VIRTUAL UNIVERSITY OF PAKISTAN

Phonetics and Phonology

ENG507

Course Handouts

GRADUP

Practice. Pass. Graduate.

thegradup.com

Table of Contents

Lesson No.	Lesson Title	Topics	Pg. No.
Lesson No. 1	**INTRODUCTION TO THE COURSE-I**		
	Introduction to the Course	001	7
	Why Studying Phonetics and Phonology?	002	7
	Focus Language - English	003	8
	Aims and Objective of the Course	004	8
	Evaluation Criteria for the Course	005	8
	Introduction to Vowels and Consonants	006	8
Lesson No. 2	**INTRODUCTION TO THE COURSE-II**		
	Introduction to English Vowels	007	9
	Introduction to English Diphthongs	008	9
	Introduction to English Consonants	009	10
	IPA Transcription of English Sounds	010	11
	Introduction to Phonology	011	11
	Introduction to Phonetics	012	11
Lesson No. 3	**INTRODUCTION TO KEY CONCEPTS IN PHONETICS AND PHONOLOGY (P&P)-I**		
	Phonetics vs. Phonology	013	12
	Introduction to Key Concepts in Phonetics and Phonology	014	12
	Types of Phonetic Studies	015	13
	Articulatory Phonetics	016	13
	Acoustic Phonetics	017	14
	Auditory Phonetics	018	14
Lesson No. 4	**INTRODUCTION TO KEY CONCEPTS IN PHONETICS AND PHONOLOGY (P&P)-II**		
	Experimental Phonetics and Phonology	019	15
	Generative Phonology	020	15
	Articulatory Phonetics-I	021	16
	Speech Production	022	16
	Sound Waves	023	17
	The Oro-Nasal Process	024	17
Lesson No. 5	**ARTICULATORY PHONETICS-II**		
	Articulatory Gestures	025	18
	Manners of Articulation	026	18
	Stop: Oral and Nasal	027	19
	Fricative	028	19
	Approximants	029	19
	Additional Consonantal Gestures		
	Trill, Tap and Flap		

© Virtual University of Pakistan

Lesson No. 6	The Waveforms of Consonants	032	21
	The Articulation of Vowel Sounds	033	21
	The Sounds of Vowels	034	21
	Long Vowels and Diphthongs	035	22
	Introduction to Suprasegmentals	036	22
Lesson No. 7	**PHONEMIC AND PHONETIC TRANSCRIPTION-I**		
	Why Transcribe?	037	23
	Introduction to IPA	038	23
	Explaining IPA Chart	039	24
	Transcription of Vowels	040	24
	Transcription of Consonants	041	25
	Transcription of Consonant Sounds-II: Explanation	042	25
Lesson No. 8	**PHONEMIC AND PHONETIC TRANSCRIPTION-II**		
	Broad and Narrow Transcription	043	26
	IPA Resource: The North Wind and The Sun Story	044	26
	IPA Story: Explanation	045	26
	IPA Story: Practice	046	27
	IPA Story: Broad Transcription	047	27
	IPA Story-Phonetic Transcription	048	27
Lesson No. 9	**PHONEMIC AND PHONETIC TRANSCRIPTION-III**		
	Transcription Beyond Words	049	28
	Transcription Beyond Words: Word Stress	050	28
	Transcription Beyond Words: Accent	051	28
	Transcription Beyond Words: Phrases	052	29
	Transcription Beyond Words: Rhythm and Beyond	053	29
Lesson No. 10	**THE CONSONANTS OF ENGLISH-I**		
	The Consonants of English	054	30
	Stop Consonants	055	30
	Fricatives	056	31
	Affricates	057	31
	Nasals	058	31
	Approximants	059	32
Lesson No. 11	**THE CONSONANTS OF ENGLISH-II**		
	Overlapping Gestures	060	33
	Aspects of Connected Speech	061	33
	Co-articulation	062	33
	Rules for English Consonant Allophones (ECA)	063	34
	Rules for ECA: Explanation	064	35
Lesson No. 12	**THE CONSONANTS OF ENGLISH-III**		
	Introduction to Diacritics	065	36
	Diacritics and Detailed Transcription		
	Aspiration		

	Nasalization	068	37
	Velarization	069	37
Lesson No. 13	**ENGLISH VOWELS-I**		
	Introduction to English Vowels	070	38
	Vowel Quality	071	38
	Auditory Vowel Space	072	38
	American and British Vowels	073	39
Lesson No. 14	**ENGLISH VOWELS-II**		
	Diphthongs	074	40
	Rhotic Vowels	075	40
	Unstressed Syllables	076	41
Lesson No. 15	**ENGLISH VOWELS-III**		
	Tense and Lax Vowels	077	42
	Fortis and Lenis Consonants	078	42
	Rules for English Vowel Allophones	079	42
Lesson No. 16	**ENGLISH WORDS AND SENTENCES-I**		
	English Words and Sentences	080	44
	Words in Connected Speech	081	44
	Stress	082	44
	Degree of stress	083	45
	Stress Explanation	084	45
Lesson No. 17	**ENGLISH WORDS AND SENTENCES-II**		
	Sentence Rhythm	085	46
	Intonation	086	46
	Explaining Intonation	087	47
	Target Tones	088	47
	Explaining Target Tones	089	47
Lesson No. 18	**AIRSTREAM MECHANISMS**		
	Airstream Mechanisms	090	49
	Pulmonic Airstream Mechanism	091	49
	Glottalic Airstream Mechanism	092	49
	Velaric Airstream Mechanism	093	50
	Summary of the Airstream Mechanisms	094	50
Lesson No. 19	**PHONATION**		
	Introduction to Phonation	095	51
	Phonation Explanation	096	51
	States of the Glottis	097	51
	Phonation Types	098	52
	Voicing and Consonants	099	52
Lesson No. 20	**VOICE ONSET TIME (VOT)**		
	Voice Onset Time (VOT)	100	53
	VOT Explanation		
	Importance of VOT		

