Vocational Higher Secondary Education (VHSE)

Second Year

ECG & AUDIO METRIC TECHNOLOGY

Reference Book - Teachers' Version

Government of Kerala
Department of Education

State Council of Educational Research and Training (SCERT),
KERALA
2016

Foreword

Dear Teachers

This reference book **(Teachers' Version)** is intended to serve as a transactional aid to facilitate classroom transaction and as a ready reference for teachers of Vocational Higher Secondary Schools. It offers some guidelines for the transaction of the course content and for undertaking the practical work listed in the course content. As the curriculum is activity based, process oriented and rooted in constructivism focusing on the realisation of learning outcomes, it demands higher level proficiency and dedication on the part of teachers for effective transaction.

In the context of the Right- based approach, quality education has to be ensured for all learners. The learner community of Vocational Higher Secondary Education in Kerala should be empowered by providing them with the best education that strengthens their competences to become innovative entrepreneurs who contribute to the knowledge society. The change of course names, modular approach adopted for the organisation of course content, work-based pedagogy and the outcome focused assessment approach paved the way for achieving the vision of Vocational Higher Secondary Education in Kerala. The revised curriculum helps to equip the learners with multiple skills matching technological advancements and to produce skilled workforce for meeting the demands of the emerging industries and service sectors with national and global orientation. The revised curriculum attempts to enhance knowledge, skills and attitudes by giving higher priority and space for the learners to make discussions in small groups, and activities requiring hands-on experience.

The SCERT appreciates the hard work and sincere co-operation of the contributors of this book that includes subject experts, industrialists and the teachers of Vocational Higher Secondary Schools. The development of the teachers' version of reference books has been a joint venture of the State Council of Educational Research and Training (SCERT) and the Directorate of Vocational Higher Secondary Education.

The SCERT welcomes constructive criticism and creative suggestions for the improvement of the book.

With regards,

Dr. J. Prasad
Director
SCERT, Kerala

Contents

About the course

The concept of health care in our country is gradually shifting from mortality care to morbidity care. In a country like India, with its growing population, lot of gaps exist in the health service sector. With the advent of newer strategies in the field of science and technology, cardiac medical practice has shifted considerably from clinical cardiology to laboratory oriented cardiology. This has resulted in newest investigatory techniques and procedures for diagnostic and therapeutic purposes. The risk of heart disease increases now days due to the change in life style and social set up. In these circumstances ECG and other cardiovascular measurement techniques included in the curriculum are essential for proper diagnosis. The purpose of this course is to create skilled technicians to meet the health need of society

Hearing is one of the most important senses possessed by man. Hearing disability affects ones communicative, educational, social and emotional abilities. Audiology is the science of hearing, balance and related disorders. Early detection of hearing loss is very important for the proper management of hearing loss. The aim of the curriculum is to provide skill in clinical Audiological procedures like puretone audiometry, speech audiometry and special tests for hearing.

Syllabus offers fundamentals to students who gone for Diploma in Cardiovascular Technology, Bachelor of Cardiovascular Technology, Bsc Audiology and Speech Language Therapy.

Job roles (Career Path)

Govt./Private Sector	Self employment
• ECG Technician • Assist the Audiologist in hearing evaluation and rehabilitation procedures • To assist Cardiologist in TMT lab • To assist Cardiologist in echocardiography • Receptionist in Cardiology and Audiology lab	• Private ECG units associated with clinical labs • Marketing of hearing aids • Health educator

Major skills

- Performs the experiments related to production and propagation of sound
- Identifies the physical and psychological properties of sound
- Recognises human range of hearing and development of auditory behaviour
- Identifies the importance of test environment for audiological test
- Identifies the anatomy and physiology of auditory system
- Classifies hearing loss.
- Identifies the causes of hearing loss
- Compares the various degrees of hearing loss.
- Differentiates the various patterns of audiograms.
- Identifies the different parts and functions of audiometers.
- Compares different types of audiometers
- Performs tuning fork tests.
- Prepares case history of hearing impaired persons
- Performs puretone audiometry procedure
- Analyses the results of pure tone audiometry
- Familiarises speech audiometry test
- Performs special tests of hearing
- Identifies the procedure and clinical importance of different objective test of audiometry
- Identifies the uses of different types of hearing aid

- Identifies the importance of cochlear implant
- Identifies the different types of ear moulds.

Learning outcomes of the course

After completing the course the learner will be able to

- Identifies the different organs systems of human body
- Identifies and classify the bones of skeletal system and their relationship to each other
- Explains the origin of Ecg waves
- Identifies the anatomy and physiology of cardio vascular system in detail
- Records the blood pressure of a person
- Creates an awareness about heart disease and its risk factors to the society
- Explains the applications of biomedical transducers
- Records the ECG of a person
- Lists out the advanced cardio vascular diagnostic procedures
- Performs CPR
- Recognizes the importance of various aspects of sound in hearing evaluation
- Explains the structure and function of auditory system
- Creates an awareness to the society about hearing loss and its causes
- Recommends the need for the early intervention of hearing
- Performs hearing evaluation procedures under the guidance of an audiologist
- Creates an awareness about special test in audiometry
- Identifies and market various types of hearing aids used for rehabilitation

Course structure

This course consists of 4 modules such as,

Module 1	Basics of Cardiology and Electronics Principles	340

Module 2	Cardiovascular diagnosis	340
Module 3	Basics of Audiology	340
Module 4	Basics of Practical Audiometry	340

SYLLABUS

Module 3

Module name: BASICS OF AUDIOLOGY

3.1 SOUND AND HEARING (65 Periods)

3.1.1 Definition of sound, Generation and Transmission of sound

3.1.2 Physical and Psychological attributes of sound

3.1.3. Types of sound:

Pure tones, complex tones, Noise

3.1.4 Range of Human hearing

3.1.5 Development of auditory behavior

3.1.6 Sound Treated Rooms

3.2. AUDITORY SYSTEM - ANATOMY & PHYSIOLOGY (130 Periods)

3.2.1. Ear- External ear, Middle ear, Inner ear

3.2.2. Auditory nerve and Central Auditory Pathway

3.2.3. Theories of hearing

3.3. HEARING LOSS **(**75 Periods)

3.3.1 .Hearing loss, Types of Hearing Loss - Organic, Non Organic

Causes- Congenital , Acquired, Prelingual vs Post lingual,

Noise Induced Hearing Loss, Presbycusis

3.3.2 Degrees of Hearing loss, Configuration of hearing loss,

Unilateral vs Bilateral, Symmetrical vs Asymmetrical, Progressive vs sudden hearing loss, fluctuating vs Stable hearing loss

3.3.3 Audiogram: Notations used for plotting audiograms

3.3.4 Audiogram patterns in different types of hearing loss

3.3.5 Effects of hearing loss on development

3.4. HEARING ASSESMENT **(70 Periods)**

3.4.1 **A**udiometers, Types of Audiometers

3.4.2 Pure tone Audiometer- Instrumentation

3.4.3 Case History Evaluation and its importance

3.4.4 Tuning fork Tests

MODULE 4

Module name: Basics of Practical Audiometry

4.1 PURETONE AUDIOMETRY (120 **Periods)**

4.1.1 Puretone Audiometry- Patients and Clinicians Role in Testing

Air conduction testing, Bone conduction testing,

Plotting Audiograms

Audiogram Interpretation

4.1.2 Play Audiometry, Free field Audiometry, Aided Audiometry

4.1.3 Masking- Minimum masking, effective Masking, Over Masking

4.1.4 Calibration of Audiometers

4.2. SPECIAL TEST OF HEARING (40 **Periods)**

Loudness Recruitment - Short Increment Sensitivity Index,

ABLB Test, Tone Decay Test

4.3 SPEECH AUDIOMETRY (**65 Periods)**

Need for Test Environment - Speech Detection Threshold, Speech Reception Threshold, Speech Discrimination Score

Most Comfortable Loudness, Uncomfortable Loudness, Dynamic Range

4.4 Objective Tests of Audiometry (**50 Periods)**

Brain Stem Evoked Response Audiometry (BERA)

Otoacoustic Emission (OAE)

Impedance Audiometry- Tympanometry, Reflexometry

4.5 HEARING AIDS AND EAR MOULDS (**65 Periods)**

4.5.1 Hearing Aids - Instrumentation, Characteristics of Hearing aids

Classification, Hearing aid selection, Care and maintenance of hearing aid, Cochlear Implants

