (alternately on and off) refers to the time the device is operative as compared to the idle time. Duty cycle is generally expressed as a percentage. For example, a 50% duty cycle refers to an equal proportion of on and off periods.
- 50msecs - is the rise and decay times in ABLB technique.
- 50msecs - is the latency of late response in electroencephalic response audiometry. Ranges upto 300msecs.
- 50% - of recovery takes place within 2minutes after adaptation.
- 50% - Relatively little gain is available, once the volume control of an hearing aid is beyond 50% of its total range, with more distortion. (Hasten and Lotterman, 1969)

- 50% - If there is abnormal decay of greater than 50% amplitude to 10dB reflex sensation level stimulus within 10secs (for pure tones 1000Hz and below), then VIII nerve pathology can be suspected.
- 050feet - is the maximum length of cable that may be used with a crystal microphone.
- 50dB - is the threshold of octave masking in normals.
- 50dB - If threshold of octave masking is less than 50dB, then the subject is susceptible to noise induced hearing loss.
- 50dB - is the threshold of nonlinearity in aural harmonics test-given by Lawrence and Blanchard.
- 50dB - If threshold of nonlinearity in aural harmonics test is less than 50dB, then the subject is susceptible to noise Induced hearing loss.
- 55 to 85 sq.mm - is the area of the tympanic membrane.
- 55° - is the angle at which tympanic membrane is situated with the floor of the meatus.
- 55% - of the genetic hearing loss is associated with renal disease in males.
- 55 to 80dB - If the hearing loss is between 55 to 80dB, there is an extreme need for hearing aid and the person should wear the hearing aid all the time.
- 55dB SPL - The 'A' weighting network in sound level meter approximates the ear's response characteristics for low level sound below about 55dB SPL.
- 55 to 85dB - The 'B' weighting network in sound level meter approximates the ear's response for levels between 55 and 85 dB.

- 60dB - loss results with Incus necrosis (with intact drum).
- 60dB - loss results with ossicular chain discontinuity with intact tympanic membrane.
- 60dB - is the level of conversational speech at 1meters from the source.
- 60 to 70dB - above the threshold of hearing at a distance of 3feet is the intensity of normal conversation.
- 60dB HL - For puretones, the air conduction output calibration measurements are done at 60dB HL dial setting.
- 60secs - is the duration of Rosenberg's screening TDT.
- 60secs - rest is given between stimulus presentations, in Hood technique of TDT.
- 60secs - duration, continuous tone is given in Olsen and Noffsinger's TDT.
- 60 to 80dBA - Noise levels must exceed 60 to 80dBA to produce temporary threshold shift, with other factors held constant.
- 60dB - is the intensity level of adapting stimulus presented during adaptation.
- 60dB SPL - at 1KHz is the adapting stimuli used by Hood in simultaneous dichotic loudness balance method of adaptation.
- 60 to 80dBA - Noise levels must exceed 60 to 80dBA (60 to 80dB on the 'A' scale of a sound level meter) to produce temporary threshold shift.
- 60dB - is the dynamic range of an high quality magnetic-tape recording system.

65dB HTL - is the median threshold value for the stapedial reflex to white noise.

67mms - is the length of the pinna. (Ranges from 60 to 75mms).

70 to 75dB - loss results if entire cortex is removed.

70 to 75dB SPL - is the levels required to awaken the babies. (Wedenberg, 1963).

70 to 100% - SISI score are +ve indicating presence of cochlear lesion.

70 to 95dB SL - is necessary to obtain contralateral acoustic reflex in normal ears. (Jepsen, 1951 et al).

70dB SPL - is the level of presentation for discrimination testing of CROS hearing aids.

70dB - The 'B' weighting network of sound level meter approximates the 70dB phon contour in the loudness contour curve.

73dB - The US EPA concluded that hearing will not be impaired if the noise level does not exceed an L_{eq} of 73dB (A) when averaged over 8hours.

75% - of efferent fibres originate from contralateral superior olivary complex and from crossed olivocochlear bundle.

75 to 80dB - If hearing loss exceeds 75 to 80dB across the speech frequencies, conventional ear level instruments may not provide optimal gain (or frequency response due to constant acoustic feedback related to a less than optimal ear-mold fit).