	Types of VOT	103	54
Lesson No. 21	**CONSONANTAL GESTURES-I**		
	Consonantal Gestures	104	55
	Articulatory Targets	105	55
	Types of Articulatory Gestures	106	55
	Stops	107	56
	Nasals	108	57
	Fricatives	109	57
Lesson No. 22	**CONSONANTAL GESTURES-II**		
	Trills, Taps and Flaps	110	58
	Laterals	111	58
	Summary of the Articulatory Gestures	112	58
	Explaining the Summary of the Articulatory Gestures	113	59
Lesson No. 23	**ACOUSTIC PHONETICS-I**		
	Acoustic Phonetics	114	60
	Explaining Acoustic Phonetics	115	60
	Acoustic Analysis	116	60
	Acoustic Analysis of Vowels	117	61
	Source Filter Theory of Speech Production	118	61
	Explaining Source Filter Mechanism	119	61
Lesson No. 24	**ACOUSTIC PHONETICS-II**		
	Tube Models	120	63
	Explaining the Tube Models	121	63
	Perturbation Theory	122	64
	Explaining Perturbation Theory	123	64
	Explaining Acoustic Analysis (Vowels)	124	64
	Acoustics of Consonants	125	65
Lesson No. 25	**ACOUSTIC PHONETICS-III**		
	Explaining the Acoustics of Consonants	126	66
	Interpreting Spectrograms	127	66
	Useful Techniques for Interpreting Spectrograms	128	67
	Individual Differences	129	67
	Analyzing Individual Differences	130	68
Lesson No. 26	**VOWELS AND VOWEL-LIKE ARTICULATIONS-I**		
	Vowels and Vowel-like Articulation	131	69
	Cardinal Vowels	132	69
	Secondary Cardinal Vowels	133	70
	Comparing Primary VS Secondary Cardinal Vowels	134	70
Lesson No. 27	**VOWELS AND VOWEL-LIKE ARTICULATIONS-II**		
	Vowels in Other Accents of English	135	71
	Vowels in BBC English	136	71
	Vowels in Other Languages		
	Advanced Tongue Root (ATR)		

	Rhotacized Vowels	139	72
Lesson No. 28	**VOWELS AND VOWEL-LIKE ARTICULATIONS-III**		
	Nasalization in Vowels	140	73
	Summary of Vowel Quality	141	73
	Semivowels	142	73
	Secondary Articulatory Gestures (SAG)	143	74
	SAGs Discussion	144	74
	Summary of the SAGs	145	75
Lesson No. 29	**SUPRASEGMENTAL FEATURES-I**		
	Introduction to Suprasegemntal (SS) Features	146	76
	Syllable	147	76
	Explaining Syllable	148	76
	Stress as a Suprasegmental Feature	149	77
	Types and Categories of Stress	150	77
	Lexical and Emphatic Stress	151	77
Lesson No. 30	**SUPRASEGMENTAL FEATURES-II**		
	Stress Timed Languages	152	79
	Explaining Stress Timed Languages	153	79
	Syllable Timed Languages	154	79
	Explaining Syllable Timed Languages	155	80
	Pitch as a Suprasegmental Feature	156	80
Lesson No. 31	**SUPRASEGMENTAL FEATURES-III**		
	Tone and Tonal Languages	157	81
	Intonation as a Suprasegmental Feature	158	81
	Functions of Intonations	159	81
	Explaining Functions of Intonation	160	82
Lesson No. 32	**LINGUISTIC PHONETICS-I**		
	Linguistic Phonetics	161	83
	Phonetics of the Community and of the Individual	162	83
	Explaining Phonetics of the Community and of the individual	163	83
	The IPA	164	84
	Explaining the IPA	165	84
Lesson No. 33	**LINGUISTIC PHONETICS-II**		
	Feature Hierarchy	166	85
	Feature Hierarchy: Discussion	167	85
	Feature Hierarchy: Explanation	168	85
	Problems with Linguistic Explanations	169	86
	Explaining the Problem with Linguistic Explanations	170	86
Lesson No. 34	**LINGUISTIC PHONETICS-III**		
	Controlling Articulatory Movements	171	87
	Memory for Speech	172	87
	Explaining Memory for Speech		
	The Balance between Phonetic Forces		