4.5.2 Ear Moulds – Types, Preparation of Ear Mould (Brief)

List of practicals

Module 3

- Experiment showing generation and transmission of sound- Tuning fork experiment
- Experiment showing resonance
- List out the environmental sound according to the frequency
- Observation of different responses to sound in infants
- Familiarize the structure of sound treated rooms
- Preparation of coloured charts

  AC pathway, BC pathway, Structure of ear, Central auditory pathway
- Identification of different parts of auditory system using models
- Examination of external ear & tympanic membrane using otoscope
- Observe the voice quality in the speech of conductive and sensory neural hearing loss patients
- Identification of different types of hearing loss from given audiogram pattern
- Identification of different parts of audiometer
- Charts and model preparation based on audiometer block diagram
- Performing tuning fork tests-
  - Rinnes test
  - Weber test
  - ABC Test
- Familiarize the format of case history
- Observation of case history
- Collection of case histories of different types during OJT
- Preparation of case histories under the guidance of experts

Module 4

- Familiarization of patient preparation for pure tone audiometry

- Observation of puretone audiometry and participating in plotting audiogram
- Performing puretone audiometry of normal cases and plotting audiogram(10 cases)
- Manifestation of threshold shift in different levels of masking in opposite ear
- Subjective calibration of audiometer
- Perform Special tests of hearing
    - Tone decay
    - SISI,ABLB
- Observation of speech audiometry(5 cases)
- Observation of objective tests of hearing during OJT
- Identification of various types of hearing aids and ear moulds

Learning outcome of the units

Module 3

3.1 Sound and Hearing

The learner will be able to

3.1.1

- defines sound
- Explains the generation and transmission of sound
- Recognizes the medium for transmission of sound
- Compares the propagation of sound through different media

3.1.2

- defines the physical properties of sound
- differentiates gross and fine discrimination of sound
- defines the psychological attributes of sound
- differentiates the variation in intensity, frequency and duration

3.1.3

- defines of pure tone, complex tone, musical sound and noise
- identifies different types of sound
- differentiates pure tone and complex tone
- compares musical sound and noise

3.1.4

- explains the audible range of human being
- Identifies the range of speech frequency
- Differentiates the intensity range of different sounds
- Compares the sound above and below audible range

3.1.5

- identifies the response of a child towards sound in different developmental stage
- Compares the sound response

3.1.6

- discusses the need of sound treated rooms
- recognizes the peculiarity of sound treated rooms

AUDITORY SYSTEM

3.2.1

External Ear

- identifies different parts of the external ear
- Explains the functions of each part
- lists the parts of external ear
- Sketches the parts of tympanic membrane, pinna, auditory canal
- locates the tympanic membrane using otoscope

Middle ear

- Categorizes different parts of middle ear

- identifies the contents of middle ear
- Lists out the functions of ear ossicles, muscles of middle ear, ligaments, blood vessels and nerves
- compares the middle ear cavity with the Eustachian tube
- explains the importance of Eustachian tube

Internal ear:

- identifies and classifies the parts of internal ear
- compares bony labyrinth and membranous labyrinth
- Differentiates the different parts of internal ear
- Lists the parts and functions of vestibular system
- Explains the mechanism of hearing
- Compares the mechanism of Air conduction and Bone conduction
- Explains the mechanism of sound localization

3.2.2 Auditory Nerve & Central Auditory Pathway

- explains the origin and branches of vestibulocochlear nerve
- identifies the transmission of acoustic reflex through auditory nerve
- recognizes the importance of 8^{th} cranial nerve in hearing and balancing
- lists the different levels of auditory pathway

3.2.3 Theories of hearing

- explains the four different theories of hearing
- compares the four theories of hearing

3.3 Hearing Loss

- defines hearing loss
- classifies hearing loss based on pathology
- Compares different types of hearing loss
- Analyses the different causes of conductive, sensory, neural and mixed hearing loss
- Differentiates congenital,acquired, Prelingual vs post lingual hearing loss
- defines N.I.H.L and Presbycusis
- compares organic and nonorganic hearing loss

- compares types of hearing loss based on severity
- classifies hearing loss based on degree of hearing loss
- differentiates mild, moderate, moderately severe, severe and profound hearing loss
- analyses different degrees of hearing loss
- analyzes the configuration of hearing loss
- differentiates Unilateral vs Bilateral, Symmetrical vs Asymmetrical, Progressive vs sudden hearing loss, fluctuating vs Stable hearing loss
- identifies audiogram and its significance
- identifies the notations used for plotting audiograms
- analyses the different patterns of audiogram
- Explains the effects of hearing loss on development

3.4 Hearing assessment

- identifies the parts and functions of audiometer
- differentiates the different types of audiometers
- compares the use of screening and diagnostic audiometer
- collects necessary information for preparing case history which leads to diagnosis
- explains the importance of case history evaluation in audiometric testing
- predicts the need for management of the patient
- Perform the various tuning fork tests

Module 4

Basics of Practical Audiometry

4.1.1 Puretone Audiometry

- recognizes the strategies adopted in pure tone testing
- chooses the frequency intensity method for test procedure
- explains the method of placing headphone for pure tone testing
- Experiments the strategies for air conduction and bone conduction testing
- records air conduction and bone conduction threshold

- analyzes the air conduction and bone conduction threshold obtained
- records audiograms using the symbols
- writes the interpretation of the results of pure tone audiometer

4.1.2

- explains play audiometry, free field audiometry and aided audiometry

4.1.3 Masking

- defines masking
- Identifies the need of masking
- Differentiates minimum masking, effective masking and over masking
- Practices masking in laboratory

4.1.4 Calibration of Audiometers

- identifies the need of calibration
- performs calibration of audiometer
- explains biological calibration of audiometer

4.2. Special test for hearing

- defines recruitment
- Identifies the different test to find out recruitment
- Explains the different test procedures of recruitment
- practices ABLB, SISI and Tone decay test
- analyzes the test results of ABLB, SISI and Tone decay test

4.3. Speech Audiometry

- identifies the importance of speech audiometric test
- chooses the right test environment
- Recognizes the various parameters associated with speech audiometry
- identifies the significance of SRT test
- Explains the procedure of SRT test
- Analyzes the SRT of each ear
- Identifies the significance of SD test
- explains the procedure of speech detection threshold
- records SD score of each ear
- analyzes the SD score
- defines MCL,UCL &DR
- explains the significance of MCL, UCL, DR
- records MCL, UCL,

- Analyzes DR

4.4 Objective tests of Audiometry

- explains objective audiometry
- Identifies the significance of objective audiometry
- defines BSERA
- identifies the significance of BSERA
- Explains the procedure in brief and BSERA graph familiarization
- Defines OAE
- Identifies significance of OAE
- Explains procedure in brief and familiarization of test results
- Defines the principle of Tympanometry
- Identifies the parts and functions of tympanometer
- Explains the procedure of Tympanometry
- compares different tympanograms i.e. middle ear compliance /impedance, middle air pressure and AMR threshold

4.5 Hearing Aids & Ear Moulds

4.5.1 Hearing Aids

- defines hearing aid
- Identifies the parts and functions of hearing aid
- classifies, categories hearing aid
- Evaluates the merits and demerits of AC and BC hearing aid
- decides the factors to be considered while selecting a hearing aid
- compares advantages of binaural hearing aid over monaural hearing aid
- analyses the need of Care and maintenance of hearing aid
- explains the cochlear implants

4.5.2 Ear moulds

- defines ear mould
- Recognizes the need of ear mould
- identifies the merits and demerits of different types of ear moulds

Scheme of Work

Module 3 and 4

Month	Unit No	Unit Name	Periods
June	3.1	Sound and Hearing	65
July- August	3.2	Auditory System (anatomy & physiology	130
September	3..3	Hearing loss	75
September - October	3.4	Hearing assessment	70
Month	**Unit No**	**Unit Name**	**Periods**
November- December	4.1	Pure tone Audiometry	120
December	4.2	Special Test of Hearing	40
January	4.3	Speech Audiometry	65
January- February	4.4	Objective test of Audiometry	50
February	4.5	Hearing Aids and ear Moulds	65

13 Structure of module 3

Module 3

Basics of Audiology 340 Periods

Unit no.	Name of unit	Periods
3.1	Sound and hearing	65
3.2	Auditory System (anatomy & physiology	130
3.3	Hearing Loss	75
3.4	Hearing Assessment	70