75msecs - is the critical off time for cochlear pathology in Bekesy audiometry.

80 to 100 - hairs are present on each outer hair cell.

+80mV - The scala media, filled with endolymph maintained at +80mV (endocochlear potential) with respect to the plasma.

+80mV - endocochlear potential of the scala media, together with the -70 to -80mV intracellular membrane potential, results in a 150 to 160mV potential gradient across the mechanosensitive section of the membrane at the top of the sensory hair surface.

80dB - If the hearing loss is above 80dB, there is only partial help from the hearing aid, but the person should use it continuously.

80 to 100% - scores at 2000, 2000 and 4000Hz which is very high in SISI test, (Jerger, 1973) is observed when there is cochlear disorder.

80 to 6,500Hz - is the frequency response of a crystal microphone for the diaphragm type.

85dB HTL - is the median threshold value for the stapedial reflex to pure tone signals in normals.

85dB - The 'C' weighting network in sound level meter corresponds to the ear's response for levels above 85dB.

90% - of the tectorial membrane contains water.

90 to 95% - of afferent fibres connect with inner hair cells, while remaining innervate outer hair cells.

90° - The anterior cochlear branches cross through the entire ventral nucleus in more or less parallel bundles, which form nearly 90° angles with the cochlear root fibres.

90 to 100dB - The normal ear should be able to tolerate sound stimulus at hearing levels of 90 to 100dB, without experiencing discomfort i.e., 122dB SPL.

90° - According to Green's modified TDT, the band should be kept at 90° to the armrest, if he perceives the stimulus as tonal.

90secs - duration of tone is used by Sorenson in tone decay test, as a variation of the Carhart procedure in which he used 60secs duration of tone.

90dB SPL - wide band noise presented to non-test-ear in supra threshold adaptation test.

-90dBm - is the output level of a capacitor microphone head.

90dB(A) - If the steady noise without meaning exceeds 90dB(A), then it affects the performance. (BroadBent, 1957).

90dBA - is the permissible noise exposure for 8 hours according to Occupational Safety and Health Act (1971).

90dB - Decrease in the quality of work output results, when the background noise exceeds 90dB.

92dBA - is the permissible noise exposure for 6 hours, according to Occupational Safety and Health Act (1971).

93dB - The 'high fence' or 100% hearing impairment is considered to be an average hearing level through the speech frequencies, in calculating disabilities (AAO method).

95% - neurons innervate inner hair cells.

95dBA - is the permissible noise exposure for 4 hours, according to Occupational Safety and Health Act (1971).

97dBA - is the permissible noise exposure for 3 hours, according to the Occupational Safety and Health Act. (1971).

100° - is the angle between the short leg and long leg of the Incus.

- 100cu.mm - is the volume occupied by the primary nuclei of cochlea. It ranges upto 150cu.mm.
- 100 - times is the maximum discharge of neurons in the cochlea per second.
- 100 to 150msecs - maximum tension in muscles is attained.
- 100 to 8000Hz - is the frequency range for TDH-39 earphone.
- 100%- SISI scores can be obtained, when 60 dB energy reaches the cochlea.
- 100msecs - is the rise and decay time of tone in ABLB test.
- 100dB - 'C' weighted network of sound level meter approximates a 100dB phon contour.
- 100dBA - is the permissible noise exposure for 2 hours, according to Occupational Safety and Health Act (1971).
- 102dBA - is the permissible noise exposure for 1½ hours, according to Occupational Safety and Health Act (1971).
- 105 to 115dB SPL - is required to elicit auroopalpebral reflex in infants, for tones of 500Hz, 1000Hz, 2000Hz and 4000Hz (Wedenberg, 1963).
- 105 to 115dB - If auroopalpebral reflex is absent in this range, but is awakened by signal greater than 70 to 75dB SPL, then conductive or retrocochlear pathology can be suspected (Wedenberg, 1972).
- 105 to 115dB SPL - If auroopalpebral reflex is present in this range, but requires greater than 75dB to be awakened then cochlear problem with recruitment may be suspected (Wedenberg, 1972).

105dBA - is the permissible noise exposure for 1 hour, according to Occupational Safety and Health Act (1971).

