GLOSSARY OF TERMS - IN SELECTED AREAS OF AUDIOLOGY

Register No.8411

An independent Project submitted as part fulfilment for First Year M.Sc.(Speech and Hearing) to the University of Mysore

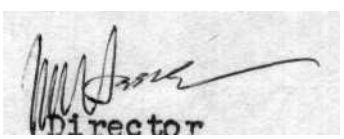
May 1985

All India Institute of Speech and Hearing
Mysore-6

To My Parents

CERTIFICATE

This is to certify that the independent Project entitled "GLOSSARY OF TERMS - IN SELECTED AREAS OF AUDIOLOGY" is the bonafide work done in part fulfilment for Firt Year M.Sc.(Speech and Hearing), of the student with Register No.8411



All India Institute of Speech and Hearing
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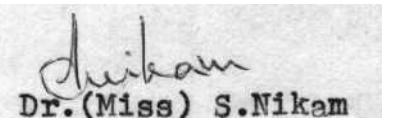
CERTIFICATE

This is to certify that the Independent Project entitled " GLOSSARY OF TERMS - IN SELECTED AREAS OF AUDIOLOGY" has been prepared under my supervision and guidance



Guide
Professor & Head of
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DECLARATION

This independent Projectis the result of my own study undertaken under the guidance of Dr.S.Nikam, Professor and Head of the Department of Audiology, All India Institute of Speech and Hearing, Mysore and has not been submitted earlier at any other University for any other Diploma or Degree.

Mysore Register No. 8411

Date 29.4.85

ACKNOWLEDGEMENT

I am extremely grateful to Dr.(Miss) S.Nikam, Professor and Head of the Department of Audiology for her invaluable guidance rendered by her at every step of this project.

I also thank Dr.M. Nithyaseelan, Director, All India Institute of Speech and Hearing, Mysore.

I sincerely thank Ms. M.S.Malini and Mr. Balakrishnan for their help extended at every stage of this project.

I appreciate and acknowledge the help extended by Padmaja, Sarala, K.Sheela, Sujatha, Usha Rani and friends.

I thank Mr. Subbanna for typing out this Project for me.

C O N T E N T S

Introduction

INTRODUCTION

Terminology is the Science of the proper use of terms. Words used with a specific purpose to express a definite concept is called "terms". The efficiency of a term depends on its precision to express a concept or concepts. It is the result of scientific thinking. It imparts ideas relevant to the subject. Every subject or Science uses an inventory of terms. As the field of science expands so do the scientific terms. Knowledge of scientific terms are absolutely necessary for scientific thinking and its application.

Audiology is an expanding field of applied science. Scientific experiments, clinical research and many other endeavours contribute to its growth.

Many terms have been coined to express specific concepts. Knowledge of such terms will help to learn the subject properly. An attempt is made to sort out all such terms which are used in this field.

The field of Audiology is highly interdisciplinary in nature and can be classified into different areas such as Auditory Physiology, Industrial audiology, Paediatric audiology, Psychophysics of Audition, etc., and each has a large number of terminologies.

In this study, due to limited time only two word terminologies from Auditory Physiology and Psychophysics of audition are selected.

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It is to be expected of course, that a young and dynamically growing area of knowledge would require a new, continually changing vocabulary. An attempt of winnowing the current literature for new terms has been done in the following pages.

It is hoped that this would prove useful especially to the students who are new to this field and also to those in allied profession as they will have easy access to the information. For the interviewe this glossary will help in reviewing the subject briefly.

The terminologies are grouped under two different sections:
(1) Auditory Physiology and Psychophysics of audition.

For the reader who wishes to acquire more information regarding a particular item, references have been given. The number below each term corresponds to the references of that particular term which is listed in the bibliography.

This study is limited in scope, in that, single and three words terms are not included. Other such inventory of terms should be collected in other areas. An alternate way of classifying could be in terms of complexity of the terms rather than in an alphabetical order aa used in this list.

With the continuous feedback available from the readers, further modifications will be carried out.

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PART - I

AUDITORY PHYSIOLOGY

A: ANATOMY OF THE AUDITORY SYSTEM

1. Acoustic Nerve:

Is a branch of vestibulocochlear nerve also known as auditory nerve.

Trauma, ototoxicity, viral infection may cause damage to this nerve and give rise to hearing loss.

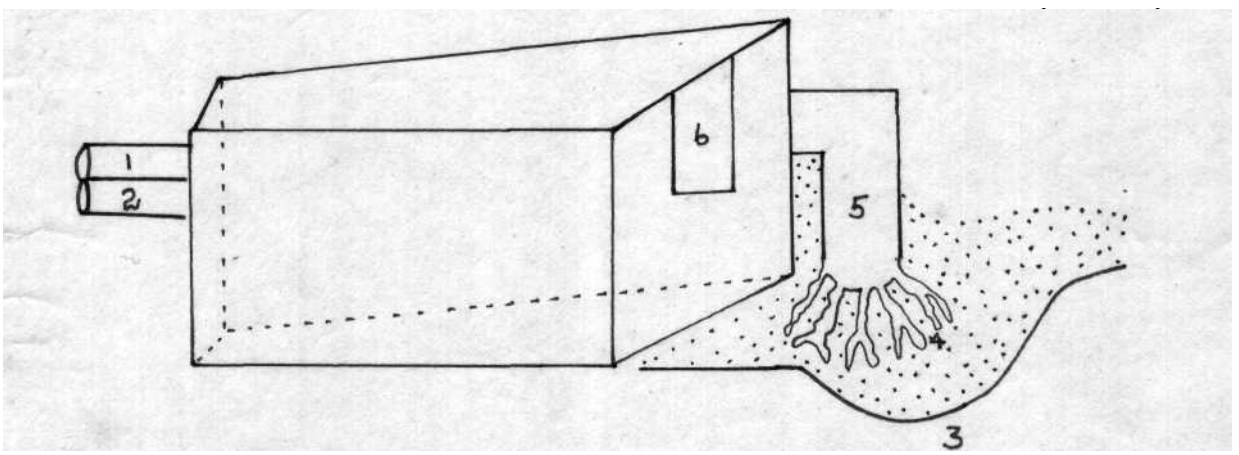
(12.30)

2. Acoustic Papilla:

Ref.: Organ of Corti

3. Auditus Antrum:

A small opening on the posterior wall of the middle ear cavity through which the middle ear communicates with the mastoid cavity.



1. CANAL FOR TENSOR TYMPANI 4. MASTOID HAIRCELL
2. AUDITORY TUBE 5. MASTOID ANTRUM
3. MASTOID PROCESS 6. ADITUS TO ANTRUM.

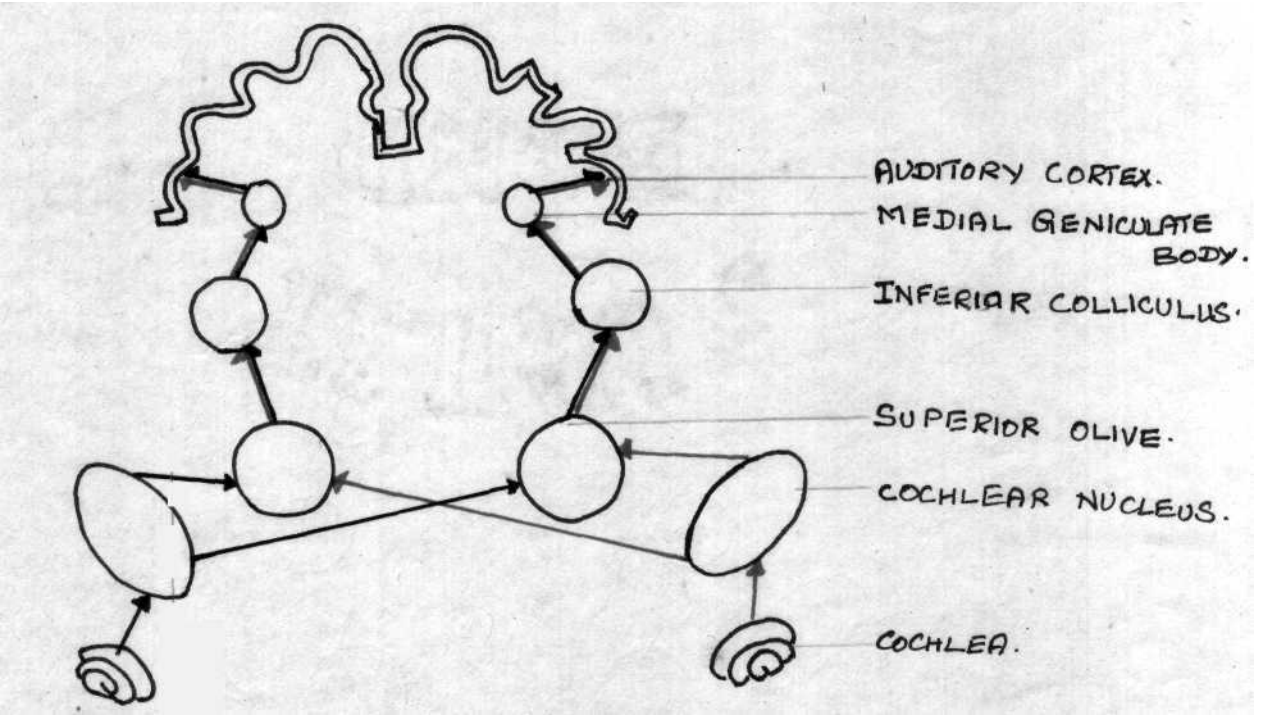
4. Afferent Pathway:

This is also known as ascending pathway.

Fibres from the spiral ganglion (first order neuron) in the cochlea enter the brainstem where they synapse with the dorsal and ventral cochlear nuclei. About hf half

the cell bodies of the second order neuron send fibres through the trepezoid body and terminate at the superior olivary complex and gives rise to the third order neuron. These ascend upwards to the lateral lemniscus and then to inferior colliculus. From there to medial geniculate body which is a thalamic nuclei and to the thalamus at Heschel's gyrus.

(12.31)



5. Annular Ligament:

This connects the stapes footplate to the ovalwindow; acts as a hinge on which stapes moves when the stapidus muscle contracts. (Ligament is a tissue which connects two bones or a bone to a muscle)

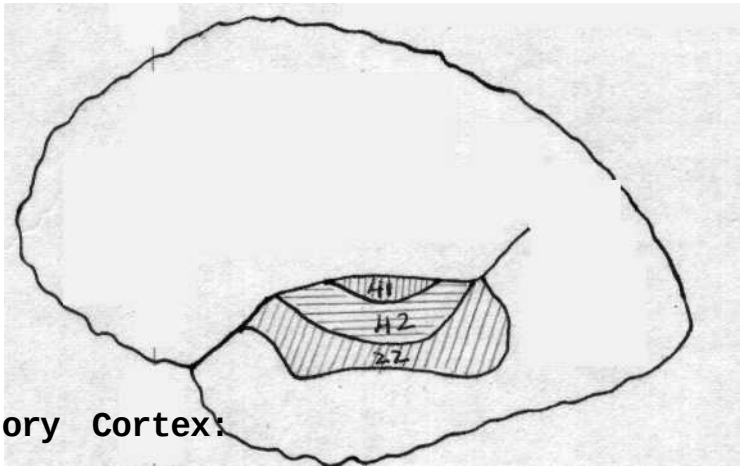
(6.6)

6. Auditory Area:

Broadman's area No. 41 & 42 & 22, situated on the posterior part of superior temporal gyrus. The first two are responsible fox reception of auditory stimulus.

The last one is related to correlation of auditory impressions with past memories.

(5.249)



7. **Auditory Cortex:**

Ref.: Auditory Area

8. Auditory Radiations:

Are the fibres arising from the medial geniculate body and end at the auditory cortex.