	Explaining the Balance Between Phonetic Forces	175	88
Lesson No. 35	**PHONOTACTICS AND SYLLABIC TEMPLATES**		
	Syllabic Templates and Syllabification	176	90
	Explaining Syllabification	177	90
	Phonotactics	178	91
	Explaining Phonotactics	179	91
Lesson No. 36	**USING PRAAT-I**		
	Introduction to PRAAT	180	92
	Introduction to PRAAT Manual	181	92
	Exploring PRAAT	182	92
	Recording and Displaying	183	93
	Segmenting and Labeling	184	93
	Exporting Visual Display to Word File	185	94
Lesson No. 37	**USING PRAAT-II**		
	The Source-Filter Model of Speech	186	96
	Measuring the Fundamental Frequency	187	96
	Measuring the Harmonics	188	97
	Measuring the Formants	189	97
	Relationship Between Harmonics and Formants	190	98
Lesson No. 38	**USING PRAAT-III**		
	Vowel Properties	191	99
	Intrinsic Pitch	192	99
	Spectral Make-up (Formant Values)	193	100
	Plotting Vowels on Chart	194	100
Lesson No. 39	**USING PRAAT-IV**		
	Sonorants and Their Formants	195	101
	Nasal Formants	196	101
	Glides and Their Formants	197	101
Lesson No. 40	**Using PRAAT-V**		
	Stop Voicing on Spectrograph	198	102
	Measuring Voice Onset Time (VOT)	199	102
Lesson No. 41	**FURTHER AREASOF STUDY IN P&P [FUTURE RESEARCH AREAS]**		
	P&P Research as the Part of English Language Teaching	200	103
	Current Trends in P&P Research	201	103
	Distinctive Features	202	103
	Experimental Phonetics	203	104
	The Study of Variety	204	104
Lesson No. 42	**THE PEDAGOGY OF PHONETICS AND PHONOLOGY**		
	The Relationship between ELT and P&P	205	105
	Developing Relevant Material	206	105
	Conducting Classroom Research for ELT	207	105
	Making Research Accessible to Teachers		
	Facilitating Action Research		

Lesson-01

INTRODUCTION TO THE COURSE-I

At the end of this section, the students will be able to:

- KNOW about the overall sketch of the course including aims, objectives and the evaluation criteria for the course.

Topic-001: Introduction to the Course

Phonetics and Phonology (P&P), course code ENG507, is an introductory level module in phonetics and phonology. The course focuses on the linguistic study of speech sounds in a phonetic and phonological perspective. The phonetic component provides a detailed analysis and description of speech sounds with particular emphasis on articulatory phonetics. The phonology component examines the internal structure of simplex and complex word forms. The module is designed for beginners' level explaining the basic concepts of phonetics and phonology. In addition to reading and attending lectures, students are expected to do regular problem-solving exercises at the end of every chapter (given in the main textbook by Ladefoged and Johnson) intended to consolidate their growing understanding of phonetics, English phonology and phonological relations.

Topic-002: Introduction to the Course (Why studying phonetics and phonology?)

In a very simple sense, 'linguistics' is the study of language; how it is put together and how it functions. In other words, various building blocks of different types and sizes are combined to make up a language. For example, sounds are brought together and sometimes when this happens; they change their form and do interesting things (phonetics and phonology). Words are arranged in a certain order (syntax), and sometimes the beginnings and endings of the words are changed to adjust the meaning (morphology). Then the meaning itself can be affected by the arrangement of words (semantics) and by the knowledge of the speaker about what the hearer will understand (pragmatics). Linguistics is the study of all of these fields.

So, like other branches, such as syntax, morphology and semantics, phonetics and phonology is the branch of linguistics which deals with the human speech sounds. It is the study of the description of speech sounds such as vowels (monophthongs and diphthongs) and consonants. In this subject, we study the sets of phonemes and sound patterns (e.g., dynamic; as in connected speech, and static; as in isolation) within a human language. Among other things, expertise in phonetics and phonology enable researchers to describe spoken languages which are not yet documented thus proving very important for language documentation and language description. Similarly, it is an important field for typological studies and for cross linguistic comparisons and generalizations in terms of sound systems (languages) and their classifications.

Topic-003: Focus Language - English

The focus language for the course is English; however, examples from local languages may also be given for comparisons where necessary. Based on the Received Pronunciation (RP) i.e. British accent of the language, English sounds are described in greater detail covering the features of consonants, vowels and diphthongs. Similarly, the suprasegmental features of English are also discussed in detail. On the other hand, for greater understanding of the relevant topics, some examples from local languages such as Urdu, Punjabi, Sindhi, Pashto, etc. are also added.

Topic-004: Aims and Objective of the Course

At the end of the course, the students will be able to:

- understand how human sound is produced;
- know the physical properties of human sounds;
- study the suprasegmental features and features of the connected speech;
- have a greater awareness of IPA symbols and transcribe any kind of English text;
- prepare themselves for more advanced level course in Experimental Phonology for their detailed future research work;
- learn about the modern software used in phonological research.

Topic-005: Evaluation Criteria for the Course

The standard evaluation criteria of the university will be used for the course. There will be quizzes, assignments, Graded Discussion Board (GDB), mid-term and final-term exams covering all the important topics of the course. Transcription will also be an important part of the evaluation.

Topic-006: Introduction to Vowels and Consonants

Human sounds are divided into two broad categories: consonants and vowels. A consonant is a speech sound in which air is at least partly blocked whereas vowel is a sound in which there is no obstruction found and the air passes through the cavity freely. Moreover, a consonant is classified in terms of the places and manners of articulation and voicing whereas a vowel is classified in terms of the position of tongue, the part of tongue and lip-rounding. Vowels are further classified in terms of pure vowels (monophthongs) and diphthongs.

Further readings on this section:

- Chapter 1 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapter 2 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)
- Online sources: http://phoneticsandphonology24.blogspot.com/
  http://ec-concord.ied.edu.hk/phoneticsandphonology/wordpress/

Lesson-02

INTRODUCTION TO THE COURSE-II

At the end of this section, the students will be able to:

- KNOW and DISTINGUISH among major contents and the reason why these contents are included in the course.
- HAVE an overall IDEA about P&P as a subject and English phonetics and phonology.