110dB - is the maximum hearing level for air conduction. Which is available in most of the pure tone audiometers.

110dB SPL - The test tone is presented at 110dB SPL continuously in STAT at 500Hz.

110dBA - is the permissible noise exposure for 30 minutes, according to Occupational Safety and Health Act (1971).

115dBA - is the permissible noise exposure for 15 minutes or less, according to Occupational Safety and Health Act (1971).

118dB - is the threshold of discomfort in the frequency range of 200 to 10,000Hz.

120metres - is the conduction velocity of neuron per second.

120dB - is the dynamic range of human ear.

120dB SPL - On the average the uncomfortable level is 120 dB SPL.

120dB - is the highest intensity of the Bekesy audiometers.

125msecs - is the critical off time for retrocochlear pathology in Bekesy audiometry.

125Hz - Starting from 125Hz, pure tones ranges upto 8000Hz in most of the audiometers (1 in octave intervals).

127mg/100ml - is the concentration of protein in the endolymph.

130* - is the angle at which the handle of malleus forms with that of the head of the malleus.

132dB - Infrasound builds up -ve middle ear pressure (fullness sensation in the ear) and this has been reported at levels of 132 dB and higher.

140* - is the angle at which tympanic membrane is situated with upper wall of the external auditory meatus.

140Eq/litre - is the sodium concentration in the perilymph.

140dB - is the threshold of pain in the frequency range of 200 to 10,000Hz.

140dB - Maximum output of the hearing aid can be upto 140dB.

140dB - Exposure to impulsive or impact noise should not exceed 140dB peak sound pressure level, according to Occupational Safety and Health Act (1971).

144mEq/litre - is the potassium concentration in the endolymph.

150Hz to 5000Hz - is the frequency coverage of hearing aid test box.

200 to 5000Hz - Frequencies of human speech lie in the range of approximately 200 to 5000Hz.

200 to 3400Hz - is the frequency range of a telephone system for the transmission of speech.

200msecs - delay in delayed auditory feedback is enough to bring out effect in normals.

200msecs - is the duration of pulse tones used in Bekesy audiometry.

200msecs - Less intensity of tone is required to get threshold response in Bekesy audiometer for 200msecs tone, compared to 20msecs duration tone.

200msecs - is the critical off time in the analysis of auditory disorders in Bekesy audiometry.

+200mm H₂O - air pressure in the external ear canal, results in a poor compliance of the tympanic membrane (i.e., tympanic membrane becomes stiff).

± 200mm H₂O - Variation in pressure between ± 200mm H₂O in made in external auditory meatus to check the compliance of the eardrum in tympanometry (Impedance audiometry).

220Hz - probe tone, with this, the range of acoustic susceptance (or compliance) is completely different in normal ears, when compared to ears with healed perforation (Feldman, 1974).

220Hz - frequency probe tone are used in most of the impedance audiometers.

230 to 360msecs - is the latency of expectancy wave (very late response) in electroencephalic response audiometry.

250Hz - Hearing aid type bone vibrators have harmonic distortion at 250Hz.

250 to 4000Hz - As the frequency range used for sensorineural acuity level (SAL) test. (Jerger and Tillman).

250Hz - SISI scores are low (0 to 20%) with cochlear disorders at 250Hz.

250Hz - Poorer discrimination for the increments with contralateral masking in SISI test with normal hearing subjects, at 250Hz. (Bleguad and Terkilsen, 1967).

250maecs - silent period, is sufficient for complete recovery from adaptation, in patients with extreme threshold adaptation (Tillman, 1966).

260m/sec - is the transmission velocity of sound in bone. It ranges upto 570m/sec.

300mg/160ml - is the concentration of protein in perilymph.

300Hz - Below 300Hz, the skull vibrates as a whole unit for bone conducted signal.

300msecs - More than 300msecs, Is the latency of contingent negative variation (very late response) in electroencephalic response audiometry.

343meters/sec - is the velocity of sound in air at any frequency,

400 to 3500Hz - is generally considered as Middle frequency range.

500 - efferent fibers are present in the cochlea.

500Hz - stimulation causes fibres within the auditory nerve to discharge at the rate of 500 times/sec (Frequency theory).

500 to 6000HZ - The greatest sensitivity of human ear lies in this frequency range.