30% Periods theory sessions and 70% period' practical activities

Module 4

Basics of Practical Audiometry **340 Periods**

Unit no.	Name of unit	Periods
4.1	Pure Tone Audiometry	120
4.2	Special test of hearing	40
4.3	Speech audiometry	65
4.4	Objective Test of Audiometry	50
4.5	Hearing aids and Ear Moulds	65

30% Periods theory sessions and 70% period' practical activities

Class room activities(general)

- PowerPoint presentation
- Charts
- Diagrams
- Models
- Animated CD's
- Discussions
- Exhibitions
- Quiz
- Interview with experts
- Debate
- Video conference
- Assignment
- Seminar

Practical activities general

Demonstration

Case study

Hands on experience

Field Study

Overview of module 3

BASICS OF AUDIOLOGY

Overview

Audiology is the branch of science which deals with the study of hearing ,balance and related disorders**.** This module deals with the basics of sound, how sound propagates, it's properties, audible frequency range of human hearing etc. It also discusses about auditory behaviour development in children. The basic concept of anatomy and physiology of human ear is very essential for audiology. This module gives a brief description about this. Depending on the site of problem in ear, there are various types of hearing loss- conductive, sensory neural and mixed type. Awareness about these types of losses and their common audiogram patterns are dealt here. Age related hearing loss, malingering and noise induced hearing loss are also discussed briefly. For testing hearing the basic instrument needed is Pure tone Audiometer. A basic awareness about its instrumentation and parts are also needed. Thus the whole module gives us a basic idea about sound, how we hear, what is hearing loss, its types and audiometer. This is the basic step for forming a strong foundation for audiology

3.1 SOUND AND HEARING

overview

For the study of human hearing and hearing loss, a basic understanding of sound such as what sound is, how sounds are produced, how sounds propagate from one place to another etc are necessary. Sound can be defined as a wave of alternating and successive compressions and rarefactions in a medium of solid, liquid or gas. Sound is a typically audible acoustic wave of alternating and successive high pressure and low pressure that travels from one place to another through a medium of solid, liquid or gas. The auditory compression felt in the auditory organ when a sound is received by the ear is hearing. This unit deals with the study of

production and propagation of sound, types of sound, human range of hearing, development of auditory behaviour and room acoustics or sound treated rooms for hearing testing.

	Concept/ skills	Learning outcome	Process /learning experience	Evaluation
	Sound • Definition of sound, Generation and transmission of sound **Skills:** • **Identification** • **Listening** • **Observation** • **comparison**	• defines sound • Explains the generation and transmission of sound • Recognizes the medium for transmission of sound • Compares propagation of	• Demonstration • Discussion • practicals	• Questions • participation in discussion • Quiz • perfection in practical • Evaluation of practical log

		sound through different media		
	Physical and Psychological attributes of sound **Skill:** • **Identification** • **Observations** • **Differentiation** • **listening**	• defines the physical properties of sound • differentiates gross and fine discrimination of sound • defines the psychological attributes of sound • Differentiates the variation in intensity	• Demonstration • Discussion • Chart • Audio recordings • Note preparation	• Questions • participation in discussion • perfection in Chart preparation • Notes in activity log
		• Defines	• Discussi	• Parti

	Types of sound Pure tone Complex tone Noise **Skills :** • **Identification** • **Differentiation** • **Comparison** • **Listening**	pure tone, complex tone, musical sound and noise • Identifies different types of sound • differentiates pure tone and complex tone • compares musical sound and noise	on • Demonstrations • practical	cipation in discussion • Activity log • Performance in practical
	Range of human hearing **Skills :** • **Observation** • **Identification** • **Differentia**	• Explains the audible range of human being • Identifies the range	• Discussion • Demonstration Assignment	• Questions • Activity log Quality of assignment

	tion • **Communication** • **Comparison**	of speech frequency • Differentiates the intensity range of different sounds • Compares the sound above and below audible range		
	Development of auditory behaviour **Skills :**	• identifies the response of a child	• Demonstration of video • Chart preparation Collecti	• Questions • Activity log • Quali

	• **Identification** • **Observation** • **Comparison**	towards sound in different developmental stages • compares the sound response in different developmental stages	on of data	ty of prepared Char Portfolio
	Sound treated rooms. **Skills :** • **Observation** • **Identification**	• explains the need of sound treated rooms • Recognise the peculiarity of sound treated rooms	• Discussion • Data collection during OJT	• Questions • Portfolio • Participation in discussion • Evaluation of collected data

Additional information

Pitch

The pitch of the voice depends upon the length and tightness of the vocal cords .In adults the vocal cords are longer in male than in the female ,thus the male voice has a deeper pitch than that of the female

Loudness

The loudness of the voice depends upon the force with which the vocal cords vibrate .The greater the force of expired air the more vibration of the cords and the louder the sound .

The quality and resonance

The quality and resonance of the voice depend upon the shape of the mouth; the position of tongue and the lips; the facial muscles; the air sinuses in the bones of the face and the skull

Assessment activity

1.Take a wooden stick and press your ears at one end of it. Ask a friend to gently knock at the other end. Are you able to hear the sound very clearly? How?

2. Make a list of the sounds you like to hear and those you prefer not to hear in the table below

Pleasant Sound	Unpleasant sound
• • • • •	• • • • •

3. Prepare a chart showing a child's response towards sound in different development.

List of items in the portfolio

- Notes in the activity log
- Collected data and pictures related to sound treated rooms
- Assignment on range of human hearing ,development of auditory bahaviour
- Practical log
- Diagrams

3.2 AUDITORY SYSTEM - ANATOMY & PHYSIOLOGY

Overview

The ear is the sense organ that enables us to hear. Hearing can be defined as the perception of sound energy via the brain and central nervous system. Hearing consists of two components: identification of sounds (what the sound is) and localisation of those sounds (where the sounds are coming from). The ear is divided into three main parts – the outer and middle ear , and the inner ear. The inner ear is filled with fluid. The inner ear also contains the receptors for sound which convert fluid motion into electrical signals known as action potentials that are sent to the brain to enable sound perception. The airborne sound waves must therefore be channelled toward and transferred into the inner ear for hearing to occur. The role of the outer and middle ear is to transmit sound to the inner ear. They also help compensate for the loss in sound energy that naturally occurs when the sound waves pass from air into water by amplifying the sound energy during the process of sound transmission. In addition to converting sound waves into nerve action potentials, the inner ear is also responsible for the sense of equilibrium, which relates to our general abilities for balance and coordination.

	Concept/ skills	Learning outcome	Process /learning experience	Evaluation
	Ear • External	• identifies dif	• Discussion • Demonstr	• Participation in

	ear ▪ Pinna ▪ Auditory canal ▪ Tympanic membrane **Skills :** • **Observation** • **Identification** • **Comparison** • **Drawing** • **Communication**	ferent parts of the external ear • Explains functions of each part • lists the parts of external ear • sketches the parts of tympanic membrane, pinna, auditory canal • locates the tympanic membrane using otoscope • categorises	ation • Preparation of chart • Assignment • Reference • Practicals in otoscopic examination	discussion • Questions • Perfection of prepared charts • Assignment • Activity log • Practical evaluation

	Middle ear ▪ Tympanic cavity ▪ Contents of middle ear ▪ Eustachian tube **Skills :** • **Observation** • **Identification** • **Comparison** • **Communication**	different parts of middle ear • identifies the contents of middle ear • lists out the functions of ear ossicles, muscles of middle ear ,ligaments, blood vessels and nerves • compares the middle ear cavity with the	• Demonstration using charts, models ,videos • discussion • illustration • chart preparation	Questions • Participation in discussion • Diagrams • Activity log • Charts • Quiz

	Internal ear • Bony labyrinth- Parts and Functions ▪ Membrane labyrinth- Parts and functions **Skills :** • **Observation** • **Classification** • **Drawing** • **Identification**	Eustachian tube • explains the importance of Eustachian tube • identifies and classifies the parts of internal ear • compares bony labyrinth and membranous labyrinth • differentiates different parts of internal ear	• Demonstration using charts, models and videos • Discussion • Preparation of charts • Drawing of flow chart • Illustration	• Activity log • Participation in discussion • Charts • Perfection of flow chart • Diagrams • Questions