Topic-007: Introduction to English Vowels

There are 44 sounds in English RP (BBC) accent. Out of them, 20 are vowels which, in turn, are further divided into pure vowels and diphthongs. Pure vowels or monophthongs are 12 out of which 5 are long and 7 are short vowels. Examples for these vowel sounds are given here:

Short vowels

- ɪ pit
- e pet
- æ pat
- ʌ putt
- ɒ pot
- ʊ put
- ə another

Long vowels

- iː bean
- ɑː barn
- ɔː born
- uː boon
- ɜː burn

Topic-008: Introduction to English Diphthongs

English diphthongs are divided into two categories: centering (which end with 'ə' sound) and closing (which end with either 'ɪ' or 'ʊ' sounds respectively). Examples for these diphthongs are given below:

Diphthongs

- ɪə peer
- eə pair
- ʊə poor
- eɪ bay

- aɪ buy
- ɔɪ boy
- əʊ no
- aʊ now

Topic-009: Introduction to English Consonants

English sounds are briefly introduced here:

- Plosives 6
- Nasals 3
- Fricatives 9
- Affricates 2
- Approximants 4

These sounds are presented with examples as follows:

Plosive sounds

- p pin
- b bin
- t tin
- d din
- k kin
- g gum

Nasal sounds

- m sum
- n sun
- ŋ sung

Fricative sounds

- f fine
- v vine
- θ think
- ð this
- s seal
- z zeal
- ʃ sheep
- ʒ measure
- h how

Affricate sounds

- ʧ chain
- ʤ Jane

Approximant sounds

- l light
- r right

- w wet
- j yet

Topic-010: IPA Transcription of English Sounds

As discussed earlier, the RP (BBC) accent of English has 44 sounds. The IPA symbols for these sounds are given here for your understanding (you can also see them from the IPA charts):

Vowels:

- Long vowels iː ɑː ɔː uː ɜː
- Short vowels ɪ e æ ʌ ɒ ʊ ə
- Diphthongs eɪ aɪ ɔɪ əʊ aʊ ɪə eə ʊə

Consonants:

- Plosives p b t d k g
- Nasals m n ŋ
- Fricatives f v θ ð s z ʃ ʒ h
- Affricates ʧ ʤ
- Approximants l r w j

Topic-011: Introduction to Phonology

Phonology is the study of the sounds of a particular language (e.g., English). In phonology, it matters whether sounds are contrastive or not, that is, whether substituting one sound for another gives a different, or "contrastive," meaning. For example in English, [r] and [l] are two different sounds - and the words "road" and "load" differ according to which of these sounds is used. Similarly, phonologists describe the contrastive consonants and vowels in a sound system (language). They are also interested in syllables, phrases, rhythm, tone, and intonation of a specific language.

Topic-012: Introduction to Phonetics

Phonetics, as a discipline, is the study of human speech sounds. It includes the understanding of how sounds are articulated using mouth, nose, teeth and tongue, and how ears hear those sounds and can tell them apart. In phonetics, the physical properties (such as the wave form of each sound) can also be analyzed with the help of computer programs (e.g., Praat). There are three major types of phonetics: articulatory phonetics, acoustics phonetics and auditory phonetics.

Further readings on this section:

- Chapter 1 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapter 5 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)
- Online source: https://www.sil.org/linguistics/what-linguistics

Lesson-03

INTRODUCTION TO KEY CONCEPTS IN PHONETICS AND PHONOLOGY (P&P)-I

At the end of this section, the students will be able to:

- KNOW and DISTINGUISH among important concepts used in P&P.

Topic-013: Phonetics vs. Phonology

Phonetics and phonology, both are important subfields of linguistics dealing with speech sounds overlapping each other. But the key difference is that phonology is the study of how sounds are organized in individual languages. It focuses on the organization of sounds by studying speech patterns (e.g., phonological rules within a specific language). The key words for describing phonology are 'distribution' and 'patterning' related to speech. Phonologists may look into questions like – why there is a difference in the plurals of cat and dog; the former ends with an 's' sound, whereas the latter ends with the 'z' sound. Phonetics, on the other hand, is the study of actual process of sound making. Phonetics has been derived from the Greek word 'phone' meaning sound or voice. It covers the domain of speech production and its transmission and reception. The sounds made by us when we talk are studied through different branches of phonetics like acoustic phonetics, auditory phonetics and articulatory phonetics.

Topic-014: Introduction to Key Concepts in Phonetics and Phonology

There are various terms which are frequently used in phonetics and phonology. They mainly include phone, phoneme and allophone. For better understanding, we need to distinguish among them.
A phone is a sound (or a segment) which has some physical feature and the term is mostly used in a non-technical sense.

A phoneme is the smallest meaningful unit of sound (therefore, a smallest unit in phonology) in a language and this meaningful unit of sound is one that will change one word into another word. For example, the difference in both 'white' and 'right' (ignore spellings here, focus on sounds) is the difference of sounds (w – r) which are phonemes and they have the ability to change meaning. Similarly, take another example of 'cat' vs. 'bat' (k – b). Linguists have also defined phoneme as a group or class of sound events having common patterns of articulation. If phoneme is a group then allophones are the group members. Let us discuss now allophone.

An allophone is a definable systematic variant of a phoneme. Compare the following sets:
's' sound in words like sill, still and spill or in words like seed, steed and speed
'k' sound in words like, key and car
't' sound in words like true and tea
'n' sound in words like tenth and ten

If you carefully analyze these words, you should find that the specific sound is not exactly the same in the given word examples. But since these variants do not change meaning (and we simply take them as alternate sounds), they are called allophone. Now, to summarize this discussion:

- Phone is a sound pattern having some acoustic features.
- Phoneme is a group of sound having the ability to change meaning.
- Allophones are the systematic variants of a phoneme.