500gms - weight is placed on the top of the earphone in air conduction calibration.

500Hz - Conventionally, 500Hz is considered as one of the speech frequency among 3 frequencies (500Hz, 1KHz and 2KHz).

500Hz - SISI scores are low (0 to 20%) with cochlear disorders, at 500Hz.

500msecs - is the duration of the tone to each ear in ABLE technique.

500Hz - is one of the affected frequency for STAT to be administered, among 3 frequencies (500Hz, 1KHz, and 2KHz).

500Hz - is one of the affected frequency for TDT to be administered, among 4 frequencies (500Hz, 1KHz, 2KHz, and 4KHz).

500Hz - is the adapting stimulus used in monaural heterophonic method of adaptation (given by Weiler).

500msecs - is the longest tone duration in Brief tone audiometry.

500Hz to 1000Hz - Weighting function of dosimeter is essentially flat in this frequency range.

512 to 2048Hz - Frequencies between this range are referred to as 6th and 7th octaves.

550gms - force on the bone vibrator is necessary during bone conduction calibration.

600Hz - Noise below 600Hz is not dangerous to the ear compared to noise above 600Hz.

600 to 1200Hz - Noise containing concentrated energy within this octave band and higher is more dangerous to the ear.

660Hz - probe tone is used in addition with 220Hz probe tone in Impedance audiometry. It is useful in detecting minor abnormalities in tympanic membrane. Multiple peaks are obtained with 660Hz frequency probe tone.

1000Hz to 1500Hz - Human ear is more sensitive in this frequency range.

- 1000Hz - Conventionally, 1000Hz is considered as one of the speech frequency, among 3 frequencies (500Hz, 1KHz and 2KHz).
- 1000Hz - At 1000Hz, SISI scores are questionable (40 to 60%) with cochlear disorders.
- 1000Hz - No effect of contralateral masking in SISI test with normal hearing subjects, at 1000Hz. (Blegvad and Terkilsen, 1967).
- 1000Hz - is one of the affected frequency for suprathreshold adaptation test, among 3 frequencies (500Hz, 1000Hz and 2000Hz).
- 1000Hz - is one of the affected frequency for TDT, among 4 frequencies, (500Hz, 1000Hz, 2000Hz and 4000Hz).
- 1000Hz - Furrer used 1000Hz as fatiguing stimuli, in his experiment with temporary threshold shift.
- 1000Hz - Time-intensity trading relationship is not possible above 1000Hz.
- 1000Hz - A pure tone of 1000Hz can be masked by a sound which is in the range 900 to 1100Hz, but would not be masked by another sound whose frequency content is in the 1900 to 2100 Hz range.
- 1000Hz - Maximum distortion is usually below 1000Hz, for body aids (Lotterman and Hasten, 1976).
- 1000Hz - Maximum distortion is usually above 1000Hz for ear level hearing aid (Lotterman and Hasten, 1976).
- 1000Hz - is the reference frequency in establishing equal loudness contour.
- 1000Hz - Beyond 1000Hz, the weighting function of dosimeter rises at the rate of 3dB/octave. (until the upper cut off frequency is 1500Hz).

1024 - is the number of stimuli used to obtain an averaged evoked response.

1200 to 1800Hz - is the resonant frequency of the middle ear.

1500 to 2000Hz - is the resonant frequency of the ossicular chain in man, for vibratory stimulus.

1500Hz - Above 1500Hz, the parts of the skull move in different direction, when a vibrator is brought in contact with the skull.

2000Hz - to 4000Hz - The stimuli reach the cochlea at full strength in this frequency range.

2000Hz - Carhart's notch is seen at 2000Hz. ^/-

2000Hz - Conventionally, 2000Hz is considered as one of the speech frequency, among 3 frequencies, (500Hz, 1KHz, and 2KHz).

2000Hz - At 2000Hz, best (lowest) threshold will be get in chronic supparative otitis media patients.

2000Hz - is one of the affected frequency, among 3 frequencies (500Hz, 1000Hz, and 2000Hz) for supra threshold adaptation test.

2000Hz - is one of the affected frequency for TDT, among 4 frequencies (500Hz, 1000Hz, 2000Hz and 4000Hz).