(36.335)

9. Auditory Tube:

Ref.: Eustachian tube

10. Basilar Membrane:

Situated in the inner ear; composed of radial fibres 33 mm in length; divided into two parts; pars tecta and pars pectineta; Narrow at the base and broader at the apex; attached to the osseous spiral lamina on the inner side and ligament on the outer side.

When stimulated it moves in a travelling wave like motion which produces maximum displacement at the base for high frequency and maximal displacement after a time lag for low frequency at the apex.

Made up of 24,000 individual fibres. Mainly responsible for the mechanical properties of the cochlea.

(12.151)

11. Boettcher Cells:

These are supporting cells found at the basal end; forms a single euboidal layer. Their contact with the basilar membrane and the adjacent parts are irregular.

(1.153)

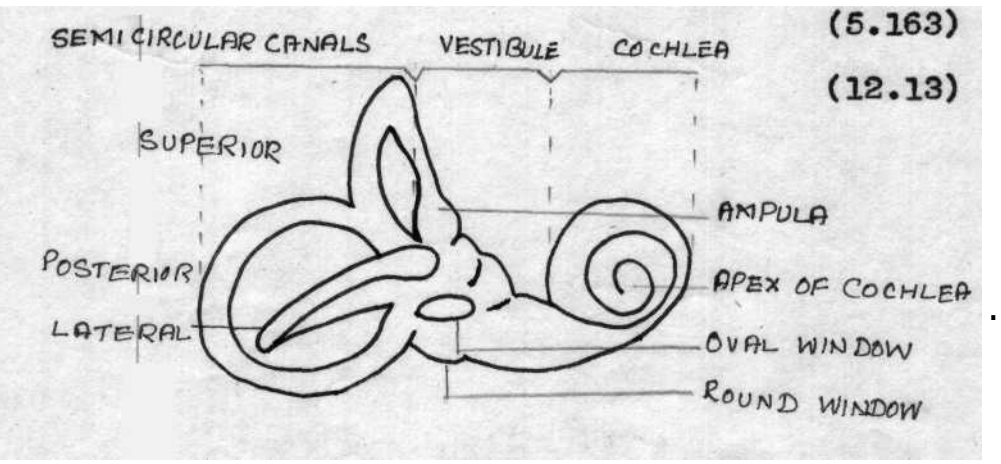
12. Bony Labyrinth:

This is constituted by a group of cavities within the temporal bone; filled with perilymph; has three parts a, cochlea, b, vestibule c, semicircular canals.

a) Cochlea is snail shaped - human cochlea 2 3/4 turns, wound round a central cone, the modiolus.

b) The vestibule is about 3 mm wide and 5 mm vertically and anteroposteriorly. Its lateral wall opens into the middle ear at the oval window. Anterior to it, is the cochlea The three semicircular canals open into its posterior wall.

c) Three semicircular canals anterior (superior), posterior and lateral (horizontal); at right angles to each other (Ref. membranous labyrinth and cochlear fluids).



(5.163)

(12.13)

..7

13. Brain Stem:

It is constituted by mid brain, pona and medulla. It includes majority of the nuclei of the auditory pathway.

Responsible for reflexes observed in response to auditory stimuli. It is a common site for acoustic neuroma.

(36.177)

14. Branchial Arch:

In human embryo, around fourth week, series of branchial grooves appear in the lower head and neck region on the outside of the embryo. Only first and second arches are of relevance to the auditory system.

Tragus, body structure of malleus and incus, anterior area of middle ear cavity and tensor tympani develop from the first arch. The second arch gives rise to auricle, lenticular process of the incus, handle of malleus and stapes; posterior portion of middle ear cavity and stapedius.

(34.24)

15* Centrifugal Pathway:

Ref. : Efferent Pathway

16. Centripetal Pathway:

Ref. ; A.ffarent Pathway

17. Cerebellopcntine Angle:

It is the junction of the cerebellum, pons and medulla. VIII nerve separates here into vestibular and cochlear part.

This is the site for 80% of the auditory nerve tumors.

(5.<nt<nt)

18. Claudius Cells

These supporting cells are columnar cells which continue laterally to the spiral ligament and stria vascularis and medically to Hensen's cells forming a layer over the basilar membrane. They are poor in mitochondria and microvilli .

(40.118)

19. Cochlear Aqueduct

Aqueduct is an opening or a canal. Cochlear aqueduct is found at the entrance of the bony canal of the cochlea; opens on the inferior surface of the temporal bone. It encloses a small vein. The scala tympanl communicates with the subarachanoid space through this.

(6.7)

20. Cochlear, Fluids

These fluids are found in the cochlea.

i) Perilymph: found in bony labyrinth; extra cellular; rich in sodium and poor in potassium; disturbance in its composition affects the cochlear microphonics and action potentials.

ii) Endolymph: found in membranous labyrinth; intra cellular; rich in potassium and poor in sodium; decrease in endolymph due to degeneration of stria vascularis and increase in its volume due to inflammatory conditions cause congenital syphilis and Meneire's disease.

iii) Cortilymph: found in tunnel of corti; rich in sodium and poor in potassium, but composition is different from perilymph which is toxic to hair cells.

Functions of cochlear fluids:

a) deliver nutrients; b) remove waste products; c) provide chemical environment needed for transfer of energy from vibrations (mechanical) to neural signals (electrical).d)To maintain balance i.e chemical balance (still under deba

(41.98)

21. Cochlear Nuclei

A pair of dorsal and ventral nuclei form the second order neuron, in the auditory pathway. They receive the fibres from the spiral ganglion. These consist of six types of nerve cells known as sphenoid cells, Tear cells, Multipolar cells, Octopid cells, Granule and Fusiform cells. Respond to sound intensity and their discrimination for frequency is good.

Asphyxia causes damage to more than 45% of cells in the cochlear nuclei within two days.

(12.156)

22. Crossed Fibres

The efferent nerve fibres innervating the inner and outer hair cells entering the cochlea have crossed and un-crossed components. The crossed components are the fibres derived from the contralateral superior olivary region of the brain stem. Also called crossed Olivo-Cochlear bundle.

(36.96)

23. Deiter's Cells

Found below the hair cells in the inner ear; consists a cell body which is attached to the Basilar membrance with nucleus below the cell. From Deiter's cells a slender

process passes to the surface forming phalangeal process; contain tubular and micro filaments. These are surrounded by mitochondria; supplies nutrition to the hair cell. Along with the piller cells form the reticular lamina.

(1.152)

24. Ductus Cochlearis

Ref.: Scala Media

26. <u>Ear Canal</u>

Extends from the pinna to the tympanic membrance; 25 mm in length; curved; divided into three parts; pars externa; pars media and pars interne. First portion traverses anterio-superiorly. the second postero-superiorly. The third portion travelling antero-inferiorly end at the tympanic membrane.

Composed of cartilage in the lateral l/3 and of bone in the medial 2/3 cartilagenous portion contains ceruminous glands secreting wax.

This protects the middle ear and inner ear structures and helps in the conduction of sound waves. The resonance frequency of the ear canal is around 3500 Hz.

Pathological conditions affecting hearing are external otitis, stenosis, impacted wax and congenital deformity like atresia. The loss usually is of conductive type between 30-35 dB HL.

(2.7)

26. Ear Drum

Ref.: Tympanic Membrane

27 Efferent Pathways

This consists of 500 efferent neurons which have their cell bodies in the olivary complex of the train stem. About 400 fibres of this originate from the contralateral accessory olivary Nucleus while remaining 100 fibres originate from homolateral superior olivary nucleus and form crossed and uncrossed fibres respectively. These two bundle continue along with the vestibular branch and after emerging from the brain stem joins the cochlear branch.

These fibres enter the internal auditory meatus and penetrate into the cochlea between the basal and second turn and supply the hair cells.

Exact function is not known, but likely to play major role in speech perception, inhibition and loudness gain.

(48.415)

28. Epitympanic Recess

Superior portion of the middle ear; known as the attic; Head of the malleus covers most of this area.

Middle ear infections may spread to the brain through this.

(5.160)

29. Eustachiantube

Extends from anterior wall of the tympanic cavity to the naso pharynx; 37 mm in normal adults.

Anterior one third is bony and the remaining two-thirds is cartilagenous. The tensor palati muscle helps in opening of the tube at the nasopharynx.

Function: (1) ventilation (2) protection (3) Clearance (4) equalization of the pressure in the middle ear cavity and atmospheric air.

The tube is always open or cannot open due to pathological conditions of the eustachian tube tissue. In Children horizontal placement of eustachian tube causes middle ear infection and adenoid infections.

(2.9)

30. External ear

It consists of pinna and the external auditory meatus The pinna projects on either aide of the head at an angle of 30°.

Function: aids in resonance, directionality excitation and pressure distribution and protection. Max. acoustic gain 1.2 to 2.6 KHz which is important for speech perception.

(Also Ref. external auditory meatus)

(12.48)

31. Facial Nerve

Seventh cranial nerve; emerges from the pons and enters the temporal bone; occupies the facial canal and branches off to supply stapedius muscle.

Lesion of lower - and upper - motor neurons, acute/serous otitis media may damage the facial nerve.

(14. 1327)

32. Fenestra Ovalis

Ref.: Oval Window

33. Fenestra Rotandra

Ref.: Round Window

34. Hair Cells

Epithelial cells found in the organ of corti; two types; Inner hair cells and outer hair cells.

ln noise induced loss hg. damage to these cells are found.

Are biological transducer of auditory system.

Also Ref. Outer haircells
Inner haircells

(1.129)

35. Hensen's cells

These supporting cells are located adjacent to the Dieter's cells in the inner ear; arranged in five or six rows.

Have poorly developed endoplasmic reticulum, few mitochondria and lipid granules.

Function: providing physcal support to the hair cells.

(1.152)

36. Inferior Colliculus

Is the junction through which the afferent and efferent fibres of auditory pathways.

This receives efferent fibres bilaterally from the superior olivary complex (SOC) and contra laterally from dorsal division of cochlear nucleus.

Plays important role in auditory reflex and spacial coding.

(36.192)

37. Inner border cells

Tall irregular cells which originates at the basilar membrane; extends to the surface of the hair cells forming a thin line of axial cells. The surface is lined with micro villi.

Cells are divided into two (1) Infra nuclear region which is rich in mitochondria, provides nutrition (2) Supra nuclear region has fewer mitochondrias.

(1.146)

38. Inner ear

Consists of (1) the vestibule (2) Cochlea; housed in the temporal bone.

Pathological conditions: viral and bacterial infections, ototoxicity and exposure to noise.

(27.265)

39. Inner haircells

The Inner Hair Cells are about 3500; found in the inner ear; in a single row, completely surrounded by supporting cells.

Each cell is 35 µm in length and 10 µm in diameter, avoid with bent neck; nucleus at the centre. Stereo-celia present on the superior region.

Innervation; 95% of efferent fibres; Many to one connections.

Responds when Basilar membrane is displaced.

Most resistent to damage; lack of oxygen causes damage to inner hair cells.

(1.128)

40. Internal auditory meatus

It forms a pass way for the afferent and efferent fibres to pass from the cochlea. It forms site for tumors of the 8th nerve.

(12. 230)

41. Lateral Lemniscus

Formed mainly by the bilateral fibres from the superior olivary complex and trapezoid nuclei and partly by the crossed fibres of the cochlear nuclei. They constitute the 3rd order neuron in the auditory pathway.