	• **Communication** • **Differentiation**	• Able to lists the parts and functions of vestibular system • explains the mechanism of hearing • Compares the mechanism of Air conduction and Bone conduction • explains the mechanism of sound localisation		
	Auditory nerve and		• Discussion	

	central auditory pathway **Skills :** • **Observation** • **Identification**	• explains and identifies the origin and branches of vestibulocochlear nerve • identifies the transmission of acoustic reflex through auditory nerve • recognises the importance of 8th nerve in hearing and balancing • lists	• Flow Chart preparation	• Questions • Participation in discussion • Evaluation of prepared charts • Evaluation of flow charts and block diagrams

		the different levels of auditory pathway		
	Theories of hearing • Place theory • Volley theory • Place and volley theory • Travelling wave theory **Skills :** • **Communication** • **Comparison**	• explains the four different theories of hearing • compares the four theories of hearing	• Group discussion • Diagramatic representation	• Participation in discussion • Activity log

Additional information

External auditory canal

In life, skin sheds and is continuously renewing. Ear canal skin grows like a fingernail from the depths to the exterior so that the skin is shed into the waxy secretions in the outer part and falls out. This is the reason for not using cotton buds to clean the ear canal because very Frequently they merely push the shed skin and wax deep into the canal, impacting it and Obstructing hearing. The ear canal has a slight bend where the outer cartilaginous part joins the bony thin skinned inner portion, so that the outer part runs somewhat backwards and the inner part somewhat forwards. This bend is yet another part of the protective mechanism of the ear, stopping foreign objects from reaching the tympanic membrane. However it means that to inspect the tympanic membrane from the outside, one must pull the ear upwards and backwards.

Amplification of sound in the middle ear

The outer and middle ears serve to amplify the sound signal. The pinna presents a fairly large surface area and funnels sound to the smaller tympanic membrane; in turn the surface of the tympanic membrane is itself much larger than that of the stapes foot plate, so there is a hydraulic amplification: a small movement over a large area is converted to a larger movement of a smaller area. In addition, the ossicular chain is a system of levers which serve to amplify the sound. The outer and middle ears amplify sound on its passage from the exterior to the inner ear by about 30 dB

The Occlusion Effect

During sound transmission through the bony structures of the human head, part of the sound energy is radiated by the vibrating walls of the *External Auditory Canal* and excites the air contained within it.

This radiation is especially effective in the outer one-third of the *External Auditory Canal* , the walls of which are surrounded by elastic cartilage. The inner two-thirds of the EAC travel through the temporal bone, the walls of which produce much less radiation

The occlusion effect is an increase in the loudness of a bone-conducted sound because of the closing of the External Auditory Canal by an earphone, earplug, or other object

The cocktail party effect

The cocktail party effect is the phenomenon of being able to focus one's auditory attention on a particular stimulus while filtering out a range of other stimuli, much the same way that a partygoer can focus on a single conversation in a noisy room

Spatial Localization.

A normal human can localize quite accurately the source of the sound. One knows from what direction the sound is coming; one knows where to turn one's head to look for a speaker; as one knows where to look for an aeroplane or a bird. There are specific neurons which deal with this in the mid brain.

On and Off Sounds

Hearing has an alerting function especially to warning signals of all kinds. There are brain cells which respond only to the onset of a sound and others which respond only to the switching off of the sound, i.e. a change. Think only of being in an air conditioned room when the air conditioner turns on, one notices it. After a while it blends into the background and is ignored. When it switches off, again one notices it for a short time and then too the absence of sound blends into the background. These cells allow the ear to respond to acoustic change - one adjusts to constant sound - change is immediately noticeable. This is true too with machinery and a trained ear notices change.

Interaction of Sound Stimuli with Other Parts of the Brain

Sound stimuli produce interaction with other parts of the brain to provide appropriate responses. Thus, a warning signal will produce an immediate general reaction leading to escape, a quickening of the heart rate, a tensing of the muscle and a readiness to move. A baby's cry will alert the mother in a way it does not alert others. The sound of martial music may lead to bracing movement of those to whom it is being played and induce fear and cowering in the hearts and minds of those at whom it is being played. Certain sounds can evoke anger, others pleasure. The point is that the sensations produced by hearing are blended into the body mechanism in the central nervous system to make them part of the whole milieu in which we live.

Assessment activity

1.Draw and label the tympanum using the following definitions given below

- The part of the tympanum which is opposite to the tympanic membrane.
- The part of the tympanum which is above the tympanic membrane.
- The part of the tympanum which is below the tympanic membrane.
- The lateral wall of middle ear cavity is formed by
- The structure in the middle ear that communicates with the nasopharynx

2. Draw a diagram indicating the articulations of ear Ossicles

3. Label the middle ear using the following terms given below

a)Tympanic membrane
b) Malleus ,Incus, Stapes
c) Tensor tympanimuscle,Stapedius muscle

4. Draw and label the diagram showing the structure of central auditory pathway

5. Complete the block diagram showing the conduction of high frequency sound across the ear

List of items in the portfolio

1. Coloured charts showing the structure of ear

2. Models of ear

3. Practical log

4, Assignment on theories of hearing

Unit 3.3 HEARING LOSS

This unit deals with different types of hearing losses and some of the most common causes. The aim of this unit is to develop an idea about defect in the auditory system leading to hearing loss.

Concept/ skills	Learning outcome	Process /learning experience	Evaluation

Hearing loss • Definition • Types of hearing loss **Skills :** • **Communication** • **Observation** • **Comparison** • **Analysation** **Classification**	• defines hearing loss • Classifies hearing loss based on pathology • Compares different types of hearing loss • analyses the different causes of conductive, sensory, neural,mixed and central hearing loss • Differentiates congenital/acquired, prelingualvs post lingual hearing loss • defines N.I.H.L and presbycusis • compares organic and non organic hearing loss	• Discussion • Case study • Assignment • Data collection	• Participation in discussion • Quality of assignment • Collected data • Activity log • Portfolio
Degree of hearing	• compares types of hearing loss based on	• Discu	• Questi

loss • Mild • Moderate • Severe • Profound **Skills :** • **Classification** • **Communication** • **Analysing**	severity • classifies hearing loss based on degree of hearing loss • t differentiates mild, moderate, moderately severe, severe and profound hearing loss • analyses different degrees of hearing loss • Analyses the configuration of hearing loss • Compares unilateral/bilateral,symmetrical /asymmetrical,progressive /sudden , fluctuating /stable hearing loss	ssion • Case study • Assignment • Chart preparation showing degrees of hearing loss	ons • Participation in discussion • Activity log • Chart • Quality of Assignment

Concept/ skills	Learning outcome	Process /learning experience	Evaluation
Audiogram • Notations used • Patterns of	• Identifies audiogram and its significance • Identifies the	• Demonstation • Discussion • Chart preparation	Participation in discussion Questions

audiogram Effects of hearing loss on development Skills • Observation • Identification • Differentiation Comparison Analyzing	notations used for plotting audiogram • Compares the different patterns of audiogram • Evaluates audiogram patterns • Predicts the effects of hearing loss on development	• Data collection during OJT/Field visit Assignment	Prepared charts Portfolio Activity log Assignment

Additional Information

SOME IMPORTANT FACTS ON DEAFNESS

There are 360 million people in the world with disabling hearing loss

This is around 5% of the world's population - 32 million of these people are children. Disabling hearing loss is defined as:

- adults (15 years and older): hearing loss greater than 40 decibels (dB) in the better hearing ear;
- children (0 – 14 years of age): hearing loss greater than 30 dB in the better hearing ear.

Chronic ear infections are a leading cause of hearing loss

The global prevalence of chronic otitis media (COM) or chronic ear infections ranges from 1-46% in developed and developing countries. COM leads to hearing loss and can cause life-threatening complications and mortality. COM is largely preventable. It can be managed effectively through medical and surgical means.

Noise is a major avoidable cause of hearing loss

Occupational noise-induced hearing loss has become the most compensated occupational hazard. The risk of recreational noise, such as that from music and other entertainment sources, is increasing globally among young people. It is estimated that 1.1 billion people are at risk of developing hearing loss due to unsafe listening practices.

Hearing loss can be due to the use of ototoxic medications

The use of some commonly prescribed medications such as aminoglycosides and anti-malarial drugs can lead to irreversible hearing loss. This can be prevented through the rational use of drugs and raising awareness amongst health-care providers about the potential risks of these drugs for hearing loss.

Up to 5 of every 1000 infants are born with or develop disabling hearing loss in early childhood

Early detection and management are important in providing appropriate support for deaf and hearing-impaired infants and toddlers that will help them enjoy equal opportunities in society.