2000Hz - is the only frequency, at which TDT is administered by Sorenson (1962).

- 2000Hz - Attenuation of sound by reflex is limited upto 2000Hz.
Above 2000Hz, there is no attenuation.
- 2000Hz - Wilson used 2000Hz as fatiguing stimulus at 80dB HL,
in his experiments on temporary threshold shift.
- 2000Hz - Stimuli above 2000Hz are most annoying to the human
being.
- 2000Hz - Pink noise provides a relatively broad spectrum, with
equal energy per octave below 2000Hz.
- 2000Hz - High frequency noise above 2000Hz appears more disrupt-
ing than low frequency noise below 2000Hz (Broadben
and Harris, 1957).
- 2000Hz - A broad spectrum noise with approximately equal energy
per octave, below 2000Hz.
- 2000Hz to 6000Hz - Noises with energy concentrated in this fre-
quency range, produce more temporary threshold shif
- 2000Hz - Very high SISI scores (80 to 100%) with cochlear dis-
orders is observed at 2000Hz.
- 2048 to 8192Hz - Frequencies between this range are referred to
as the 8th and 9th octaves.
- 2500Hz - is the resonance of the combination of the meatus and
concha.
- 2900Hz - is the resonance of the ear canal.

- 4000 - outer rods are present in tunnel of corti (inner ear) ,
and inner rods are about 5000.
- 4000HZ - improved discrimination for the increments with con-
tralateral masking in SISI test, with normal
hearing subjects is observed at 4000Hz (Blegvad
and Terkilsen, 1967).
- 4000Hz - is one of the affected frequency for TDT, among 4
frequencies (500Hz, 1000Hz, 2000Hz and 4000Hz).
- 4000HZ, 6000HZ, and 8000HZ - More temporary threshold shift
is observed in right ear at 4000Hz, 6000Hz and
8000Hz (Weller).
- 4000Hz - dip indicates noise induced hearing loss.
- 4000Hz - The growth of noise induced permanent threshold shift
(NIPTS) at 4000Hz is most rapid during the first
10-15 yrs of exposure after which the loss seems
to slow down to other frequencies.
- 4500 - inner hair cells are present in the organ of corti and
outer hair cells are about 12,500.
- 5500Hz - is the resonance of the concha
- 6000 - inner rods are present in tunnel of corti (inner ear) and
outer rods are about 4000.
- 6000Hz - Beyond 6000Hz, the energy distribution of human speech
is falling off quite rapidly.

6000Hz to 7000Hz - The band width of white noise is limited to frequency range between 6000Hz to 7000Hz.

6000Hz - The frequency response of TDH-39, and TDH-49 earphones is typically limited to about 6000Hz.

8192Hz to 16,000Hz - The frequencies between 8192 to 16,000Hz range, are referred to as 10th octave.

10,000Hz - In monaural heterophonic method of adaptation (by Weiler), the comparative stimulus used is 10,000Hz.

10,000Hz - upto 10,000Hz, Random incidence corrector makes precise measurements on sounds having variable or random incidence.

12,5000 - outer hair cells are present in the organ of corti and inner hair cells are about 4,500.

16,000Hz - High quality crystal microphones will respond upto 16,000Hz.

17,000 - hair cells are present in the organ of corti (4,500 inner hair cells and 12,500 outer hair cells).

20,000 - ganglion cells provide different types of nerve fibers, which differ in diameter sizes in organ of corti.

20,000Hz - Ultra sound is normally referred to as air borne acoustic energy, in the frequency region above 20,000Hz.

22,000 to 24,000 - Basilar membrane contains 22,000 to 24,000 fibres.

30,000 - neurons, whose dendrites have a different course along the organ of corti.

60,000 to 1,00,000ohms - is the output impedance of a crystal microphone.

ABBREVIATIONS USED IN THIS PROJECT

ABLB - Alternate binaural loudness balance.

A/C - Air conduction

B/C - Bone Conduction

BSERA - Brain Stem Evoked Response Audlometry

C_1 - is the volume of the cavity between the probe tip and the ear drum.

DAF- Delayed Auditory Feedback.

DLI - Difference limen for Intensity

HL - Hearing Level

HTL - Hearing Threshold Level

MLD - Masking Level Difference

SAL - Sensorineural Acuity Level Test.