(5.231)

42. Mastold Antrum

Situated in the posterior portion of the temporal bone Contains air cells. Connected to these is the tympanic antrum. Antrum communicates with epitympanic recess of the Middle ear via aditus ad antrum. This antrum is bordered by mastoid process (inferior) tegmen tympanium (sup) and lateral semi-circular canal (medially) and squamous (lateral)

(12.3)

43. Medial geniculate

Is a thalamic nuclei forming the junction between the fibres from inferior colliculus to auditory radiations. Has three divisions - dorsal, ventral and medial: only ventral portion is involved in relaying signals of the auditory system.

(5.240
36.184)

44. Membranous labyrinth

This is lodged within the bony labyrinth; filled with endolymph.

Consists of utricle and saccule; sac like structures housed in the bony vestibule; within bony semicircular canals are the three membranous semicircular duct and within the bony cochlea is the cochlear duct.

(see also bony labyrinth
and cochlear fluids)
(12.15)

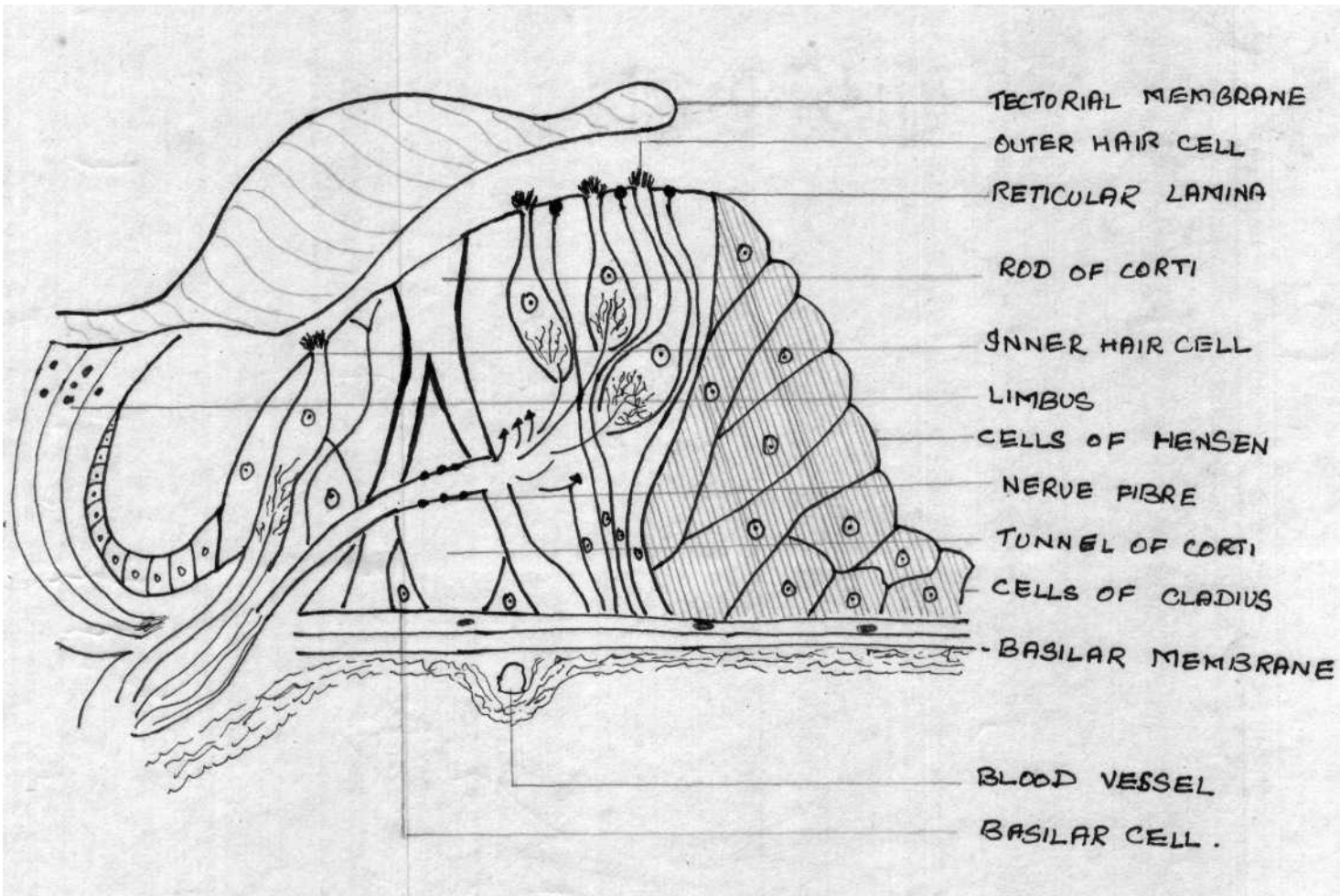
45. Middle ear

Ref.: Tympanic cavity

46. Organ of Corti

Sensory organ of hearing; in the scala media of the inner ear. It is a series of neuro epithelial hair cells and supporting cells; extends from the base to the apex; lies between the osseous spiral lamina and spiral ligament.

(1.128)



47. Organon Spirale

Ref.: Organ of Corti

48. Ossicular Chain

A chain of three smallest bones;found in the middle ear; connected to the tympanic membrane on the lateral end and attached to the oval window at the medial end. The three ossicles are malleus incus stapes; held in position by five ligaments and 2 muscles.

Transmission of sound is through lever action when loss of energy is minimized.

Conditions affecting continuity of the chain are Trauma fractures; inflamation of the M.E., radiation, and congenital defects.

(12. 11)

49. Outer hair cells

These cells are present laterally to the tunnel of corti and bordered by outer phalangeal cells. Outer hair cells 12,000; arranged in three rows; longer at the apex than at the base.

Each outer hair cell is slender cylindrical; placed obliquely with an upper cuticular surface; 45 µm in length at the base and 25 µm at the apex; average diameter 6-7 µm nucleus at its base.

Innervation Both by afferent and efferent fibres.

Responds to the BM displacement; susceptible to damage earlier than the inner hair cells.

(1.134)

80. Oval Window

One of the two openings on the bony cochlea through which the middle ear communicates with the inner ear fluids.

(2.10)

51. Pans flaccida

The upper part of the T.M; thin and slack has 2 layers (1) skinny (2) mucous.

Only few fibres are in this area.

(48.34)

52. Pars Pectinate

This forms the lateral portion of the basilar membrane. In this the fibrils are arranged in groups forming string like fibres. These fibres consist of a large number of micro-fila ments. Below the plasma membrane there is a fine fibrillar layer which is divided into two. Between the two sub-divisions there is second homogenous layer.

(1.156)

53. <u>Parstecta</u>

This is the axial portion of the Basilar membrane.

In this there is a single layer of densely packed fibrils radially directed. At the base of outer pillar cells the single fibrous layer splits into two distinct fibrous layers separated by a layer of unstructured matter. There are occasional cells and appears cloudy under electronic microscope. There is densely packed layer of microfibrils, then a homoge- nous layer and finally, cells of the tympanic cover layer.

(1.155)

54. Pars Tensa

The lower part of the tympanic membrane which is tense; has three layers (a) skinny (b) fibrous and (c) mucous layers.

Fibrous layer has radial and non-radial fibres. This has the cone of light which is due to sparsely scattered radial fibres.

(2.10)

55. Phalangeal Cells:

They are cup shaped supporting cells holding inner hair cells in the inner ear.

They mainly aid in maintaining the position of the inner hair cells and their related nerve fibre bundles.

(1.152)

56. Pillar Cells

Ref. : Rods of Corti

57. Reissner's Membrane

A delicate cellular membrane attached to the spiral limbus and to the spiral ligament in the inner ear. It separates the scalamedia from the scala vestibuli and forms the roof of scala media.

Composed of mesothelial layer and mesodermal layer which have regenerative capacity; help in maintaining the haemostasis of the inner ear fluids.

Acoustic trauma and ototoxic drug causes damage to the Reissners membrane; disrupts the ionic composition of endolymph which in turn effects tactorial membrane and hair cells causing hearing loss.

(41.67)

58. Reticular lamina

Is a stiff membrane formed by processes of the supporting cells. Makes contact with the cuticular plates of the hair cells in the inner ear.

(12.16)

59. Rods of Corti

These are supporting cells placed obliquely on the basilar membrane to form the tunnel of corti. The inner rods are 6000 in number and outer rods 4000; each cell is straited consists of a base, elongated body and an upper end.

These cells provide mechanical reinforcement to hair cells.

(1.146)

60. Round Window

Is located on the lateral wall of the inner ear below the promontry, covered by round window membrane(secondary tympanic membrane); which separates the middle ear from the scala tympani.

Helps in pressure releasing when the inner ear fluid is compressed.

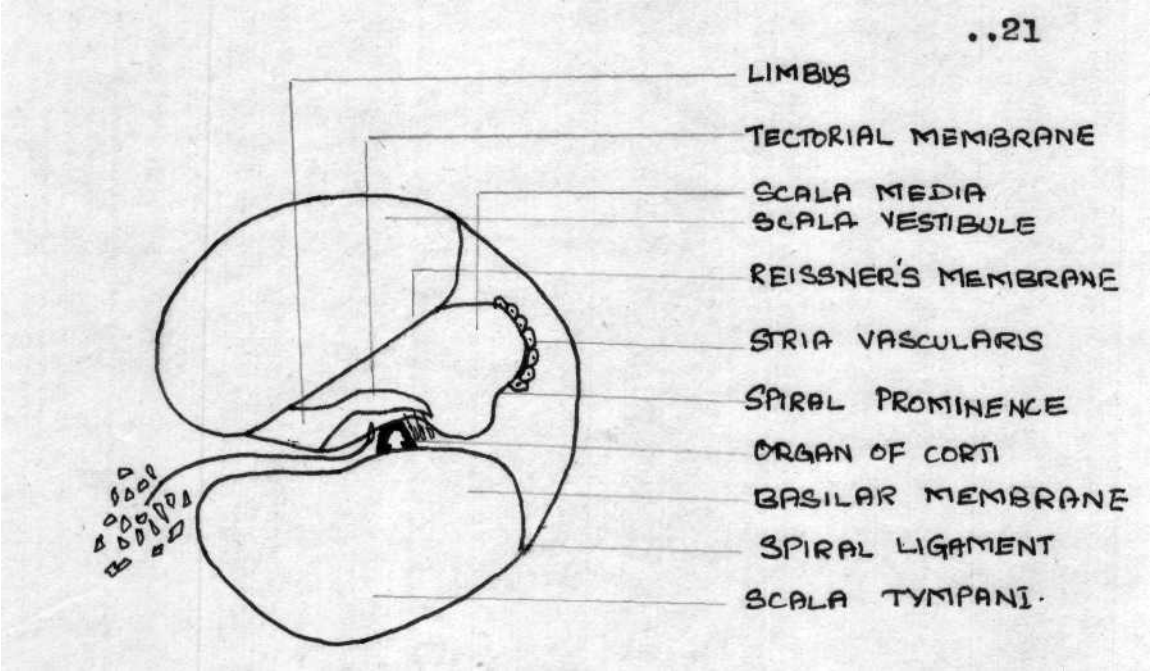
(2. 10)

61. Scala Media

Found in the inner ear; triangular in shape; filled with endolymph; houses the organ of corti.

It is separated from scala vestibuli by Reissner's membrane and from scala tympani by basilar membrane. Lateral side is lined by stria vascularis which is main source of vascular supply to organ of corti.

(41.34)



62. Scala Tympani

Is one of the passages in the inner ear; filled with perilymph; extends from the round window at the base and to helicotrema at the apex. The basilar membrane separates it from the scala media.

The oval window movement displaces the fluid; which in turn moves the basilar membrane.

(41.34)

63. Scala Vestibuli

Is another passage in the cochlea filled with perilymph; extends from the oval window at the base and to the helicotrema at the apex. It is separated from the scala media by Reissner's membrane and communicate with scala tympani through helicotrema.