Topic-015: Types of Phonetic Studies

Phonetics is the scientific study of speech sounds. It has three major branches: articulatory phonetics, acoustics phonetics and auditory phonetics. Phonetics as a field of study has a long history, going back certainly to well over two thousand years ago. The central concerns in phonetics are the discovery of how speech sounds are produced; how they are used in spoken language; how we can record speech sounds with written symbols and how we hear and recognize different sounds. In the first of these areas, when we study the production of speech sounds we can observe what speakers do (articulatory observation) and we can try to feel what is going on inside our vocal tract (kinesthetic observation). The second area is where phonetics overlaps with phonology: usually in phonetics we are only interested in sounds that are used in meaningful speech, and phoneticians are interested in discovering the range and variety of sounds used this way in all the known languages of the world. This is sometimes known as linguistic phonetics. Thirdly, there has always been a need for agreed conventions for using phonetic symbols that represent speech sounds; the International Phonetic Association has played a very important role in this regard. Finally, the auditory aspect of speech is very important: the ear is capable of making fine discrimination between different sounds, so much so that sometimes it is not possible to define in articulatory terms precisely what the difference is (but we can still hear the difference).

Phonetics is a multidisciplinary field and it also studies language in terms of ‘general linguistics’, ‘language development’, ‘dialectology’, ‘sociolinguistics’, ‘psycholinguistics’, ‘anatomy’, ‘physiology’, ‘developmental psychology’, ‘robotics’ and ‘information processing’. There are various other fields which are newly emerging and taking phonetics into account for a detailed analysis such as ‘instrumental phonetics’, ‘applied research in speech technology’ and ‘theoretical and experimental phonetics’.

Topic-016: Articulatory Phonetics

Articulatory phonetics deals with studying the making of single sounds by the vocal tract. It is the branch of phonetics which studies the way in which speech sounds are made (‘articulated’) by the vocal organs. It derives much of its descriptive terminology from the fields of anatomy and physiology, and is sometimes referred to as physiological phonetics. This area has traditionally held a central place in the training of phoneticians, the movements involved being reasonably accessible to observation and, in principle, under the control of the investigator. The classification of sounds used in the International Phonetic Alphabet (IPA), for example, is based on articulatory variables. In the recent years, there has been much progress in the development of instrumental techniques for observing and measuring such factors as tongue, lip, palate and vocal fold movement. Important discussions included in this field are: air

stream mechanism, speech production, places of articulation, manners of articulation, phonation (voicing), and other processes such as the oro-nasal process and the description of vowel production.

Topic-017: Acoustic Phonetics

Acoustic phonetics is related to the study of physical attributes of sounds produced by the vocal tract. It is the branch of phonetics which studies the physical properties of speech sound as transmitted between mouth and ear according to the principles of acoustics (the branch of physics devoted to the study of sound). It is primarily dependent on the use of instrumental techniques of investigation (such as Praat software), particularly electronics, and some grounding in physics and mathematics is a prerequisite for advanced study of this subject. Its importance to the phonetician is that acoustic analysis can provide a clear, objective datum for the investigation of speech – the physical 'facts' of speech sounds (such as duration, formants F1, F2 and F3, etc.). Thus, acoustic evidence is often referred to when one wants to support an analysis being made in articulatory or auditory phonetic terms. On the other hand, it is important not to become too reliant on acoustic analyses, which are subject to mechanical limitations (e.g. the need to calibrate measuring devices accurately), and which are often themselves open to multiple interpretations.

Topic-018: Auditory Phonetics

Auditory phonetics deals with understanding how human ear perceives sound and how the brain recognizes different speech units. This branch of phonetics studies the perceptual response to speech sounds as mediated by ear, auditory nerve and brain. It is a very less well-studied area of phonetics, mainly because of the difficulties encountered as soon as one attempts to identify and measure psychological and neurological responses to speech sounds. On the other hand, anatomical and physiological studies of the ear are well advanced, as are techniques for the measurement of hearing, and the clinical use of such studies is now established under the headings of audiology and audiometry. But relatively little pure research has been done into the attributes of speech-sound sensation, seen as a phonetic system, and the relationship between such phonetic analyses and phonological studies remains obscure. The subject is closely related to studies of auditory perception within the domain of psycholinguistics.

Further readings on this section:

- Chapter 1 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapters 2 and 5 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)

Lesson-04

INTRODUCTION TO KEY CONCEPTS IN PHONETICS AND PHONOLOGY (P&P)-II

At the end of this section, the students will be able to:

- DEFINE and EXPLAIN the fundamental features of speech production, sound waves and articulatory gestures such as the oro-nasal process.

Topic-019: Experimental Phonetics and Phonology

Experimental phonetics and phonology as a subject aims to integrate research in experimental phonetics, experimental psychology and phonological theory to provide a hypothesis-based investigation of phonological phenomena (of the kind which is a standard in the experimental sciences). Although quite a lot of the work done in phonetics is descriptive (providing an account of how different languages and accents are pronounced), and some is prescriptive (stating how they ought to be pronounced) yet an increasing amount of phonetic research is experimental, aimed at the development and scientific testing of hypotheses. Experimental phonetics is quantitative (based on numerical measurement). Like other scientific subjects, it makes use of controlled experiments, which means that the expert has to make sure that the results could only be caused by the factor being investigated and not by some other element. Nowadays, experimental research is carried out in all fields of phonetics. For example, in the articulatory field, we measure and study how speech is produced. Similarly, in the acoustic field we examine the relationship between articulation and the resulting acoustic signal, and look at physical properties of speech sounds in general. Finally, in the auditory field we do perceptual tests to discover how the listener's ear and brain interpret the information in the speech signal.