Nearly 1 out of every 3 people over 65 years are affected by hearing loss

Left untreated hearing loss affects communication and can contribute to social isolation, anxiety, depression and cognitive decline. Age-related hearing loss can be managed effectively through a variety of means, including hearing aids.

About 20% of people with hearing loss would benefit from devices such as hearing aids and cochlear implants

It is estimated that there are 56 million potential users who would benefit from the use of a hearing device. However, the production of hearing aids, for example, meets only 10% of global need, and 3% of developing countries' need.

Sign language facilitates communication with deaf people

Deaf and deaf-blind people often use sign language. Sign languages differ across cultures, but they are legitimate languages, with their own vocabulary and grammar. Family members, medical professionals, teachers and employers should be encouraged to learn signs/sign language in order to facilitate communication with deaf people

50% of hearing loss is preventable through public health actions

These include:

- immunization
- healthy ear and hearing care habits
- effective treatment for both acute and chronic ear conditions.

Raising awareness is essential for effective ear and hearing care

There is a need to raise awareness within and among:

- communities
- health professionals
- policy-makers
- international partners.

WHO International Ear Care Day: 3 March

International Ear Care Day is an annual advocacy event held on 3 March. Designated at the First International Conference on Prevention and Rehabilitation of Hearing Impairment in Beijing, China in 2007, the Day aims to raise awareness and promote ear and hearing care across the world. Each year, this Day addresses a specific theme and activities are carried out by WHO and its partners.

Hearing loss and deafness

A person who is not able to hear as well as someone with normal hearing – hearing thresholds of 25 dB or better in both ears – is said to have hearing loss. Hearing loss may be mild, moderate, severe or profound. It can affect one ear or both ears, and leads to difficulty in hearing conversational speech or loud sounds.
'Hard of hearing' refers to people with hearing loss ranging from mild to severe. They usually communicate through spoken language and can benefit from hearing aids, cochlear implants and other assistive devices as well as captioning. People with more significant hearing losses may benefit from cochlear implants.
'Deaf' people mostly have profound hearing loss, which implies very little or no hearing. They often use sign language for communication.

Causes of hearing loss and deafness

The causes of hearing loss and deafness can be divided into congenital causes and acquired causes.

Congenital causes

Congenital causes may lead to hearing loss being present at or acquired soon after birth. Hearing loss can be caused by hereditary and non-hereditary genetic factors or by certain complications during pregnancy and childbirth, including:

- maternal rubella, syphilis or certain other infections during pregnancy;
- low birth weight;

- birth asphyxia (a lack of oxygen at the time of birth);
- inappropriate use of particular drugs during pregnancy, such as aminoglycosides, cytotoxic drugs, antimalarial drugs and diuretics;
- severe jaundice in the neonatal period, which can damage the hearing nerve in a newborn infant.

Acquired causes

Acquired causes may lead to hearing loss at any age, such as:

- infectious diseases such as meningitis, measles and mumps;
- chronic ear infections;
- collection of fluid in the ear (otitis media);
- use of particular drugs, such as some antibiotic and antimalarial medicines;
- injury to the head or ear;
- excessive noise, including occupational noise such as that from machinery and explosions, and recreational noise such as that from personal audio devices, concerts, nightclubs, bars and sporting events;
- ageing, in particular due to degeneration of sensory cells;
- wax or foreign bodies blocking the ear canal.

Among children, chronic otitis media is the leading cause of hearing loss.

Impact of hearing loss

Functional impact

One of the main impacts of hearing loss is on the individual's ability to communicate with others. Spoken language development is often delayed in children with deafness.
Hearing loss and ear diseases such as otitis media can have a significantly adverse effect on the academic performance of children. However, when opportunities are provided for people with hearing loss to communicate, they can participate on an equal basis with others. The communication may be through spoken/-written language or through sign language.

Social and emotional impact

Limited access to services and exclusion from communication can have a significant impact on everyday life, causing feelings of loneliness, isolation and frustration, particularly among older people with hearing loss.
If a person with congenital deafness has not been given the opportunity to learn sign language as a child, he or she may feel excluded from social interaction.

Economic impact

In developing countries, children with hearing loss and deafness rarely receive any schooling. Adults with hearing loss also have a much higher unemployment rate. Among those who are employed, a higher percentage of people with hearing loss are in the lower grades of employment compared with the general workforce. Improving access to education and vocational rehabilitation services, and raising awareness especially among employers about the needs of people with hearing loss, would decrease unemployment rates among this group.
In addition to the economic impact of hearing loss at an individual level, hearing loss substantially affects social and economic development in communities and countries.

Prevention

Half of all cases of hearing loss can be prevented through primary prevention. Some simple strategies for prevention include:

- immunizing children against childhood diseases, including measles, meningitis, rubella and mumps;
- immunizing adolescent girls and women of reproductive age against rubella before pregnancy;
- screening for and treating syphilis and other infections in pregnant women;
- improving antenatal and perinatal care, including promotion of safe childbirth;
- following healthy ear care practices;
- screening of children for otitis media, followed by appropriate medical or surgical interventions;
- avoiding the use of particular drugs which may be harmful to hearing, unless prescribed and monitored by a qualified physician;
- referring infants at high risk, such as those with a family history of deafness or those born with low birth weight, birth asphyxia, jaundice or meningitis, for early assessment of hearing, prompt diagnosis and appropriate management, as required;
- reducing exposure (both occupational and recreational) to loud sounds by raising awareness about the risks; developing and enforcing relevant legislation; and encouraging individuals to use personal protective devices such as earplugs and noise-cancelling earphones and headphones.

Identification and management

Early detection and intervention are crucial to minimizing the impact of hearing loss on a child's development and educational achievements. In infants and young children with hearing loss, early identification and management through infant hearing screening programmes can improve the linguistic and educational outcomes for the child. Children with deafness should be given the opportunity to learn sign language along with their families. Pre-school, school and occupational screening for ear diseases and hearing loss is an effective tool for early identification and management of hearing loss.

People with hearing loss can benefit from the use of hearing devices, such as hearing aids, cochlear implants, and other assistive devices. They may also benefit from speech therapy, aural rehabilitation and other related services. However, global production of hearing aids meets less than 10% of global need and less than 3% of developing countries' needs. The lack of availability of services for fitting and maintaining these devices, and the lack of batteries are also barriers in many low-income settings. Making properly-fitted, affordable hearing aids and cochlear implants and providing accessible follow-up services in all parts of the world will benefit many people with hearing loss.

People who develop hearing loss can learn to communicate through development of lip-reading skills, use of written or printed text, and sign language. Teaching in sign language will benefit children with hearing loss, while provision of captioning and sign language interpretation on television will facilitate access to information.

Officially recognizing national sign languages and increasing the availability of sign language interpreters are important actions to improve access to sign language services. Human rights

legislation and other protections can also help ensure better inclusion for people with hearing loss.

Age-Related HearingLoss

People lose their hearing when they age because of changes in the entire hearing system. Hearing loss due to the aging process is called Presbycusis. In most cases, hearing loss happens slowly over time. It usually happens in both ears and may affect the person's ability to understand speech.

Some people may not admit they are having trouble hearing. Denial is the most important barrier to hearing aid use .The following are some of the most common reasons that older people give for not using a hearing aid:

Everyone is mumbling, or they are not speaking up

My hearing is not bad enough for a hearing aid.

It would make me feel old, or I'm too ashamed to wear one.

They cost too much.

People with hearing loss that is not treated are more likely to experience depression and worry compared to those who wear hearing aids.

Hearing loss that is not treated may have serious emotional and social effects on older adults by:

a . cutting them off from family members and friends,

b . limiting social activities,

c . lowering their feeling of good health.

Role of family members

Hearing loss affects not only the person with hearing loss but often family members as well. There are some simple things that family members and friends can do to help an older adult carry on a normal conversation:

a. Speak clearly and in a normal tone of voice.

b. Don't shout. Shouting just makes it harder for the person with hearing loss to understand.

c. Get the person's attention before speaking.

d. Keep your hands away from your mouth.

e. Talk in quieter places.

f. Build breaks into your conversation

Swimmer's Ear (Otitis Externa)

Swimmer's ear is an infection of your outer ear canal. Swimmer's ear can be caused by:

- Moisture trapped in the ear canal
- An injury to the ear canal

Swimmer's ear can be painful. It can happen to children or adults..