Movement of the oval window displaces this fluid; enhances the Basilar membrane movement.

(Ref.: fig. 5)

(41 .34)

64. Semicircular Canals

They are three in number: (1) Superior (2) Posterior and (lateral) semicircular canals: unequal in length. Each has dialation at one end called the ampulla and open into the vestibule through five orifices.

The semi-circular canals are lined by cristae responsible for the maintenance of kinetic equilibrium.

(12.14)

65. Sensory cells

Ref.: Hair Cells

66. Spiral ganglion

Consists of group of cell bodies of afferent fibres of the VIII nerve; bipolar; one process projecting to the hair cell and the other to the cells of cochlear nucleus.

These form the 1st order neuron in the auditory pathway.

(36.31)

67. Spiral Lamina

Is a bony shelf; divides the cochlear duct into scala vestibuli and scala tympani; wide at the base and narrows down the apex.

Composed of two bony layers. Between these two layers are small openings known as habenula perforata through which the nerve fibres enter and exit from the cochlea.

(72.27)

68. Spiral Ligament

Is a mass of connective tissue fibres and cells in the inner ear to which lateral epithelial wall of the cochlear duct is attached.

Houses blood vessels on the lateral wall of the cochlea The tissue fluid freely diffuses with the perilymph in scala tympani and scala vestibuli.

(41.56)

69. Stapidius Muscle

It is the smallest muscle in the body; found in the middle ear.

Arises from the wall of the conical cavity in the pyramidal eminance on the posterior wall of the middle ear, and inserts into the posterior surface of the neck of,the stapes and supplied by the facial nerve function; helps in stapes foot plate movement, protects the middle ear structures and inner ear being damaged by loud noise.

(14.1327 & 36.19)

70. Stria Vascularis

Is a vascularised epithelial structure; covering the spiral ligament within the scala media.

Made of (1) marginal cells (2) intermediate cells (3) Basal cells. The blood vessels enter the cochlea through the modiolus and to the stria vascularis.

This is the source of endolymph. Aids in generation of +ve DC potentials of endolymph and high rate of metabolism.

(41.36)

71. Sulcus cells

Sulcus cells form a ribbon like structure along the outer sulcus in the inner ear sending irregular extensions outward in the spiral ligament. They have ovoid bodies; a distinct basement membrane between the sulcus cells and the underlying tissue. (41.34)

72. Superior Olive

Superior Olive are a group of auditory neuclee in the brainstem just above the cochlear nuclei known as superior olivary complex. This constitutes of (a) medial superior olivary nucleus (MSO) (b) the lateral superior olivary nucleus.

The SOC gives rise to the olivocochlear bundles (OCB).

This has large audible range and echo location.

(7.428)

73. Supporting Cells

Found in the inner ear; extends from the basilar membrane to the surface of the epithelium cells forming a firm flexible framework. At the surface along with the receptor cells they form reticular membrane.

Function: to support the hair cells and supply nutrition.

Different types of supporting cells.

1. Inner border cells
2. Pillar cells, inner and outer (rods of corti)
3. Deiter cells
4. Hensen cells
5. Claudius cells
6. Boettcher cells
7. Inner phalyngeal cells.
8. Sulcus cells.

Ref.: Organ of Corti

74. Synaptic cleft

The space between two nerve cells is called the synaptic gap or synaptic cleft- usually 0.00005 mm. This prevents a pre-

synaptic action potential from jumping between the two cells.

(1A.9)

75. Synaptic Vesicles

These vesicles are small sack like structure found at the nerve endings. They store the neurotransmitters and prevent them from being destroyed by enzymes inthe nerve ending terminals.

The inner spiral bundle contains large number of vesicles in the organ of corti.

The efferent endings which are filled with clear synaptic vesicles form synaptic contacts with both hair cells and afferent nerve fibres.

(1.142)
(1A.9)

76. Tectorial membrane

Is found in the organ of corti; ribbon like structure; composed of 10% gel like substance and 90% of water; originates from the spiral limbus and extends upto Hensen cells. The free end is in close contact with the cilia of hair cells.

When the basilar membrane moves, even the tectorial membrane moves, but there is an important difference in their motion due to difference in their support; thin creates the shearing forces on the cilia. This in turn stimulates the nerve fibres at the base of outer hair cells. Thus the mechanical energy is transduced into electro-chemical activity by the hair cells.

(1.146)

77. Tegmen Tympani

Is the roof of tympanic cavity. It is a thin plate of bone which separates the tympanic cavity from the cranial cavity.

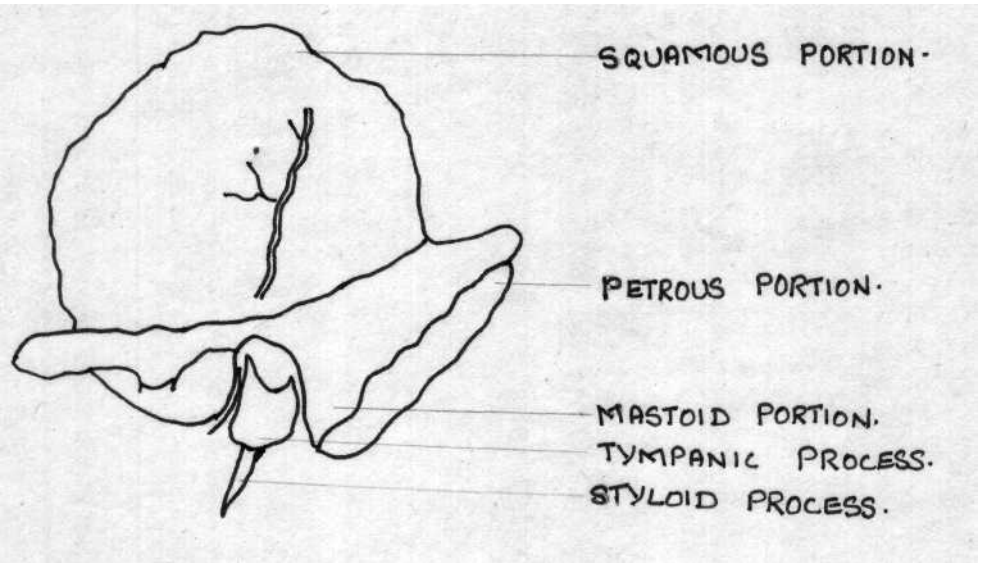
(5.160)

78. Temporal Bone

Temporal bones on either side of the cranium forms the lateral walls and the base of the skull.

Divided into 5 parts (1) squamous portion (2) mastoid portion (3) petrous portion (4) tympanic and (5) styloid process.

It houses a major portion of the hearing mechanism.



(14.1324)

79. Tensor tympani

This is found in the middle ear cavity; 12 mm in length; arises from the cartilaginous portion of the eustachian tube; and adjoining part of the greater wing of spenoid and also from the bony canal in which it is housed; inserted into the handle of the malleus, near its root.

Innervation:branch of the mandibular nerve.

Function: protects the ear from loud sounds.

(14.1327)

80. Trapezoid body

The medial nucleus of the trapezoid body (MTB) is associated with the ascending auditory system.

This lr relays information from the cochlear Neucleus of the opposite side to the ipsilateral Sup.olive. The afferent axons form the largest fibres of the Trapezoid body. So these cells receive short latency and synaptic inputs.

(36.169)

81. Tympanic cavity

Lies between the external and inner ears; divided into three parts (1) mesotympanum (2) epitympanum (3)hypotympanum.

It measures about 15 mm from above downwards and 13 mm, from behind forward. It has six sides 1. Roof 2.Floor 3. Medial wall 4. Anterior wall 5. posterior wall and 6. Lateral wall.

This contains (1) three ossicles (Malleus, incus snd stapes), 2) two muscles (tensor tympani and stapidus (3) chorda tympani nerve and (4) the tympanic plexejas of nerves.

Function: Transformer action and impedance matching.

(2.10)

82. Tympanic Membrane

Separates the external auditory meatus from the middle ear cavity.

Its transluscent, greyis, oval disc whose long axis is 10 mm; composed of three layers (1) outer (cuticular) (2) intermediate (fibrous) and (3) inner (mucous).

Lateral surface; Unbo where maximal concavity of the membrane is present. The membrane is divided into two; pars and pars flaccida.

It helps in the conduction of sound waves to the middle ear.

Trauma, otitis media cause middle ear infection damage to the membrane. (Also Ref.:Pars Tensa Pars flaccida)

(41.14)

83. Uncrossed fibres

The efferent nerve fibres innervaing the inner and outer hair cells entering the cochlea have crossed and uncrossed components. The uncrossed components are the fibres derived from the ipsilateral superior olivary region of the brain stem and are called the uncrossed olivo-cochlear bundle.

(36.84)

84 Vestibulo Cochlear Nerve (8th Cranial nerve)

Found in the groove between the pons and medula oblangata.

This has two branches (1) the anterior branch or cochlear nerve and (2) Posterior branch or vestibular nerve.

This conducts neural signals from the internal ear to the brain.

This is developed from the neural crest and regard it as a modified nerve.

(48.73)

B. PHYSIOLOGY

85. Action potential (AP)

These are generated by the nerve fibres of the inner ear.

Synchoronous firing of a large number of fibres is necessary for the production of AP. Its magnitude is relayed to he number of fibres discharing simultaneously due to the uniformity in diameter of the nerve fibres; results in uniform conduction of velocity. From any given region all firings arrive at the same time and summate at the recording electrode.

This is affected by Na^+ free solutions; lack of Ca^+ in extracellular fluid decreases AP production rapidly.

(6.27)

86. Acoustic reflex

When a loud sound is presented results in the contraction of middle ear muscles in both ears. This is known as acoustic reflex.

Measurement of acoustic reflex aids in the diagnosis of a number of auditory disorders.

(9.57)

87. All-or-none principle

A single weak tut adequate stimulus which triggers off a nerve impulse just as any other stronger stimulus will do is called as all-or-none phenomenon.

(49.514)

88. Auditory feedback

When one speaks he hears himself and thus monitors his speech. This faculty is known as auditory feedback permits him to vary the level of his own speech.

88. When the delay of 2 to 3 m.sec in auditory feedback is introduced then fluency will be disrupted.

(7.346)

89 Auditory Closure

Involves the ability to recognise and synthesise discrete parts of sound production into the whole. This may be at word or sentence level.

(21.1019)

90. Auditory cognition

This is the highest level of auditory perception and results from summation of all auditory tasks. It is an ability to form a relationship between linguistic sound and its meaning.

(21.1019)

91. Auditory filters

Each cochlear nerve fibre comes from a different place along the coil of the cochlea and particular part of the cochlea responds to particular frequencies. As the nerve fibres act as filters which have narrow bandwidth; which helps us to distinguish different sounds. This occurs at the level of haircells.

(6.65)

92. Auditory Perception

Is the ability to recognise the sensation through hearing; retaining the image and relating it to previous experience.

(7.87)

93. Auropal pebral reflex

It is an eyeblink in response to sound or cochleopal puberal reflex and commonly observed in infants.

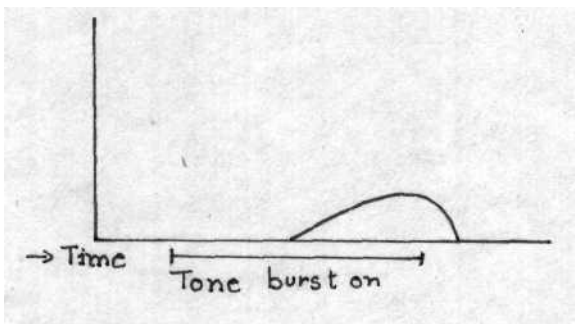
This can be elicited in children and adults in a quiet room, with broad band signals at 50-70 dB SPL and for warble tones at about 55-90 dB SPL.