Topics explored through experimental phonetics and phonology include; 'infant speech perception', 'experimental paradigm for testing infants', 'categorical perception of child acquisition', 'speech perception abilities of infants' and 'changes in perception'. Peter Ladefoged explored the following three areas of experimental phonetics in 1967:

- Stress in respiratory activity
- The nature of vowel quality
- Perception and production of speech

Topic-020: Generative Phonology

Like other areas of grammar, a major change in the theory of phonology came about in the 1960s when many people became convinced that important facts about the sound systems of languages were being missed by phonologists who concentrated solely on the identification of phonemes and the analysis of relationships between them. Morris Halle and Noam Chomsky showed that there were many sound processes which, while they are observable in the phonology, are actually regulated by grammar and morphology. This area of phonology is mainly related to specific phonological rules within languages. These rules describe how they work and regulate changes such as substitutions, deletions and insertions of

sounds in specific contexts. In order to highlight these phonological rules, an elaborate method of writing in an algebra-like style was evolved: this can be seen in the best known generative phonological treatment of English (The Sound Pattern of English by Chomsky and Halle, 1968). This type of phonology became extremely complex; it has now been largely replaced by newer approaches to phonology, many of which, despite rejecting the theory of the Sound Pattern of English, are still classed as generative since they are based on the principle of an abstract, underlying phonological representation of speech which needs rules to convert it into phonetic realizations.

Following are the theories that have stemmed from 'generative phonology':

- Autosegmental phonology
- Metrical phonology
- Lexical phonology
- Optimality theory

Topic -21: Articulatory Phonetics - I

It is the branch of phonetics that studies articulators and their actions related to human speech production. Actually, we can only produce speech sounds by moving parts of our articulators (body parts), and this is done by the contraction of muscles. Most of the movements relevant to speech take place in the mouth and throat area (though we should not forget the activity in the chest for breath control), and parts of the mouth and throat area that we move when speaking. These are called articulators. In this branch of phonetics, we study the principal articulators (such as tongue, lips, lower jaw and the teeth, velum or soft palate, uvula and larynx) and other processes related to speech production. This includes the features of various sounds such as vowels and consonants and their specific properties including places and manners of articulation, phonation, etc.

Topic-22: Speech Production

The process of speech production mainly includes respiration, phonation, articulation and resonance. This simply means that in order to produce speech, we need the air stream mechanism (so that the process of speech is activated), the exploitation of the air stream at larynx (this process is called phonation or voicing), the modification of the air passage with the help of articulators at the cavity (either oral or nasal) and finally the transfer of energy. In phonetics, speech production is a term used for the activity of the respiratory, phonatory and articulatory systems during speech, along with the associated processes required for their co-ordination and use. A contrast is usually drawn with the receptive aspects of spoken communication, such as speech perception and recognition.

As the anatomy of speech, some experts (such as Ladefoged) highlight the following four main components—the airstream process, the phonation process, the oro-nasal process, and the articulatory process. The airstream process includes all the ways of pushing air out that provide energy for speech. The phonation process is the name given to the actions of the vocal folds. The oro-nasal process is the possibility of the airstream going out through the mouth, as in [v] or [z], or the nose, as in [m] and [n]. And finally, the movements of the tongue and lips interacting with the roof of the mouth and the pharynx are part of the articulatory process.

Topic-23: Sound Waves

A sound wave is the pattern of disturbance caused by the movement of energy traveling through air (sound always travels in the shape of waves in the air). Sound basically consists of small variations in air pressure that occur very rapidly one after another. These variations are caused by actions of the speaker's vocal organs that are (for the most part) superimposed on the outgoing flow of lung air. Thus, in the case of voiced sounds, the vibrating vocal folds chop up the stream of lung air so that pulses of relatively high pressure alternate with moments of lower pressure. Variations in air pressure in the form of sound waves move through the air somewhat like the ripples on a pond. When they reach the ear of a listener, they cause the eardrum to vibrate. A graph of a sound wave is very similar to a graph of the movements of the eardrum. We need to understand the physical features of sound waves (such as its amplitude, its loudness and its time duration of vibration) for many purposes in phonetic studies. Sound waves have important role in acoustics.

Topic-024: The Oro-Nasal Process

The possibility of the airstream going out through the mouth, as in [v] or [z], or the nose, as in [m] and [n], is determined by the oro-nasal process. Consider the consonants at the end of rang, ran, ram (ŋ, m, n) which are all nasal sounds. When you say these consonants by themselves, note that the air is coming out through the nose. In the formation of these sounds in a sequence, the point of articulatory closure moves forward, from velar in 'rang', through alveolar in 'ran' and to bilabial in 'ram'. In each case, air is prevented from going out through the mouth but is able to go out through the nose because the soft palate, or velum, is lowered. In the most speech, soft palate is raised so that there is a velic closure. When it is lowered and there is an obstruction in the mouth, we say that there is a nasal consonant. Raising or lowering the velum controls the oro-nasal process, the distinguishing factor between oral and nasal sounds.

Further readings on this section:

- Chapter 1 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapter 1 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)
- Online sources: https://www.slideshare.net/bethfernandezaud/anatomy-of-speech-production

Lesson-05

ARTICULATORY PHONETICS-II

At the end of this section, the students will be able to:

- RECOGNIZE and EXPLAIN various places and manners of articulation involved in the production of consonantal sounds.

