

**Objectives:**

1. To orient the students on the technological bases of instrumentation used to assess speech, voice and swallowing.
2. To enable the students to carry out calibration, understand the working principles of instrumentation applicable to assess speech, voice and swallowing.
3. To sensitize the students on various methods of analysis of various parameters of assessment of speech, voice and swallowing.

**Outcomes:**

1. Students will be able to gain knowledge in various methods to acquire speech and swallow signals.
2. Students will be able to understand the basics of instrumentation required in analysis and interpretation of speech, voice and swallow signals.
3. Students will be able to understand the various types of tests like Electrolaryngography, Electromyography, Videofluoroscopy, Nasoendoscopy etc. to assess swallowing.
4. Students will be able to understand the purpose and need for instrumentation to assess swallowing.

**Unit 1: Signals and Systems properties (10 Hours)**

Signal Transduction, Signal types: Analog & Digital, Continuous & Discrete, Stationary and Non Stationary, Periodic & Aperiodic, Chaotic, Energy and Power signals, Voice Signals in Power and Frequency Domain. System: Continuous Time Systems, Discrete Time Systems, Linear Systems, Time Invariant Systems, Chaotic Systems, Control Systems, Instrument Systems for Measurement. Principles of Measurements: Types of Measures, Measurement Accuracy, Signal Transduction, Amplification, Calibration, Anti-Aliasing Filtering, Post Digitization Signal Processing, Measurement Accuracy & Precision, Normalization, Multiple Measures in Design of Experiments.

**Unit 2: Electrophysiology and Electromyography (10 Hours)**

Activating Muscles, Neurons, Neuromuscular Junctions, Motor units. Electromyography: Ground Electrodes, Touch Proof Connectors, Electromyographic Electrodes, Surface Electromyography of Head and Neck, Laryngeal Electromyography, Concentric Needle Electromyography, Quantitative Electromyography, Qualitative Electromyography. Measuring Muscle Activation, Recruitment and Timing, Examination Pattern of Muscle Activation, Correlating Patterns of Muscle Activation with Physiological Measures, Averaging, Swallowing Reflex Producing and Measuring Reflex Responses.

**Unit 3: Acoustic recording and Analysis of Speech (10 Hours)**

Acoustic Recordings of Speech and other Sounds, Microphones: Placement, transducer type and property, Sensitivity, Directionality, Frequency Response, Accelerometer, Preamplifiers, Amplifiers, Attenuators, Sound Level Meter, Filters, Quality Control, Recordings in clinical and natural environments. Acoustic Analysis: General principles, Theories of Speech Production, General types of Analysis, Measurement Scales, Methods of Analysis Hardware and Software used, Analog Instruments, Commonly Used Analysis, Measurement relating to laryngeal source, Formant Measurements, Measures of Timing and Segment Duration.

**Unit 4: Videofluoroscopy and Electroglottography (10 hours)**

Videofluoroscopy: Hardware and Software, Procedures and Data Analysis, Safety and Comfort. Measuring Movements during Voice, Speech and Swallowing, Spatial Dimensions and Degrees of Freedom, Principles

of Measurement of Movement, Imaging Techniques used for making movement measures.

Videofluoroscopy for studying swallowing.

Electroglottography: Hardware and Software, Procedure and Data Analysis, Safety and Comfort EGG Principles, Instrumentation, Types of Electrodes, Factors Effecting Recording.

**Unit 5: Measuring Swallowing (5 hours)**

Measuring Swallowing Disorders: Purpose of Evaluating Swallow, Need for Quantitative Measures, Qualitative

Measures of Swallowing from MBS studies, Nasoendoscopic Swallowing Evaluation, Comparisons of Nasoendoscopic

Examination and Swallowing.

**Practical:**

1. To acquire signals using Electromyography.
2. To acquire signals from swallow muscles during swallowing.
3. To record EGGs during phonation.
4. To record EGGs during swallowing.
5. To present case studies on swallowing assessments.

**Text Books:**

1. Ludlow, C., D. Kent, R. and C. Gray, L. (2019). *Measuring Voice, Speech and Swallowing in Clinic and*

*Laboratory*. 1st ed. San Diego, CA: Plural publishing, Inc.

2. Hardcastle, M. (2016). *Determination of Vocal Cord Movement Through Electroglottography*. Boston

University Academy: CreateSpace Independent Publishing Platform.

3. Code, C. and Ball, M. (1984). *Instrumentation in speech-language pathology*. San Diego, CA: College-Hill Press.