(34. 149)

94. Build responses

These are the responses of the build-up cells found in the fusiform layer of the dorsal cochlear nucleus. It is not an on response, but longer duration of the stimulus is related with an increase in the activity of the cells.

(36.163)



95. Cerebral Dominance

In the initiation and control of various functions one cerebral hemisphere has greater specialization than the other.

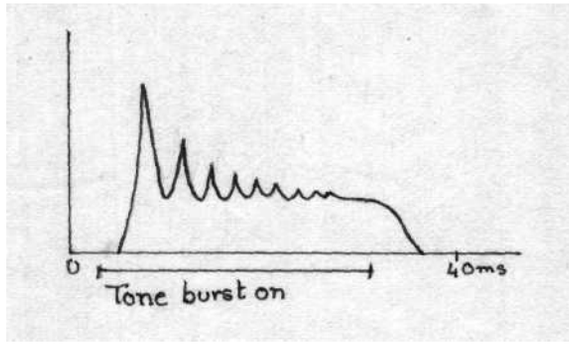
For analytical and temporal functions left hemisphere is dominent while the right hemisphere is dominent for speech and spatial relations.

(20.52)

96. Chopper response.

They are the responses found throughout in the cochlear nucleus firing repetitively during a sustained tone burst, at a rate which is unrelated to the period of the stimulus waveform.

The PSTH shows a series of peaks.



(36.161)

97. Cochlear-echoes.

When a low-level click is presented to the ear a sound is reflected from the ear. This is detected using a microphone sealed into the ear. This is known as 'Kemp's echo' or cochlear echo.

These reflections are generated at various points on the basilar membrane; are non-linear. They are observed only in persons with normal hg.

This is not found in the ear which is exposed to intense sound or oto-toxic drugs.

(31.260)

98. Cochlear Microphonic (CM)

CM are also referred as weaver-bray effect. These are the electrical activitis of the cochlea measured at round window and cochlear fluids.

These are faithful reproduction of the stimuli presented. It is proportional in magnitude to the intensity of the stimulus at higher intensities. The upper limit of CM is dependent on specific frequency and electrode location.

CM does not have threshold and persists for a while after death. CM is affected if haircells are damaged.

(36.24)

99. Compound action potentials

The compound action potential of auditory system differs from the single unit action potential and represents the sum of many single unit discharges, all of which occurred almost synchronously following the arrival of an acoustic stimulus at the ear.

This can be recorded in response to a click or tone burst with a rapid time. Continuous tones or tones with slow rise time will not elicit a response even though the tones are audible to the listener.

(3A.122)

100. Defensive response (DR)

This is a reflexive response of the autonomic nervous system which prepares the organism for flightor fight.

This response becomes stronger as the intensity of the signal is increased.

It is inhibited if the sound is presented repeatedly.

(22.533)

101. Diffusion Potentials

These are generated by the nerve cell membranes.

Nerve cell membranes are more permeable to some ions than others for (eg) in resting state they are many times more permeable to K^+ than to Na^+ . Because of this, K^+ tends to diffuse passively down its gradient taking positive charge and leaving the -ve charges, hence this potential is called diffusion potential.

(36.109)

102. Ear advantage

This is the superiority of one ear over the other ear in perceiving speech.

It is found that right ear responds better for speech and digits while left ear responds better for melodic signals.

(12.346)

103. Endocochlear Potential (E)

These are produced at the stria vascularis in the inner ear, is a resting electric polarization of endolymph.

It is about millivolts with respect to perilymnh in scala tympani and about 25 milli volts with respect to the perilymph in the scala vestibuli.

Without EP the inner ear will not perform the mechanical to electrical transduction process.

(13.97)

104. Evoked response (Electric response)

When any sensory system is stimulated, action potentials are generated in the afferent neurons and propagated centrally through a number of synaptic relays. The electrical activity which accompanies these events are detectable using appropriately placed electrodes and with suitable amplification. These electrical activities in the afferent pathways are called evoked responses or evoked potentials.

(48.205)

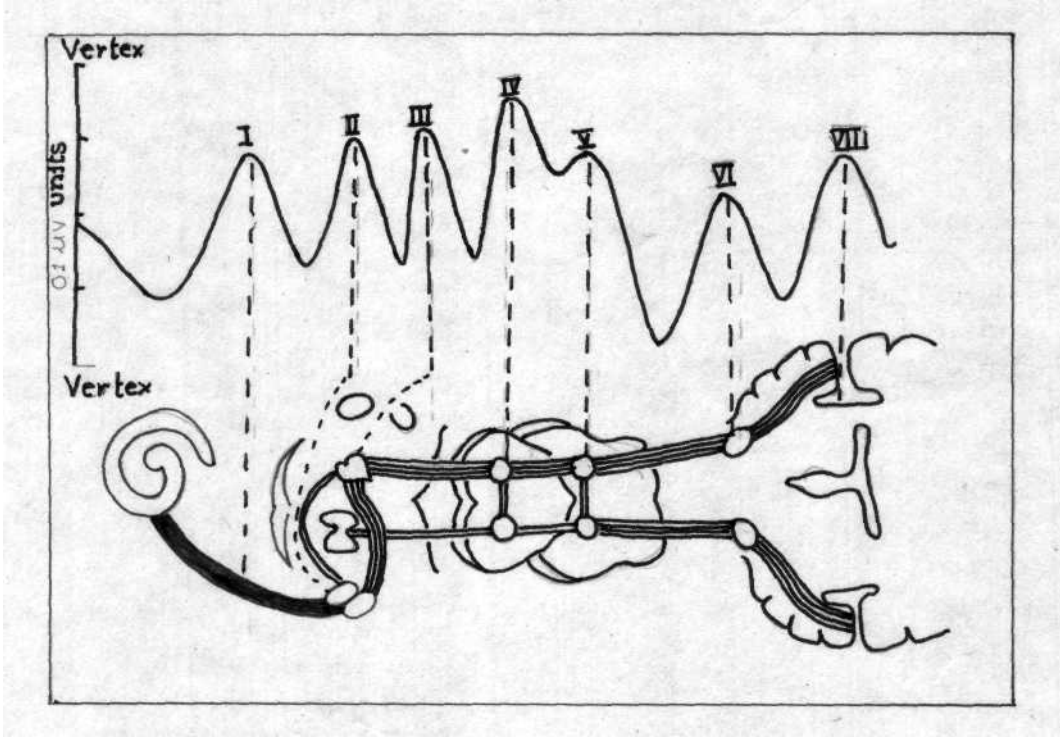
105. Fuzziness detection

This is a method to measure the surface vibration of the basilar membrane. Fuzziness is detected at amplitudes around .05μm.

6) Medial geniculate body

7) Auditory radiation

This is used to diagnose neurological disorder and threshold tests.



(12.172)

109. Kisch's Reflex

This is also known as auriculopalpebral reflex.

It is blinking of the eyes, due to stimulation by sudden acoustic, thermal, tactile or some irritant, touching the external ear canal.

(8.26)

110. Membrane theory

States that a cell is surrounded by a semipermeable membrane separating a double layer of ions, the positive ions outside and the negative ions inside. In condition of rest the positive and negative charges are stable. As a result a small electrical potential exists between the inside of the cell and its surrounding intracellular fluids.

(49.611)

111. Moro's response

It is the tendency of a young infant to stiffen and throw out the arms following a sudden loud sound or sudden vibration.

(13.251)

112. Mossbauer effect.

This is a Doppler phenomenon at the nuclear level which permits the measurements of small velocities onthe order of 0.2 mm/sec.

Mossbauer effect is used in measuring the vibration of the basilar membrane.

(30. 49)

113. Miller's doctrine

Refers to the specificity of different senses. According to this the neural signal coming from the ear is interpreted as sound irrespective of the nature and type of the auditory stimuli.

(12.39)

114. Non-acoustic reflex

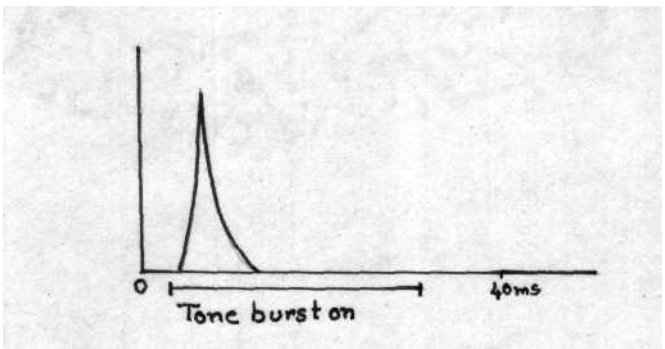
The middle ear muscles give a reflex response to non-acoustic stimuli such as a tactile stimulus in the circumaural region. These responses are termed non-acoustic reflexes.

(9.32)

115. Onset responses

These are responses to short tone bursts given just above threshold at the neurons characteristic frequency.

The post-stimulus time histograms (PSTHs) show a sharp peak at the beginning of the tone burst and then either no activity or sustained activity. Such cells with wide tunning Curves are found throughout the cochlear nucleus.



(36. 160)

116. Orienting response

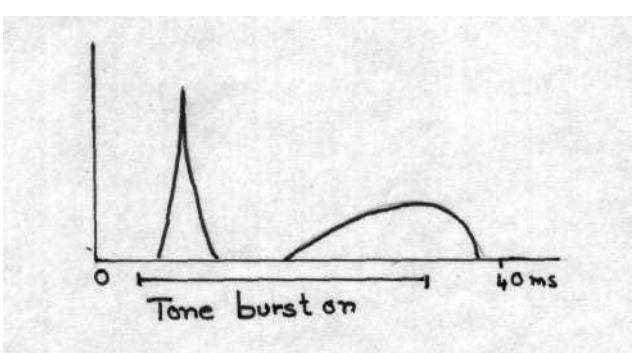
This is one of the reflexive response of autonomic nervous system, wherein the organism becomes alert to any sound stimulus and make the organism ready for the purpose of receiving and responding appropriately to the stimulus situation.

(22.532)

117. Paucer Response

They are responses of paucer cells in the cochlear nucleus; have initial onset response, a silent period and then a gradual resumption of activity. The paucer cells are found in the fusiform layer of the dorsal cochlear mucleus.

(36.163)



118. Phase-locking

At low frequency the nerve fibres fire randomly; on an average of 100 cycles, put when they fire, they do only in phase which is known as phase-locking. At low intensities a tone produces significant phase locking though the firing rate is not increased. This is a sensitive indicator of the activation of the fibre.

(36.82)

119. Phonemic regression

This is observed among elderly individual who hove mild or moderate sensorineural loss with poor speech discrimination.

The poor speech discrimination is not proportional to the magnitude of hearing loss.

(18.161)

120. Physiological noise

When an earphone is applied to the ear, physiological noise is heard by an individual which is not present in the uncovered ear. This is due to the reverberation of pulse, vascular and breathing noises transmitted to the walls of the closed meatal and tragal cavity.

(23.107)

121. Place Principle

Information about the frequency of a sound may be signalled by auditory receptors in 2 ways(l) place principle and (2) telephonic principle.

In place principle the anatomical groups of receptor cells differs as to the characteristic frequencies.

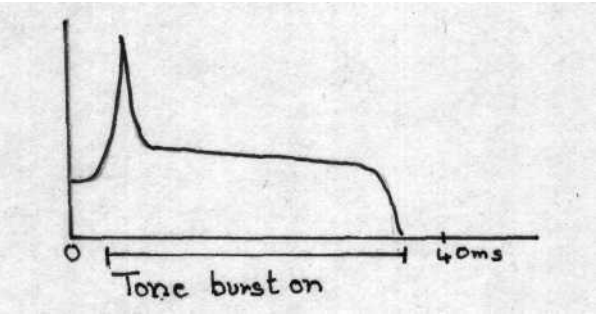
(30.913)

122. Primary like cell

These are found throughout the ventral cochlear nucleus. The post stimulus tims histograms (PSTHS) shows in initial peak at the onset, declining gradually to lower levels.