Topic-025: Articulatory Gestures

In order to fully describe a sound, we need to know various actions made by articulators during the process of articulation. The articulators make gestures required for speech by moving toward other articulators to produce speech sounds. This movement is called articulatory gesture. Bearing all these terms in mind, let us go through the major articulatory gestures used in the production of English sounds:

Bilabial: This sound is made with two lips (for example, /p/ and /b/). The lips come together for these sounds.
Labiodental: This sound is made when the lower lip is raised to touch the upper front teeth (for example, /f/ and /v/).
Dental: This sound is made with the tongue tip or blade and upper front teeth. For example, say the words *thigh, thy* and you will find the first sound in each of these words to be dental.
Alveolar: This sound is made with the tongue tip or blade and the alveolar ridge. You may pronounce words such as *tie, die, nigh, sigh, zeal, lie* using the tip of the tongue or the blade of the tongue for the first sound in each of these words (which are alveolar sounds).
Retroflex: This sound is produced when the tongue tip curls against the back of the alveolar ridge. Many speakers of English do not use retroflex sounds at all but it is a common sound in Pakistani languages such as Urdu, Sindhi, Pashto, Balochi and Punjabi.
Palato-alveolar: This sound is produced with the tongue blade and the back of the alveolar ridge (for example, first sound in each of words like *shy, she, show*)
Palatal: This sound is produced with front of the tongue and the hard palate (such as the first sound in *'yes'*.
Velar: This sound is produced with back of the tongue and the soft palate (such as /k/ and /g/).

Topic-026: Manner of Articulation

In order to classify a speech sound, one of the most important things that we need to know is what sort of obstruction it makes to the flow of air: a vowel makes very little obstruction, while a plosive consonant makes complete obstruction. The type of obstruction is known as the manner of articulation. There are several basic ways to pronounce a consonant sound which are based on the configuration and interaction of the articulators involved. For example, a stop sound [p] is pronounced by blocking the air passage completely in the oral cavity. Similarly, there are certain parameters for determining the manners of articulation such as stricture, laterality and nasality. Consonantal sounds are divided, in terms of their manner of articulation, into two major types: obstruents (such as stops, fricatives and affricates) and

sonorants (such as nasals, liquids and glides). The possible manners of articulation are described in detail in the next sections. The International Phonetic Association classifies consonants according to their manner and place of articulation.

Topic-027: Stop: Oral and Nasal

Stop refers to any sound which is produced by a complete closure in the vocal tract, and thus traditionally includes the class of plosives. Both nasal and oral sounds can be classified as stops, though the term is usually reserved for the latter. The term 'stop' is used in the phonetic classification of consonant sounds on the basis of their manner of articulation (it refers to a sound made when a complete closure in the vocal tract is suddenly released; the air pressure which had built up behind the closure rushes out with an explosive sound). Thus the sound stop has two processes; the closure of air passage (stop) and the burst (release). Examples in English are [p, b, t, d, k, g]. Plosion is the term used to refer to the outwards movement of air upon release. Plosive consonants are one type of stop consonant. Nasal stops include [m, n, ŋ]. It is also possible (using a different airstream mechanism than the one which produces an outward flow of lung air) to produce plosives (implosives) where the air upon release moves inward.

Topic-028: Fricative

A fricative consonant is made by forcing air through a narrow gap so that a hissing noise is generated. This may be accompanied by voicing (in which case the sound is a voiced fricative, such as [z] or it may be voiceless as [s]). The quality and intensity of fricative sounds varies greatly, but all are acoustically composed of energy at relatively high frequency. There are several fricative sounds in English, both voiced and voiceless, as in fin [f], van [v], thin [θ], this [ð], sin [s], zoo [z], ship [ʃ], measure [ʒ] and hoop [h]. A distinction is sometimes made between sibilant or strident fricatives. Sibilant fricatives (such as s, ʃ) are strong and clearly audible and strident fricatives are weak and less audible (such as θ, f). BBC pronunciation has nine fricative phonemes: f, θ, s, ʃ, h (voiceless) and v, ð, z, ʒ (voiced).

Topic-029: Approximants

Approximant is a phonetic term used to denote a consonant which makes very little obstruction to the airflow. Traditionally approximants have been divided into two groups: (1) "semivowels" such as [w] in English 'wet' and [j] in English 'yet', which are very similar to close vowels such as [u] and [i] but are produced as a rapid glide; and (2) "liquids" sounds which have an identifiable constriction of the airflow but not the one that is sufficiently obstructive to produce fricative noise. This category includes laterals such as English [l] in 'lead' and non-fricative [r] (phonetically ɹ) as in 'read'. BBC English has four approximant sounds which include [l] as in light, [r] as in right, [w] as in wet and [j] as in yet.

Topic-030: Additional Consonantal Gestures

There are some additional consonantal gestures which may be useful to discuss at this stage. One of such gestures not yet discussed is 'affricate'. It is a type of consonant consisting of a plosive followed

by a fricative with the same place of articulation (e.g., [tʃ] and [dʒ] sounds at the beginning and end of the English words ‘church’ and ‘judge’). It is often difficult to decide whether any particular combination of a plosive plus a fricative should be classed as a single affricate sound or as two separate sounds, and the question depends on whether these are to be regarded as separate phonemes or not. It is usual to regard [tʃ], [dʒ] as affricate phonemes in English (usually symbolized č, ǰ by American writers).

Topic-031: Trill, Tap and Flap

It might be useful to know the terms trill (sometimes called roll), tap and flap and distinguish among them. These are also called central approximants. In the case of tap and flap, there is only one rapid contact while in the case of trill [r] the tongue is striking continuously (rrrrr) as the stricture of intermittent closure.