SL - Sensation Level

SISI - Short Increment Sensitivity Index.

SDLB - Simultaneous dichotic loudness balance.

SPL - Sound Pressure Level

SSPL - Saturation Sound Pressure Level

S/N - Signal to Noise ratio.

TDT - Tone Decay Test.

Yrs - years.

BIBLIOGRAPHY

- Anson and Donaldson, J.A., "Surgical anatomy of the temporal bone and ear" 2nd edition, 1973, W.B.Saunders Company, London.
- Ballantyne, J, "Diseases of the Ear, Nose and Throat", Vol.1, 4th edition, 1979, Butterworth and Co.(Publishers) Ltd.
- Beagley, H.A., "Audiology and Audiological medicine", Vol.1, Oxford University Press, New York.
- Cheremisnoff, P.N., and Cheremisnoff, P.P., "Industrial noise control - Hand book", 1978, Ann Arbor Science Publishers Inc., Michigan.
- Gayathri Hattangadi, "Acronyms for Audiologists", Independent Project No.56, 1984, submitted to the University of Mysore.
- Goodhill, V., "Ear-Diseases, Deafness, and Dizziness", 1979, Harper and Row Publishers, Inc, U.S.A
- Hodgson, W.R., and Skinner, P.H., "Hearing aid assessment and use in audiological habilitation", 2nd Edition, 1981, Williams and Wilkins, U.S.A.
- Jerger, "Modern developments in Audiology", 2nd Edition, 1973, Academic Press, New York and London.
- Katz, J., "Handbook of clinical audiology", 2nd Edition, Williams and Wilkins Company, U.S.A.
- Katyayini, H.N., "Review questions in selected areas of Audiology", 1983, Project, No.46, submitted to University of Mysore.
- Libby, E.R.(Editor), "Binaural hearing and amplification", 1980, Zenelion Inc., Chicago.
- Mani Meghalai, "A manual for noise measurement", 1982, Independent Project, No.36, submitted to the University of Mysore.
- Markids, A., "Binaural hearing Aids", 1977, Academic Press, London.

- Martin, P.N., "Introduction to Audiology", 2nd Edition, 1981, Prentice Hall Inc, Engle wood Cliffs, New Jersey.
- May, D.N., "Handbook of noise assessment", 1978, Van Nostrand Reinhold company. New York.
- Moore, E.J., "Bases of auditory Brainstem Evoked Responses, 1983, Grune and Stratton, Inc, New York.
- Newby, H.A., "Audiology", 4th Edition, 1979, Prentice Hall Inc., Engle wood cliffs, New Jersey.
- Northern, J.L., and Downs, M.P., "Hearing in children", 2nd Edit: 1978, The Williams and Wilkins Company, U.S.A.
- O'Neill, J and Oyer, H.J., "Applied Audiometry", 1977, Dodd, Mead and Company Inc, New York.
- Pickles, J.D., "An introduction to the physiology of hearing", 1982, Academic Press Inc., New York.
- Pollack, M.C., "Amplification for the hearing impaired", 2nd Edition, Grune and stratton Publishers, New York.
- Richard, A.M., "Basic experimentation in psychoacoustics", 1976, University Park Press, New York
- Rose, D.E., "Audiological assessment", 2nd Edition, Prentice-Hall, Inc, Englewood Cliffs, New Jersey.
- Simpson, J.F., et al., "A synopsis of otolaryngology", 1971, Williams and Wilkins company, U.S.A.
- Tobias, J.V., "Foundations modern auditory theory". Vol.II, 1972, Academic Press, Inc, New York.
- Tremaine, H.M., "Audio Encyclopedia", 2nd Edition, 1979, Howard, W.Sams and Co.Inc, U.S.A.,
- Usha, D., "Glossary of terms-in selected areas of audiology", Independent Project No.74, 1985, submitted to University of Mysore.
- Zelnick, E., and Martin, F., "Audiology and audio journal for continuing education, Vol.6, No.1, 1981.
- Zemlin, W.R., "Speech and Hearing Sciences-Anatomy and Physiology" 2nd Edition, 1981, Prentice-Hall Inc, Englewood Cliffs, New Jersey.