Symptoms include:

- Redness and swelling of the outer ear and ear canal
- Pain when you touch your ear
- Drainage from the ear canal
- Itchiness inside the ear

The best way to avoid an infection is to keep the ear canal dry. Here are some tips to keep the ears dry and healthy:

- Dry ears well with a towel after swimming or bathing.
- Tilt head to drain water from ears. Pull the earlobe to straighten out ear canal and let the water out.
- If ears still seem wet, try using a hair dryer on low and hold it several inches from ear until your feel dry.
- Wear earplugs if swim a lot.
- Don't put anything in ears. Cotton swabs, fingernails, and pointed objects can scratch ear canal. This can make it easier to get an infection.
- Earwax helps protect ears from infection .Consult a doctor to safely remove earwax if wax build up.

Assessment Activity

1. Complete the table given below

Conductive hearing loss	Sensory neural hearing loss
• Ear wax accumulation • • • •	• Head injury • • • •

2.Complete the table

Conductive hearing loss	Defect in external and middle ear
Sensory hearing loss	
Neural Hearing Loss	
Mixed hearing loss	
Central hearing loss	

3.4 HEARING ASSESSMENT

Over view

Hearing assessment is very important for the proper diagnosis of hearing loss and for selecting the proper hearing aid. It involves hearing evaluation using case history and doing pure tone audiometry. Pure tone audiometer is the electronic device which is widely used for testing hearing. It helps us to provide subjective information about a patients hearing loss. It also identifies a person's ability to hear speech. There are various types of hearing tests available, including Pure tone audiometry and speech audiometry.

Audiometer Instrumentation Skills Observation, identification differentiation	• Identifies the parts of audiometer and their functions • Lists the different parts of audiometer	• Demonstration of parts • Discussion • Block diagram preparation • Model preparation • Data collection	• Participation in discussion • Evaluation of charts and models • Portfolio

		during OJT/field visit	

Concept/ skills	Learning outcome	Process /learning experience	Evaluation
Diagnostic vs. Screening Audiometer • Types of Audiometre • Screening • Diagnostic audiometer **Skills :** • **Observation** • **Comparison** **Identification**	• differentiates the use of screening and diagnostic audiometer	• Discussion • Demonstration • practicals	• Questions • Activity log • Practical assessment

Case history evaluation and its importance ➢ Case history Performa ➢ Importance of case history **Skills :** • **Communication** • **Observation** • **Decision making**	• collects necessary information for preparing case history which leads to diagnosis • explains the importance of case history evaluation in audiometric testing • predicts the need for management of the patient	• Demonstration of Performa • Filling of Performa • Data collection	• Questions • Assignment • Evaluation of collected data • Activity log
Tuning fork test • Rinne test • Weber test • Absolute Bone Conduction test **Skills:** • **Observation** • **Identification**	• explains different T.F test • identifies the principle and procedure of different T.F.T • Performs the T.F test • Compares the	• Demonstration • Discussion • Practical • Chart preparation	• Participation in discussion • Practical evaluation • Evaluation of charts • Activity log

• **Comparison** • **Differentiation** • **Communication**	results obtained in different tests		

Assessment activity

1. Identify the parts of audiometer

2. Prepare a format of case history

3. Preparation of case history under guidance

4. Demonstration of various tuning fork tests

5. Prepare a chart showing the results of tuning fork test

List of items in port folio

- Chart showing block diagram of Audiometer
- Prepared notes and diagrams about the audometer
- Collected data about different types of audiometers
- Practical log

Extended activity

1. Conduct a seminar on the impact of noise pollution

2. Visit an Audiology Lab and prepare a note on the structure of sound treated room.

3.Prepare a power point presentation about the structure of ear

4.Observe the voice quality in the speech conductive and sensory neural hearing loss

5. Collection of case histories of different types during OJT

6. Conduct awareness programmes on international ear care day

Module 4

Overview

MODULE 4 – BASICS OF PRACTICAL AUDIOMETRY

Hearing testing is very important for identifying hearing loss and for the proper rehabilitation. After getting information about the basics of audiology, there is a need to develop skill in practical audiometry. Practical audiometry involves a battery of tests. This includes basic tests and special tests. Audiological test methods, like various other clinical investigations, can be categorised into behavioural, subjective and objective techniques. The behavioural and subjective classes are often grouped as one.

Behavioural methods involve monitoring the patients' reactions to auditory stimuli. The response may be involuntary, e.g. when using the distraction technique an infant will instinctively turn to locate a sound of interest. It may also be voluntary.

Subjective methods require the patient to volunteer a response, such as in pure tone or speech audiometry.

Objective hearing tests require only passive co-operation from the participant. These tests which may be performed to gain insight into the potential causes of the abnormality include*, tympanometry, otoacoustic emissions (OAEs)and electophysiological testing (BERA).*

This module gives us basic awareness about these audiological tests.

Once hearing loss is identified, next step is rehabilitation. In case if surgical or medical treatment is not effective, then the audiologist will suggest hearing aid. Hearing aid technology has advanced so fast that, they are available in a wide variety and range. There are permanent implants like cochlear and middle ear implants, which actually replaces the lost function of ear. For proper fitting of hearing aids, particularly for Behind The Ear (BTE) type, an ear mould is essential. An earmould is a device worn inserted into the ear for sound conduction or ear protection. Thus this module gives information about various audiological tests, hearing aids, cochlear implants and ear moulds.

Pure Tone Audiometry

Over view

Pure Tone Audiometry is an important investigation for auditory dysfunction. It not only gives an idea about the hearing handicap and the degree of hearing loss but it is also a valuable method for diagnosing ear diseases. Pure tone audiometry is a subjective method for the assessment of hearing loss.The procedures undertaken in this study involves diagnostic air conduction and bone conduction testing ,free field screening and play audiometry for estimation of hearing loss. Masking procedures that are adopted in PTA are to ensure that the thresholds obtained by PTA are of test ear itself.The calibration procedures are instrumental and biological , which ensures that the hearing measurements undertaken are carried out in exact measures.

Concept/ skills	Learning	Process	Evaluation

	outcome	/learning experience	
Puretone Audiometry Clinician's and patients role in testing • Case history • Clinicians role in recording • Ear examination • Seating of the patient while testing • Instructions to the patient • Headphone placement/ free field speaker • Frequency selection • **Skills:** • **Communication** • **Observation** • **Decision making**	• recognize se the strategies adopted in pure tone testing • chooses the frequency ,intensity method for test procedure • explains method of placing headphone for pure tone testing	• Demonstration • Practical • Role-play	• Questions • Practical evaluation • Evaluation of role play
Techniques of pure tone audiometric testing • Air conduction testing	• experiments the strategies for air conducti	• Practical Demonstration • Practicals • Plotting	• Evaluation of Practical procedure

• Bone conduction testing • Audiogram • Plotting and interpretation • Free field • Play Audiometry **Skills :** • **Observation** • **Communication** • **Experimenting** • **Analyzing** • **Reporting**	on and bone conduction testing • records air conduction and bone conduction threshold • analyzes the air conduction and bone conduction threshold obtained • record saudiograms using the symbols • writes the interpretation of the results of pure tone	audiogram	• Evaluation of audiograms and results • Practical log

	audiometer • Explains free field and play audiometry		
Masking: • Definition • Need for masking • Minimum masking • Effective masking • Over masking **SKILLS:** • Identification • Differentiation • Observation	• defines masking • Identifies the need of masking • Differentiates minimum masking, effective masking and over masking • Practices masking in laboratory	• Demonstration • Discussion • Practical	• Questions • Participation in discussion Evaluation of practical procedure
Calibration of audiometer • Biological calibration • Instrumental calibration **Skills:** • Observation	• identifies the need of calibration • performs calibration of	• demonstration • discussion • practical	• activity log • participation in discussion • performance in practical

• Identification • communication	audiometer • explains calibration of audiometer		s

Additional information

Patients and Clinicians Role in Testing

Patient information:

The examiner must establish a good rapport with the patient before the test begins. This will enable the examiner to obtain a reliable case history and to study the patient's communicative behaviour. Overall impairment of the patient can be made by varying the vocal intensity during questioning.

Ear canal examination :

The ear canals are not occluded with debris such as cerumen or cotton. This should be confirmed by the examiner, using an otoscope. The examiner should trained in this procedure so that the tympanic membrane can be visualized easily and quickly.

Instructions to the patient:

The examiner must be sure that the following points are clearly understood by the patient

a) The aim of test is to faint the faintest tones the listener can hear

b) The different tone pitches will be heard in only one ear at a time .

c) An immediate physical response should be made each time a tone is heard , even when very faint

d)The motor response should cease immediately after tone cessation.