These primary-like response together with the synaptic delay suggests the existence of 'secure' synaptic connection.

This shows that cells relay the activity of auditory nerve fibres to the higher centre directly.



(36.159)

123. Psophomotor reflex

In ERA, in some cases amplitude increases with neck muscle tension and markedly diminishes with relaxation, curarization, or obstruction of the motor nerve. These responses are of myogenic origin. (38.2)

124. Receptor potentials

These are stimulus related potentials. Different types are cochlenr microphonics and summating potentials.

Ref.: Cochlear microphonics
Summating Potentials

(6.28)

125. Refractory period

Is the recover time required for the fibre to fire to an action potential. This limits the neurons maximum firing rate which is 1000 spikes per second.

Is of two types: (1) Absolute Refractory period is the time required for the cell to restablish the polarization it needs to fire again; which is about 1 m.sec. (2) Relative Refractory period is during which the neuron will respond provided the stimulus is strong.

(12.42)

126 Resonance Theory

It suggests that freouency resolution is due to the stimulation of tuned transverse fibres along the basilar membrane.

A sound with its characterisic frequency would activate the fibres tuned to that frequency signaling to the sensory cells.

(33.276)

127. Resting Potential

These are positive and negative direct current polarizations recorded from various tissues and their surrounding fluids in the cochlea.

(12.95)

128. Saltatory Conduction

This is characterized by outward current flow only at the nodes and takes place from node to node rather than continuously.

(49.513)

129. Specific impedance

Impedance is charateristic of the media alone is called specific impedance. (eg) when a sound wave travels through air and water; water media offers greater impedance when compared to air media.

(36.5)

130. Summating Potential

Is a direct current potential that resembles the envelope of the eliciting stimulus.

The SP persists as long as the stimulation lasts. Like CM this potential can also be measured from any location in the vicinity of the cochlea but its magnitude is greatest in the scala media.

The magnitude and the Polarity of the SP depend on the complex interaction of intensity frequency and electrode location.

(6.36)

131. Tone decay

This is inability of an impaired ear to hear a continuous tone for a period of time at a stretch.

This is used in finding outauditory disorder, several different techniques have been advocated

1) Carhart tone decay test (1957)

2) Green Modified tone decay test MTDT (1960)

3) Supra threshold adaptation test (STAT) 1975

(15.188)

132. Tono topic Organization

This is the orderly representation of frequency according to place in the auditory pathway.

There is more or less an exact "mapping" of the audible frequency within each nuclear mass. Neurons most sensitive to high frequeny are in one area and those sensitive to low frequency are in another part. Those sensitive to intermediate are located between them.

(36.16)

133 Transformer action

The middle ear couples sound energy from tympanic membrane to the oval window of the cochlea. The sound is transmitted by middle ear ossicles; coupling energy from the low impedane air to the higher impedance cochlear fluids by reducing the reflection of sound energy.

This is achieved by 3 mechanisms.

1) areal Ratio; the area of the oval window is smaller than that of the tympanic membrane; increasing the pressure exerted at the oval window.

2) The level action of the ossicles which gives mechanical advantage.

3) The buckling motion of the tympanic membrane increases the force and decreases the velocity. The pressure is increased by the ratio of the two.

(36.15)

134. Travelling wave

The sound is propogated in the cochlea in the form of a travelling wave in the basilar membrance. This wave travels from the base to the apex of the cochlea. The maximum amplitude of the wave occurs at a point that corresponds to the freauency of the stimulus.

(27.376)

135. Volley Theory

This suggests that during refractory period of one set of neurons, another set is actively firing. This holds good for only frequencies upto 4000 Hz.

(27.276)

PART - II

PSYCHOPHYSICS OF AUDITION

PSYCHOPHYSICS OF AUDITION

1. Absolute pitch

Some individuals have the ability to recognise and define the pitch of a musical tone without reference to a comparison tone. It is observed in less than 1% of the population.

(31.146)

2. Absolute threshold

The minimum detectable level of a sound in the absence of any other external sounds.

This depends on several factors such as mode of presentation etc..

(31.286)

3. Acoustic Admittance

Acoustic admittance refers to the ease of sound flow. This consists of two components, viz. susceptance and conductance which are the reciprocals of reactance and resistance respectively.

It is measured at the surface of the tympanic membrane.

(9.6)

4. Acoustic conductance

Is the real flow of energy through a resistance. It is the reciprocal of acoustic resistance measured in acoustic milli ohms.

(9.6)

5. Acoustic emission

Ref.:

6. Acoustic impedance

The opposition to energy flow in most systems is called as "impedance". Acoustic impedance measured in acoustic ohms

refers to the oppositionta the flow of acoustic signal. This consists of two components: acoustic reactance and acoustic resistance. They ere equal in magnitude but are at right angles to each other.

(9. 6)

7. Acoustic Pulse

A sound of limited duration which begins and ends abruptly. It may be click, burst of noise tone pip, etc..

These are used as stimuli in hearing evaluation and research.

(13.243)

8. Acoustic resistance

Is the component of the acoustic impedance which is responsible for the dessipation of energy. It is measured in acoustic ohm.

(9.6)

9. Acoustic reactance

This is composed of two factors namely stiffness and inertia. Stiffness gives rise to negative reactance while reactance due to inertia is positive and expresses the storage and return of energy.

Negative reactance or compliance, and positive reactance or mass reactance are measured in acoustic ohms.

(9.6)

10. Acoustic resonance

A phenomenon exhibited by an acoustic system (eg. pipe or Helmholtz resonator) in which the response of the system to sound waves becomes very large when the frequency of the sound

approaches the natural vibration frequency of the air in that system.

(30.)

11. Acoustic spectrum

Refers to the distribution of intensity as a function of the frequency components of a complex signal.

(44.6)

12. Acoustic susceptance

This refers to stiffness of the ear which influences the flow of acoustic energy in low frequency.

It is used to express the storage of energy as the reciprocal feature of acoustic in acoustic milli ohms.

(9.105)

13. Air-bone gap

It is the difference between air conduction and bone conduction thresholds.

This helps in diagnosis of conductive loss cases.

(24.325)

14. Air Conduction

Considered to be the normal mode of hearing. Acoustic energy is directed to the inner ear via the air in the external auditory meatus and middle ear.

(39.16)

15. Albrecht effect

When an individual is exposed to loud sound continuously he stops hearing the signal after a certain duration of time. He tends to realise the presence of the signal only on its cessation.

(47. 263)

16. Amplitude modulation (AM)

In laboratory studies sine waves can be modulated for their frequency or amplitude.

The sound wave consists of carrier frequency (a sine wave) on which some other signal is impressed. In AM the carrier amplitude is varied so as to follow the magnitude of the sine wave while frequency of carrier is unchanged.

(31.87)

17. Ambient noise

It is the background noise present in the environment. Sometimes this may also be present in the instrumentation in the form of hum or hiss.

(39. 1)

18. Anechoice Chamber

Is a specially designed room which has reverberation time of '0' sec. and the cut off frequency at least 10-15% lower than the desired cut-off freauency for the room.

This chamber provides free field conditions that are required in speech and hearing research.

Also used in calibration of microphones, loud speakers and measurements of hearing aids.

(39. 6)

19. Auditory adaptation

The decrement in loudness resulting from continued auditory stimulation is known as adaptation. It is a neural phenomenon common to all sensory systems.

(47.301)

20. Auditory blending

The ability to form words out of seprately articulated phonemes is called auditory blending.

(21.1019)

21. Auditory discrimination

Ability to differentiate between two auditory/acoustic stimuli. In speech, auditory discrimination is the ability to recognize fine difference betweer two or more phonemes.

(21. 1019)

22. Auditory fatigue.

Any change in the sensitivity higher/lower following exposure to auditory stimulus is known as auditory fatigue.

This is attributed to temporary dysfunction of the hair cells.

(47.308)

23. Auditory flutter

Is the wavering auditory sensation produced by periodical interruption of a continuous sound at a sufficiently slow rate.

(21.1018)

24. Auditory fusion

Is a phenomenon in which a series of (primary) sounds of short duration with successive arrival times at the ear(s) produce the sensation of a single (secondary) sound.

This effect is produced by presenting monaural, diotic or dichotic sound stimuli. when presented dichotically it is known as binaural fusion.

(21.1018)

25. Auditory lateralization

Is an intracranial phenomenon. The term is used when the subject is asked to identify whether it is on the left or the right side along a plane between the two ears.

This occurs if the short term storage does not contain any information that can be applied or if the signals cannot be related to any of the stimulus pattern in long term storage of an individual previous exposure.

(12.997)

26. Auditory localization

This is an extracranial phenomenon. This term is used when the subject is asked to locate the source or give its azimuth angle.

This depends on the interaural difference between the time, phase and intensity. The interaural difference between time and phase aids in localizing the low frequency sounds; interaural difference between the intensity due to head shadow effect aid in localization of high frequency sounds.

Apart from this, familiarity with the volume and timbre of the source, as well as, peculiarities of the room in which the source is situated, also play a role in localization.

(12.397)

27. Auditory memory

It is the ability to retain information including sequences of sound, patterns of stress, voice inflection, duration, pitch and rate.

(21.1019)

..50

28. Aural Harmonics

At high frequencies a single pure tone may produce in the ear a series of tones whose frequencies are multiples of the frequency of the tone which is presented. They prise due to the non-linear process in the middle or inner ear.

They are negligible ot low frequencies.

(31.57)

29. Asymptotic adaptation

As the adaptation process goes on, at one stage, the rate of decrease in loudness becomes equal to the rate of increase in loudness level. This is known as asymptotic adaptation.

(47.301)

30. Backward masking.

Backward masking is the condition in which the masking sound is given after the presentation of probe tone. The effect is observed if the tone is presented 100 ms earlier than the masking noise.

(49.93)

31. Beam hypothesis

It propounds that the tectorial membrane lies on top of organ of corti like a stiff beam and that the cells are pressed against this beam during the upward displacement of the Basilar membrane.

(45.231)

32. Beat frequency

When two tones of different frequency are added together they reinforce and cancel each other alternately. This response in a fluctuating tone. The number of amplitude flucuations per second is called the beat frequency. (3.80)

33. Best frequency

It is the frequency to which a given cochlear fibre responds to the greatest firing rate.

Ref.: Characteristic frequency.

(12.129)

34. Binaural beats

It occurs when a tone of one frequency is presented to one ear and a tone of slightly different frequency to the other ear, the sound appears to fluctuate at a rate corresponding to the frequency difference between the two tones.

It reflects ability of the auditory system to process phase difference at the two ears.

(31.153)

35. Binaural hearing

A general term for the normal hearing condition in which the stimuli are heard through both the ears. For example, the ability to localize a sound source is dependent upon differences in the intensity and time of arrival of the sound at the two ears.

36. Binaural separation

Is the ability of a listener to attend to and report back different signals presented simultaneously to the two ears.

(21.1019)

37. Binaural summation

A tone which is barely audible when heard monoaurally, will increase in loudness when heard through both the ears. This effect is known as binaural summation. This intensity increase level is about 3-6 dB.

(3.128)

38. Binaural synthesis

When two incomplete stimuli are presented simultaneously or alternatively to two ears, the listener integrates and perceives the stimulus meaningfully.

This is known as binaural synthesis.

(21.1018)

39. Bio acoustical pulse

These are complex sounds formed by a series of pulses. In mammals these arise as a result of complex co-ordinated patterns of muscle actives of a sound generating system.