Response Strategy

The patient must raise and lower the forearm/hand/ finger or use a patient signal switch that activates a light visible to the examiner.

Ear phone placement

The patient must remove eye glasses, ear jewelry, hearing aids or chewing gum.

The position of ear phones are maximally extended on the head band before placement to provide adequate room for the patients head

The head phones are placed according to the universal colour codes (red for right ear & blue for left ear)

Ear phones should not be hand held during the test because the pressure and position can easily vary over time, and also an undesirable low frequency energy can be transmitted to the ear canal through contact with the hand .

Ear selection

The test should begin with the ear that appears more sensitive .

Frequency selection :

Threshold test usually begins at 1000 Hz because of following reasons

a) Pitch familiar to most listeners

b) Threshold levels obtained at this frequency tend to be more reliable

c)Test retest reliability is maximum at 1000 Hz

Listener position :

If threshold tests are conducted in single room, the patient must be seated so that movement of the examiner cannot be directly observed but those of the patient are visible to the examiner.

Listener familiarization:

Initial presentation at 30db for every listener. If the tone is heard the test is begun. If not the tone is presented 20db higher. If still inaudible a 10db increase is recommended until a response is obtained.

OR

Begins at the minimum audiometer hearing level. The level of a signal is gradually increased until a response first detected . The tone is then turned off for a minimum of 2 second and presented again at the same level. If a response occurs, the test can begin at that intensity

Assessment activity

1. Evaluate the performance of students in conducting puretone audiometry
2. Plotting audiograms with their interpretation
3. Patient handling
4. Preparation of calibration charts

List of items in portfolio

1.Practical log

2. Audiogram of normal cases (10)

3. Data collected during OJT(audiogram patterns)

4. Calibration charts

4.2 Special Test of Hearing

OVERVIEW

The pure tone special tests of hearing was developed for the purpose of differentiating between cochlear and retrocochlear pathologies in cases of hearing loss such as recruitment or tone decay.The most common special test are ABLB,SISI and TDT

Concept/ skills	Learning	Process	Evaluation

	outcome	/learning experience	
Special tests of hearing • Loudness recruitment • Definition • Test to identify recruitment SI SI test ABLB test Tone decay Test **Skills:** • **Communication** • **Observation** • **Identification recording**	• defines recruitment • Identifies the different test to find out recruitment • Explains the different test procedures of recruitment • practices ABLB, SISI and tone decay test • analyze s the test results of ABLB, SISI and tone decay test	• Group discussion • Practical demonstration • Performing ABLA,SISI& TDT in lab	• Participation in discussion • Questions • Performance in doing ABLB,SISI & TDT • Practical log

Assessment activity

1. Which are the increments used in SISI test?

2. Which intensity increment is used for evaluation in the SISI test?

3. In which order one dB increments are presented for SISI test ?

4. Draw ladder gram for the ABLB Test conducted

5. Performance in conducting SISI, ABLB, Tone decay

6. Laddergrams

List items in Portfolio

Practical log

Data collected during OJT/Field visit

Laddergrams

4.3 Speech Audiometry

Overview

Speech audiometry has become a fundamental tool in hearing-loss assessment. In conjunction with pure-tone audiometry, it can aid in determining the degree and type of hearing loss. Speech audiometry also provides information regarding discomfort or tolerance to speech stimuli and information on word recognition abilities.

The information gained by speech audiometry helps to determine proper gain and maximum output of hearing aids and other amplifying devices for patients with significant hearing losses and help assess how well they hear in noise. Speech audiometry also facilitates audiological rehabilitation management.

Speech audiometry • Need for speech	• Identifies the		• Participation in

audiometry • Test environment **Skills:** • **Identification** • **Communication** Speech detection threshold SDT Speech reception threshold (SRT) test **Skills:** • **Identification** • **Recording** • **Communication** • **Analyzing**	importance of speech audiometric test • chooses the right test environment • Recognizes the various parameters associated with speech audiometry • Identifies the significance of SDT • identifies the significance of SRT test • Explains the procedure of SRT test • Analyzes the SRT of each	• Demonstration • Discussion • Practical demonstration • Performing SRT test • Practicing SRT test • Interpretation of test results • Practical demonstrati	discussion • Activity log • Performance in practical • Practical log • Evaluation of test results

Speech discrimination score **Skills:** • **Identification** • **Communication** • **Recording** • **Analysing**	ear • Identifies the significance of SD test • explain s the procedure of speech discrimination test • Records SD score of each ear • analyzes the SD score	on of SD test • Practicing SD test • Interpretation of test results	• Performance in practical • Practical log Evaluation of test results
Most comfortable loudness(MCL) Uncomfortable loudness(UCL) Dynamic range(DR) • Definitions • Significance • Tests **Skills :** • **Observation** • **Analyzing**	• defines MCL,UCL &DR • explains the significance of MCL, UCL, DR • records MCL, UCL,	• Group discussion • Practical demo • Recording of MCL, UCL • Compute DR	• Participate in discussion • Questions • Performance in recording • Evaluation of test results • Practical log

• **Communication** • **Recording**	• Analyzes DR		

Assessment activity

1. 'X' has SDS of 40% and 'Y' has SDS of 10%. Assessing the discrimination score. Find out the one which is suspected to have a retro cochlear lesion.
2. In your practical classes, do a pure tone audiometry and SRT in a patient and find out the PTA- SRT correlation is following or not.
3. With the help of your teacher, visit an audiology clinic and observe a two room audio booth. Write a note in your activity log.

List of items in portfolio

Practical log

List of spondaic words

List of PB words

Collected data during OJT

4.4 OBJECTIVE TESTS OF HEARING

Overview

Objective tests of hearing require no voluntary indication from the patient that an auditory stimulus has been perceived. It is possible, however, for the patient to influence the results by interfering with the procedure. Objective tests are not a measure of hearing as such; they assess the integrity at various levels of the auditory pathway but not its entirety. It also helps us to test difficult to test population i.e. children, disabled persons, malingerers etc.

Objective hearing tests include:

- **Otoacoustic emission testing** – to check the function of the tiny hairs in the cochlea. The faint sound made by the hairs in response to sound is called the otoacoustic emission.
- **Auditory brainstem response testing** – to check the electrical activity in the brain in response to a sound. Electrodes are placed on the head to measure the brain waves.
- **Tympanometry** – a rubber tip is inserted into the ear and air is pumped into the ear canal. This is not a test of hearing, but checks if the eardrum can move normally.

  This chapter is devoted to a brief description of objective measurements widely used in audiology- immittance audiometry,evoked otoacoustic emission and the auditory brainstem response (ABR).

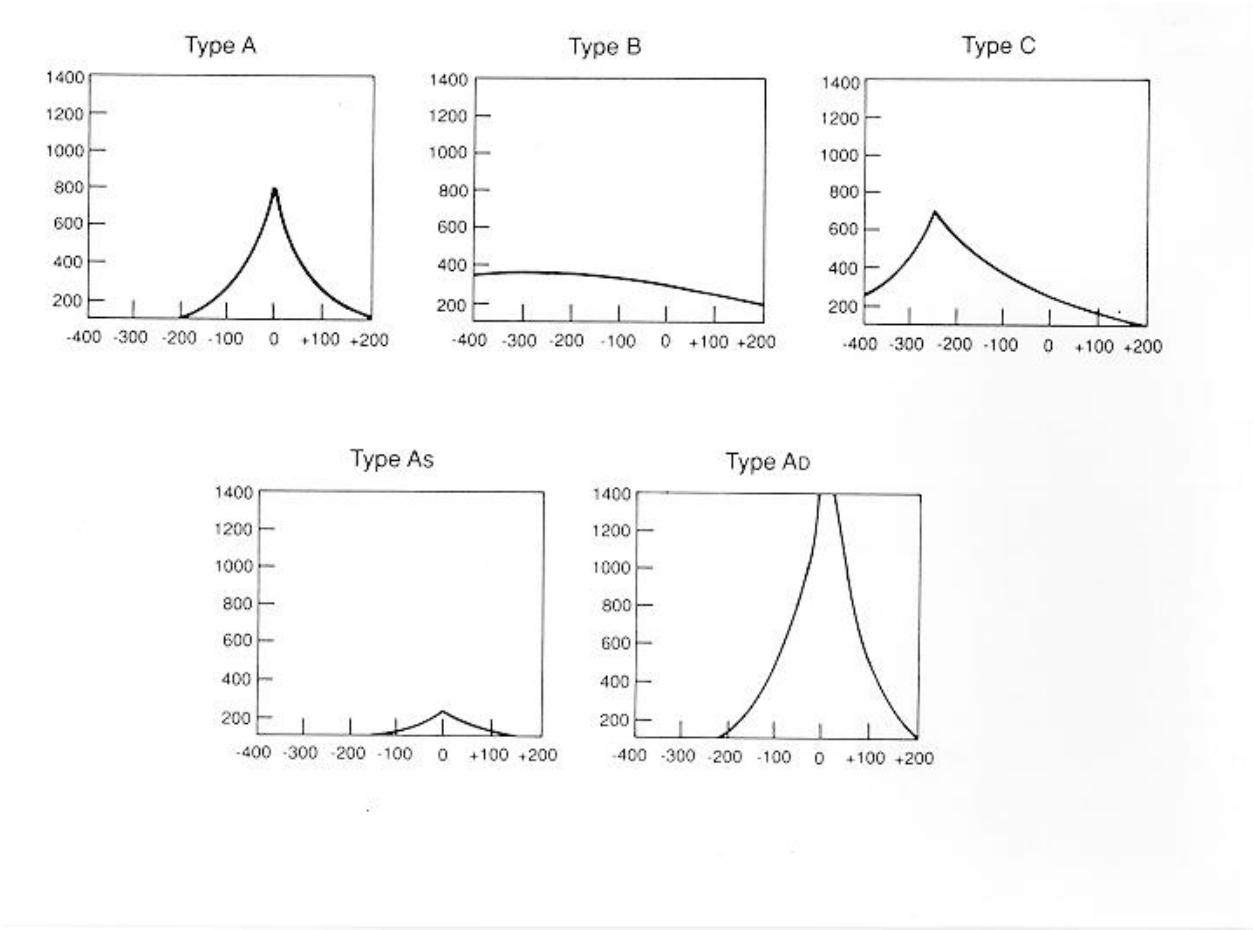
Concept/ skills	Learning outcome	Process /learning experience	Evaluation
Objective tests of audiometry • BSERA • OAE screening • Tympanomet	explainS objective audiometry • Identifies the	• Discussion • Observation of procedures during field visit or OJT	• Participation in discussion • Evaluation of OJT or field visit report

ry • Reflexometry **Skills:** • Communication • Identification • Comparison	significance of objective audiometry • defines BSERA • identifies the significance of SERA • Explains the procedure in brief and BSERA graph familiarization • Defines OAE • Identifies significance of OAE • Explains procedure in brief and familiarization of test results • Defines the principle	• Interaction with experts • Data collection • Assignment Drawing of different types of tympanograms- A, Ad, As, B, C	• Participation in interaction • Activity log • Portfolio • Assignment

	of Tympanometry • Identifies the parts and functions of tympanometer • Explains the procedure of Tympanometry • compares different tympanograms i.e. middle ear compliance /impedance, middle air pressure and AMR threshold		• Interpretation of various types of tympanograms

Additional Information

Different types of tympanograms



Assessment activity

1. Eustachian tube dysfunction causes -Ve pressure in Middle ear. Mention tympanogram type with diagram
2. Draw a tympanogram of condition showing fluid in Middle ear
3. Draw different types of tympanogram and mention the ear conditions associated with each of them.

List items in Portfolio

Activity log

Tympanograms

Data collected during OJT about Objective tests

4.5 Hearing Aids and Ear moulds

Overview

Hearing aids, or hearing instruments, are typically prescribed to people who have some residual hearing, and physically normal and healthy ears, and are available in a wide range of styles.

The main function of the hearing aid is to provide audibility of a wide range of sounds without making them uncomfortably loud to the hearing aid user. In order to achieve this, the hearing aid comprises as a minimum a microphone that picks up surrounding sounds, an amplifier that increases the level of sounds depending on the input level, and a receiver that delivers the amplified sound to the ear. To operate, the hearing aid needs power that it gets from a battery. Most modern

hearing aids are digital, which means that the analogue signal picked up by the microphone is converted to digital form.

Hearing aids are fitted with proper ear moulds, preferably custom ear moulds.

This unit deals with different types of hearing aids, characteristics of hearing aids ,cochlear implants and earmoulds.

Concept/ skills	Learning outcome	Process /learning experience	Evaluation
Hearing aids and ear mould • Definition • Parts of hearing aid • Characteristics of hearing aid • Classification of hearing aid **Skills:** • **Communication** • **Observation** • **Identification** • **Comparison**	• defines hearing aid • Identifies the parts and functions of hearing aid • Explains the characteristics of hearing aid • classifies, categories hearing aid • Evaluates the merits and demerits of AC and BC hearing	• Discussion • Demonstration using photos and models • Drawing of block diagrams • Assignments • Data collection during OJT or field visit • Quiz Reference	• participation in discussion • questions • assignment • OJT or field visit report • Performance in quiz

	aid • decides the factors to be considered while selecting a hearing aid • compares advantages of binaural hearing aid over monaural hearing aid, Care and maintenance of hearing aid		
Ear mould • Definition • Need • Types • Custom ear moulds Skills: • **Communication** • **Observation** • **Identification** • **Classification**	• defines ear mould • Recognizes the need of ear mould • identifies the merits and	• Discussion • Demonstration • Data collection during OJT or field visit • Seminar	• Participation in discussion • Questions • portfolio • Seminar report

	demerits of different types of ear moulds		

Additional information

cochlear implant

A cochlear implant is a small electronic device consisting of surgically implanted internal components with an externally worn speech processor. An implant has four basic components:

- Microphone
- Speech processor
- Transmitter and receiver/stimulator
- Electrodes

At this time, a cochlear implant will **not** provide normal hearing. However, it can give children and adults with significant hearing loss useful auditory information for improved communication and awareness of their environment.

The microphone in the cochlear implant picks up sound and sends it to the speech processor, which arranges the sound for delivery to the transmitter/receiver. The transmitter converts this sound signal to an electrical signal, which is collected by the internal receiver (just under the skin) and sent to the electrodes. The receiver instructs certain electrodes to activate inside the cochlea (the end organ of hearing). This activation sends the electrical signal to the brain, where it is interpreted as sound and decoded.

Candidacy for an implant is based on two primary factors:

- Severity of the hearing loss
- Inability of the patient to recognize speech with or without hearing aids

Cochlear implant surgery typically lasts between 3 and 5 hours and may be done on either an outpatient or inpatient basis. It will include the patient being given general anesthesia, a surgical cut and drilling of the skull just behind the ear into the mastoid bone to access the inner ear (the cochlea) insertion of the electrodes into the cochlea, and placement of the receiver in the temporal bone, above the mastoid bone. Most patients return to their normal activities within a few days of surgery

Assessment activity

1. Identify the different types of hearing aids

2. Identification of different types of ear mould

List of items in portfolio

- Discussion points and notes related to the unit
- Data collected during OJT and field visit related to recent advances in hearing aid technology
- Photos and diagrams
- Block diagrams

Extended Activities

- Screening of hearing impaired in normal school under expert guidance
- Participation in medical camps for handicapped conducted by medical experts
- Visit a hearing aid centre and interact with the experts.

On the Job Training

As ECG & Audiometric Technology course is in the group of Allied Health Sciences, the activities which has to be performed is not limited in the class room. To fulfill the learning outcomes the students must be exposed to on the job training.

OJT helps the students

- To develop vocational skill
- To develop personal qualities.
- To develop values, attitudes and interests.
- To apply their knowledge in real situations
- To develop a professional attitude

The OJT can be given at the end of the forth module for 15days each. It can be decided according to the facility and convenience ofthe school and OJT centers. The OJT centers can be

Primary health centers with the facility of ECG recording

Government and private hospital

Recognized clinical labs.

Hearing aid distributing centres

Audiology Labs

References

Human Anatomy-Head Neck & Brain ,B D Chaurasia ,volume III ,CBS Publishers and distributors ,New Delhi

Dhingra, PL (1992),Disease of Ear ,Nose & Throat. Churchill Livingstone,NewDelhi

Martin F.N.(1994).Introduction to Audiology .V .rd . NJ: Prentice Hall,

Kartz Jetal (Ed) 2002,Hand Book of Audiology,Baltmore ,Williams of Wilkins

Basand Hummes (1990) Audiology – Fundamental- Williams and Wilkins