(30.667)

40. Bone conduction

Is the process through which the acoustic energy reaches the inner ear via the bones in the skull. Two types (1) interlial bone conduction ; operates at low frequency. (2) compression bone conduction occurs at higher frequency.

(39.17)

41. Broad-band noise

A sound in which energy is present over a wide range of frequencies.

The energy per cycle is equal and it is used for masking in speech audiometry.

(39.4)

42. Brownian motion

Is random molecular motions of thermal origin which gives a low noise level that exists in solids, liquids and gases (constitutes of broad-spectrum noise).

For constant temperature, the mean velocity of these motions is highest in gases, less in fluids and least in solids.

The motion is inversely related to the density of the medium or on the coupling 0between the particles.

(46.476)

43. Centre Frequency

It is the frequency at the centre of a bandwidth.

(39.4)

44. Central deafness

A hearing loss due to the dysfunction of the auditory pathway at or above the level of the brain stem.

This is caused due to turners, head injury or vascular changes in the brain.

Their main difficulty is in processing speech.

(24.326)

45. Central masking

When a tone is presented to the test ear and the masking noise to the non-test ear, it may produce threshold shift in the test ear.

The threshold shift may be observed even when the masking noise is less than the interaural attenuation level which is due to central masking.

(18.89)

46. Click pitch

When the duration of a very short tone burst is increased a click with tonal quality is perceived which is known as click pitch.

(12.224)

47. Combination tones

These are produced in the auditory system due to the interaction among the primary tone and the harmonics of these tones.

(36.100)

48. Complex noise

This consists of low frequency and amplified harmonics. It has buzzying, low pitch quality.

It is a good masker of low frequency tones tut not as good masker of high frequency tone.

(18.89)

49. Complex wave.

It is a periodic sound wave consisting of a fundamental frequency combined with other sine wave components of different frequency.

(39.4)

50. Critical bond.

A narrow band of frequencies surrounding the test tone ie., when a signal is masked by noise, only those frequency components of the noise which are close to the test frequency are effective in masking the signal.

Those frequency components of noise which lie outside this critical band do not increase the efficiency of the masker, but just increase its loudness.

(39.4)

51. Damping effect

A decrease in the amplitude of vibrations because of the absorption of energy by the surrounding medium.

(44.11)

..55

52. Dead Room

Ref.: Anechoic Chamber

53. Dichotic listening

It refers to the simultaneous presentation of two different stimuli to two ears.

This method may be used to study the normal and abnormal function of the auditory system.

(24.327)

54. Difference Limen(DL)

It is the minimum difference in a signal in terms of frequency, intensity or time that can be detected by an individual. It is also known as the J.N.D.(Just noticeable difference). The D.L. volue is the reciprocal of the J.N.D.

DL for intensity depends on intensity and frequency. DL for is less at high intensity. This is used to detect the presence of recruitment.

The value of DL for frequency is high at low frequency.

(15.179)

55. Difference tone.

Is one of the technique used to study the nature of combination tone.

The difference tone is heard only when primary tones are presented well above the threshold, for instane 50 dB SL. It is the combination of the difference between the(f_2 - f_1) higher frequency tone and lower frequency tone.

(12. 282)

56. Directional hearing.

Ref.: Auditory localization

..56

57. Doppler effect

The apparent change in pitch which results when the listener and the sound source are moving rapidly away from or towards each other is known as 'Doppler Phenomenon'.

(33.29)

58. Dynamic Range

Is defined as the range between the level at which a person can just perceive the loudness of the signal to a level where the signal becomes uncoinfortably loud.

(33.17)

59. Equal-loudness Contour

These are the curves which show the relationship that must be maintained between SPL and frequency if tones of various frequencies are to produce the same loudness sensation for 'normal' listeners. These curves show that tones of the same SPL do not sound equally loud.

This is also known as phone curve.

(13.348)

60. Figure ground

This term was initially used in relation to vision. In audition, this is an ability to identify a primary signal or message in the presence of competing sound. This can be monaural or binaural.

This task is difficult since both primary and competing sounds change their acoustic features continually over time.

(21. 1018)

61. Formant frequency.

Is characterised by peak energy in a speech sound and visible as a dark band in a spectogram. In general it is a resonance frequency of the vocal tract.

The forments of the sound are directly dependent on the shape of the vocal tract and are largely responsible for characteristic quality.

Presence of the formants enable us to recognise the different vowels and are fronted by 2 or 3 formant ranges.

(24.348)

62. Forward masking

This is a phenomenon observed when the signal is presented within 100 m.sec. of the cessation of the masking signal, the latter being presented prior to the former.

(45.93)

63. Fourier analysis

The collection of sinusoids can always be recombined to reproduce the complex wave form exactly.

Mathematically this procedure is called fouriers analysis.

(7.87)

64. Frequency modulation

Frequency modulated wave consists of a carrier frequency (a sine wave) on which some other frequency signal is impressed.

In FM the carrier's instantaneous frequency is varied in proportion to the modulating signals magnitude, but the amplitude remains same.

(31.87)

65. Frequency Resolution

This describes the ability to filter out, on the basis of frequency, one stimulus component from another in a complex stimulus.

(36.284)

66. Fundamental frequency

The fundamental frequency is the lowest frequency component in a complex periodic wave.

(39.7)

67. Gaussian noise.

It is a continuous sound with equal amplitude at all frequencies. It has a wide band width.

(32.27)

68. Harmonic Distortion

It is the unwanted introduction of harmonic components of a sine wave input signal which arises due to the non-linear response of an amplifier or transducer.

(39.8)

69. Head-shadow effect

The head acts like a barrier to certain frequencies especially to high frequencies as it has the shorter wave length and reduces the level of nackground noise.

Head-shadow effect has been utilized in variation of cross aids for Eg. in high cross hearing aids.

(25.5.)

70. Huffman sequence

It is a signal of finite duration and constructed of 'n' digital samples 'n' is the power of two. The wave shape of

all these signals are different but their energy spectra and duration are identical.

(30.830)

71. Interaural attentuation

This is caused by the non-linear amplifier response. It is characterized by the presence of frequency equal to the sums and differences of exact multiples of the input frequency components at the output of an amplifier.

(39.8)

72. Intermodulatory Distortion (IM)

It is due to the non-linear amplifier response. It is characterized by the presence of freouencies equal to the sums and differences of the multiples of the inputfrequencies.

IM distortion at 500, 760 and 1000 influences the performances of normal listeners in the perception of phonetically balanced lists and concessive IM reduces intelligibility.

(39.8)

73. Inter-stimulus interval.

It is the time interval between successive stimuli presentation in an experiment or test.

Sufficient inter-stimulus interval to elicit best response of the system, eg. in pure tone . Interstimulus interval of 1-2 is given for the system to return to normal before eliciting next response.

(39.9)

74. Line-busy effect.

If one stimulus had produced the firing of a nerve fibre, then the super imposed stimuli would not be able to produce an increase in firing rate. This phenomenon is called as line-busy effect. (36.98)

75. Listening check

Is the method used to check the continuity of the ear-phone cord and bone vibrator cord.

(18.28)

76. Logan Stimulus

This stimulus is produced by passing DC pulse through narrow band pass filter. These are amplitude modulated sine wave. The amplitude is modulated using Gauzzian noise.

It is characterised by three peaks in a 50% negative, 100% positive and 50% negative sequence followed by a 50% positive, 100% negative and 50% positive sequence reversing on each successive stimulus.

These stimuli are used in Brain stem evoked response audiometry.

(32.30)

77. Lombard effect.

When speaking in a noisy environment, we unconsciously increase the intensity of the voice to compensate for the masking effect.

Based on the phenomenon tests have been used to identify functional hearing loss which is reported in the literature.

(33.149)

78. Midplane localization.

Two equally inttense sounds of similar spectra presen-ted simultaneously to the two ears are heard as a single sound at or near the middle of the head in ear phone listening.

Since localization of these sounds is done in the mid-

plane it is known as midplane localization. This is used to measure loudness adaptation.

(45.14)

79. Modulation Transfer.

The ability of a system to transmit changes in intensity with time, either in specified frequency bands or for the whole spectrum.

The advantage of MTF over the articulation index is that, it can effectively characterize the effects on intelligibility from the study of temporal properties.

(24.330)

80. Monaural hearing

Is hearing with one ear only and used with reference to testing with earphone.

Eg. Pure tone and supra threshold testing such as ABLB, SISI, TDT.

This helps in studying the responses of each ear separately and thereby aids in diagnosis of hg.disorders.

81. Narrowband noise

It is a noise whose energy content is restricted to a narrow frequency range, and is produced by the selective filtering of white noise. The difference in Hz between the upper and lower frequency limits of the noise represents the noise band width.

(39.9)

82. Occlusion effect

Improvement of Bone conduction threshold noticable at 1000 Hz and below when the ears are occluded during testing.

during

It is observed in normal hearing subjects and in patients with sensorineural loss and is absent in patients with conductive loss.

(33.170)

83. Periodicity pitch

It is the common time interval between the firings, ie., when a complex tone consisting of 600,800 and 1000 Hz are presented to the ear, then the subject will perceive this tone as having a pitch of 200 Hz.

This 200 Hz is known as the periodicity pitch.

(31.114)

84. Perstimulatory fatigue

Decrease in the loudness of a stimulus when presented continuously at an intensity level above the threshold.

(47.244)

85. Phase difference

This refers to the relative locations of two periodic waveforms at a given point in time. For example the first sine wave will have reached its maximum amplitude at the moment that the second sine wave begins.

(39.10)

86. Phone Deafness

This describes the condition of a person's hearing aid which serves well in all situations except in a particular situation when the aid is incompatible with the telephone.

(39A.22)

87. Pink noise

Is a type of noise in which equal energy per octave is presented. The spectrum of noise falling off at a rate of

3 dB/octave, is inversely proportional to the signal freauency.

(39.10)

88. Precedence effect

It is a binaural phenomenon. The interaural difference in time of arrival of a sound which aids in the accurate assessment of its location in the presence of echoes.

(31.163)

89. Pulsation Threshold

When the test signal is attenuated in the presence of masking sound, the listener may report that he hears it continuously. The lowest level at which this is reported is called pulsation threshold.

(3.122)

90. Pure tone

Is a sound which has a definite tonal quality. The wave form is a sine wave. The frequency of a puretone (hz) is the number of complete cycles which the sound wave passes through in 1-sec.

(39.10)

91. Random noise

This is a complex sound wave in which the amplitude of the component of frequencies vary in time. It contains no periodic frequency components and its spectrum is continuous.

(13.252)

92. Remote Masking

The masker and the maskee frequencies are different and fall outside the critical band.

This takes place due to the distortion of mechanical vibrations in the cochlea.

(39.10)

93. Rotating tones

It is a lateralization phenomenon; when two tones of the same intensity but with slightly different frequency are presented simultaneously to the two ears the individual experiences shifting/rotating of the tone from one ear to another.

(36.)

94. Sawtooth masking noise

A sound made up of a fundamental frequency of about 60 or 120 Hz together with all its harmonics upto 10,000 Hz in random phase.

(8.49)

95. Sinusoidal Wave

Refer Puretone

96. Signal-to-noise

Is the ratio between a signal and noise; expressed generally in dB and got by subtracting the dB value of the noise from the dB value of the signal.

(39.12)

97. Speech Spectrum

This is obtained on acoustic analysis of speech and is represented in graphic form.

The frequencies are marked in the horizontal scale in hertz and h the relative amplitude of the components in the vertical scale i n 'Y' axis.

(11.58)

98. Sound Intensity.

The acoustical power passing through a unit area is defined as the sound intensity.

$I = W/A$ Where

W = Acoustical sound power of the source

A = Surface area (mts^2)

A just audible sound intensity for a human ear is 10^{-16} watt/cm^2

(28 .)

99. Sound power

It is the rate at which acoustical energy is radiated from a sound source.

It's unit is watt

$LW = 10 \log_{10} W_1/W_2$ where

LW = sound power level

W_1 = Acoustic power of intensity

W_2 = reference sound power level

(10^{-12} Watts)

(28.)

100. Sound Pressure

Is the force exerted by a sound wave over a unit area of surface; measured in dynes/cm^2 ; the smallest pressure sufficient to produce an audible sound is approximately .0002 dyne/cm^2 or

$Lp = 20 \log_{10} P_1/P_2$ where

Lp = sound pressure

P_1 = RMS sound pressure

P_2 = reference sound pressure (0.002 dynes/cm^2)

(28.)

101. Squelch effect

It is an auditory phenomenon where one can tune into a wanted signal and at the same time minimize the interfering effects of unwanted background noise.

(25. 5)

102. Square Wave

A succession of identical acoustical or electrical rectangular pulses so spaced that the time duration of the pulse is just equal to the tune period between successive pulses.

These are rectangular pulses spaced in such a way that the duration between the successive pulses are equal to duration of pulses.

(13.254)

103. Standing waves

When two sound waves which have the same frequencies and amplitude, travel in opposite direction, they produce a fixed or stationary wave pattern. The place where the amplitude is maximum, the sound is heard loudly and the place where it has null point the sound not heard.

The standing wave in a room is affected by the frequency in the sound, the size and shape of the room material on the walls etc.

(13.254)

104. Stenger Principle (effect)

When two tones of same frequency and of different intensity are introduced simultaneously into both ears, only

the louder tone will be perceived; used to identify unilateral functional hg. loss. Even speech can be made use off.

(33.170)

105. Temporal integration

The process by which the response to a short duration (200 ms.) sound or the perception of a sound increase with time.

This is found when measuring threshold for short duration sounds.

This phenomenon has found application in brief tone audiometry. It is based on the observation that the capacity of temporal integration is reduced in patients with cochlear lesion.

(24.100)

106. Temporal Summation

Refer Temporal Integration

107 Threshold of Discomfort

It is the intensity level at which an individual reports that the auditory signal causes discomfort or becomes uncomfortably loud.

The normal ear is able to tolerate about 120 dB SPL sound stimulus without experiencing discomfort.

The threshold of discomfort is lower in patients with cochlear lesion.

Measurement of threshold of discomfort also aid in selection of hearing aids.

(18.108)

108. Threshold of hearing.

Represents the number of dB relative to audiometric zero at which a subject first perceives a given tone or speech.

(39.19)

109. Threshold shift

A change in hearing sensitivity which is caused by exposure to noise. This may be

1) Temporary (TTS) which lasts about 16 hours, improving gradually.

2) Permanent Threshold shift (PTS) which is not reversible.

3) Composite threshold shift which is observed 8 hours of noise exposure which reaches maximum of 60-80 dB SPL. Subsequent shifts are lower than these values. This pehnomenon includes both temporary and permanent threshold shift.

(12.254)
(17.337)

110. Tone bursts

These have rise-decay time of 25m.sec. and duration of 30-50 m.sec. Stimulus is presented once in 2 to 4 sec.

This is produced by passing 0.1 m.sec. tone through the filters and its spectrum depends on the characteristic of the filters through which it passes.

(32.30)

111. Tonal Island

A narrow band of frequencies which can be heard better than the frequency band on either side.

(8.336)

112. Tone pips

These are used as auditory stimuli for testing and are produced by passing 0.1 m.sec. tone through a 1/3 octave filter. Its rise decay time is 2-3 m.sec.

(32.30)

113. Transient distortion

This is produced when an acoustic signal is turned on or off rapidly or is presented. It is like a click or a thump for a very brief duration. To reduce this, fast rise and fall times should be avoided. This is very essential in threshold testing because if not checked subject may mistake it for the test tone.

(39.15)

114. Tuning curve

Is a graph of the lowest level at which the nerve fibre will respond. It is plotted as a function of frequency for a single nerve fibre.

Also called frequency threshold curve (F.T.C.)

(31. 288)

115. Virtual Pitch

Refer Periodicity pitch

116. Warble tone

Warble tone is produced by frequency modulation which refers to a periodic modification of a base or centre frequency to values either above or below, or around the base frequency, while amplitude is held constant.

Warble tone varies as a function of three basic parameters:

1) the centre or base frequency
2) the frequency deviation (FD) ± 0.2% above the base to as high as ± 10% around base frequency.
3) The modulation rates (MR) 2 to 10%

117. White noise

This consists of a continuous spectrum throughout the audible range. The energy per cycle is constant at all frequencies. The band width of white noise is limited to between 6000-7000 Hz.

Also known as broad band or wideband noise.

(39.16)

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BIBLIOGRAPHY

1. Ades, W.H., Engtrom.H.: Anatomy of the inner ear.(Ed.) W.D.Keidel Handbook of Sensory Physiology, Vol.1. New York. Springer Verlag, 1974

l.A. Atrens, D.M. The neurosciences and behaviour. An Introduction. Second edition. Sydney, Academic Press. 1982

2. Ballentyne, J.: Anatomy of the ear. Diseases of the ear. nose and throat. Vol.1. (Ed.) John Ballentyne and John Groves. London. Butterworth. Ch.I. 1979.

3. Varoba, B: Experimenting in the hearing and speech science, Minnesota, Starkey Laboratories Inc., 1978

3.A. Berlim, I.C.: Electrophysiological Indices of Auditory function. Paeditric Audiology (Ed.) F.N.Martin, New Jersey, Prentice Hall Inc., 1978.

4. Borden, J.G. and Harris, S.K.: Speech Science Primer. Physiology Acoustic and Perception of Speech. Baltimore. Williams and Wilkins. 1980.

5. Chaurasia.D.B.: Human Anatomy: Regional and Applied. Delhi. CBS Publishers & Distributors. 1980.

6. Dallos, P.: Auditory periphery Biophysics and Physiology. New York. Academic Press. 1973.

7. Daniloff, I.: The Physiology of Speech and Hearing. An Introduction. Englewood Cliffs. Prentice Hall. 1980

8. Delk, H.J.: A complete dictionary of Audiology; The National Hearing Aid Journal. 26(3). p.37. 1973.

9. Feldman, A.S. & Wilber, L.A.: The measurement of middle ear function. (Ed.) A.S.Feldman and L.A. Wilber. Acoustic impedance and Admittance. Baltimore. The Williams & Wilkins Company. 1976.

10. Fletcher, H.: Speech and Hearing in communication. Princeton. D. Van Nostrand Company. Inc. 1953.

11. Fry, B.D.: Physics of Speech. London Cambridge University Press. 1982

12. Gelfand, A.S.: Hearing. An Introduction to Psychological Physiological Acoustics. New York. Marcel Dekker. Inc. (1981).

13. Glorig, A.: Audiometry. Principles and Practice. Baltimore, The Williams and Wilkins Company. 1965.

14. Davis, D.V.: Gray's Anatomy. Thirty fourth edition. London. Orient Longmans. 1967.

15. Green, D.S.: Tone decay (Ed.) Jack Katz. Handbook of Clinical Audiology. Second edition. Baltimore. The Williams & Wilkins Company. 1972.

16. Groves, J.: Physiology of Hearing. (Ed.) Ballantyne & Groves. Diseases of the Ear. Nose and Throat. Vol.1. London. Butterworths. 1979.

17. Haughton, M.P.: Acoustics. Physical Principles of Audiology, Bristol. Adam Hilger Ltd. 1980.

18. Hodgson, R.W.: Basic Audiologlc evaluation. Baltimore. Williams & Wilkins. 1980.

19. Howard, T.M.: Audio Encyclopedia. Second Edition. Indiana. Howard W.Sams & Co. Inc. 1979.

20. Irwin, V.J. & Newhoff, M.: Communication:Structure and acquisition. (Ed.) R.J. Van Hattum. An introduction: Communication Disorders. New York. Mscmillan publishing Co. Inc. 1980.

21. Keith, R.W.: Central Auditory Tests, (Ed.). N.J. Lass. Speech, Language and Hearing. Vol.III Philadelphia. W.B. Saunders Company. 1982.

22. Kryter, K.D.: Extra-auditory effects of noise on hearing. New York. Raven Press. 1976

23. Sittler, S.T.: The Physics of ear. London. Pergamon Press. 1965.

24. Sutman, I.: Hearing Science and Hearing Disorders. New York. Academic Press. 1983.

25. Markides, A.: Binaural hearing aids. London. Academic Press. 1977.

26 Martin, F.N.; Pediatric Audiology, New Jersey. Prentice Hall. Inc. 1978.

27. Martin, F.N.: Introduction to Audiology. second Edition. New Jersey. Prentice Hall. 1981

28. May, D.; Handbook of Noise assessment. New York. Van Nostrand Reinhold Company 1978.

29. Mo11er, R.A.: Basic Mechanics in hearing. New York. Academic Press. Inc. 1973.

30. Mo11er, R.A.: Auditory Physiology. New York. Academic Press. 1983,

31. Moore, J.: An Introduction to the Psychology of Hearing. Second Edition. London. Academic Press. 1982.

32. Moore, J.: Bases of auditory Brain-stem Evoked Responses. New York. Grune & Stratton. 1983.

33. Newby, A.H.: Audiology. Third Edition. New Jersey. Prentice Hall. Inc. 1972.

34. Northern, L.J. & Downs, M.P.: Hearing in Children. Second edition. Baltimore. The Williams & Wilkins Company. 1978.

35. O'Neill & Oyer.: Applied audiometry.(Ed.) Karl.R. Wallace. New York. Dodd, Mead & Company. Inc.1970.

36. Pickles. O.J.: An Introduction to the Physiology of hearing.London. Academic Press. 1982.

37. Reneau, P.J. & Hnatrow, G.2.: Evoked Response Audiometry. London. University Park Press. 1975.

38. Rhode, W.S.: An Investigation of post-mertem cochlear michrophonies using Mossabauer effect. (Ed.). A.R. Moller. Basic mechanisms in hearing. New York. Academic Press. 1973

39. Richards, A.M.: Basic experimentation in psychoacoustics, Baltimore. University Park press. 1976.

39A. Sake, D.: Telephone/hearing aid compatibility. Past-Present-Future, Audecibel. 33(3). 1984.

40. Schubert, A.: Hearing. Its function and Dysfunction. New York. Springer-Verlag Wein. 1980.

41. Smith, A.C.: Structure of the cochlear duct.(Ed.) Beagley Audiology and Audiological medicine. Vol.I.

42. Stedmans Medical Dictionary . Twenty first edition. The Williams and Wilkins Company, Calcutta. 1966.

43. Stevens, S.S.: Handbook of experimental Psychology New York. John Wiley & Sons. Inc. 1966.

..iv

44. Travis, E.L.: Handbook of Speech Pathology and Audiology. Second Edition. New Jersey. Prentice Hall. Inc. 1971.

45. Tobias, V.J.: Foundations of Modern Auditory Theory. Vol.1. New York. Academic Press. Inc. 1970.

46. Tandorf, J.: Stenociliary dysfunction. A cause of sensory hearing loss. Recruitment poor speech discrimination tinnitus. Acta Otalaryngologica. 91 (5-6). 1981.

47. Ward, W.: Auditory fatigue and masking (Ed.) J.Jerger. Modern developments in Audiology. New York. Academic Inc.1963.

48. Yost, A.W. & Nielson. W.D.: Fundamentals of Hearing. New York. Holt, Rinehart & Winston. 1977.

49. Zemlin, W.R.: Speech and Hearing Science, Englewood Cliffs. Prentice Hall. Inc. 1981.