Tap: Tap is up and down movement of the top of the tip of tongue. For example, pronouncing the middle sound in word ‘pity’ with typical American accent [ɾ]. It is very brief and is produced by a sharp upward throw of the tongue blade. In this sound, tongue makes a single tap against the alveolar ridge.

Flap: Flap is front and back movement of tongue tip at the underside of tongue with curling behind. It is found in abundance in Indo-Aryan (IA) languages [ɽ]. Typical flap sounds found in IA languages is a retroflex sound and the examples are [ɽ], [ɖ] and [ɳ].

Trill: In the production of trill the articulator is set in motion by the current of air [r]. It is a typical sound of Scottish English as in words like ‘rye’ and ‘row’.

Further readings on this section:

- Chapter 1 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapters 4, 6 and 7 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)
- Online sources:
  - http://clas.mq.edu.au/speech/phonetics/phonetics/consonants/manner.html
  - http://www.learnlanguagesonyourown.com/manners-of-articulation.html
  - https://www.slideshare.net/shtyfurak/consonants-8595636

Lesson-06

ARTICULATORY PHONETICS-III

At the end of this section, the students will be able to:

- INTRODUCE the waveforms of consonants and suprasegmental features
- RECOGNIZE and EXPLAIN various manners of articulation involved in the production of different sounds.

Topic-032: The Waveforms of Consonants

As part of the acoustics of consonants, we need to note down a few distinctive points about their waveforms. Although the places of articulation are not obvious in any waveform yet the differences in some of the principal manners of articulation—stop, nasal, fricative, and approximant—are usually apparent. Furthermore, as already pointed out, we can also see the differences between voiced and voiceless sounds. The difference between a vowel and a consonant in the waveform is very easy to understand. For the vowel sounds, the lips open and the amplitude gets larger. We can also observe the time duration of a sound from its waveform (vowels are longer than consonants). In case of a stop sound, the closure and the burst are also easy to judge. Similarly, we can also note down the voicing bar for a 'voiced' sound producing small voicing vibrations instead of a flat line. A fricative with a more nearly random waveform pattern can also be judged from its waveform. Go to page 18 (Figure 1.11) of your textbook (Ladefoged and Johnson, 2012) for the analysis of the waveform of a phrase 'my two boys know how to fish'. Think about various hints from the waveforms related to their respective sounds.

Topic-033: The Articulation of Vowel Sounds

In the articulation of vowels, the articulators do not come close together and the air stream is relatively undisturbed. Vowels are the class of sounds which make the least obstruction to the flow of air. They are almost always found at the center of a syllable, and it is rare to find any sound other than a vowel which is able to stand alone as a whole syllable. In phonetic terms, each vowel has a number of properties that distinguish it from other vowels. These include (firstly) the shape of the lips, which may be rounded (as for /u:/ vowel), neutral (as for /ə/) or spread (as in /i:/ vowel). Secondly, the front, the middle or the back of the tongue may be raised, giving different vowel qualities: the BBC vowel in ('cat') is a front vowel, while the ɑ: in 'cart' is a back vowel. Thirdly, the tongue (and the lower jaw) may be raised close to the roof of the mouth, or the tongue may be left low in the mouth with the jaw comparatively open. Lip rounding may also be important in the description of vowel sounds in some languages.

Topic-034: The Sounds of Vowels

Vowels as sounds can be defined in terms of both phonetics and phonology. Phonetically, they are sounds articulated without a complete closure in the mouth or a degree of narrowing which would produce audible friction; the air escapes evenly over the center of the tongue. If air escapes solely through

the mouth, the vowels are said to be oral; if some air is simultaneously released through the nose, the vowels are nasal. In addition to this, in a phonetic classification of vowels, reference would generally be made to two variables, the first of which is easily describable, the second much less so: (a) the position of the lips – whether rounded, spread, or neutral; (b) the part of the tongue raised, and the height to which it moves. Acoustically, vowels are mainly distinguished by the first two formant frequencies F1 and F2; F1 is inversely related to the vowel height (which means that smaller F1 amplitude = higher vowels), and F2 is related to the front or back of the vowels (smaller F2 amplitude = more back vowels). These features will be further elaborated during the part of this course on acoustic phonetics.

Topic-035: Long Vowels and Diphthongs

Long vowels (transcribed with the diacritic [:]) occur in some languages. A contrast of length (between short and long) is also sometimes encountered with vowels. Length is an important feature in many ways in speech: in English and most other languages, stressed syllables tend to be longer than unstressed. Some languages (such as English) have phonemic differences between long and short sounds, contrasting short vowels (such as i, e, ɒ, ʊ, ə) with long vowels (iː ɑː ɔː uː ɜː). Similarly, the most important feature of a diphthong is that it contains a glide from one vowel quality to another one. BBC English contains a large number of diphthongs: there are three ending in /i/ (ei, ai, ɔi), two ending in /ʊ/ (əʊ, aʊ) and three ending in /ə/ (iə, eə, ʊə).

Topic-036: Introduction to Suprasegmental

'Supra' means above (beyond) and 'segments' means sounds (such as vowels and consonants) so the term 'suprasegmental' means 'above sounds'. The term suprasegmental was initially invented to refer to aspects of sound such as intonation that did not seem to be the properties of individual segments (i.e. the vowels and consonants of which speech is composed). The term has tended to be used predominantly by American writers, and much British work has preferred to use the term prosodic instead. There has never been full agreement about how many suprasegmental features are to be found in speech, but pitch, loudness, tempo, juncture, syllable, rhythm and stress are the most commonly mentioned ones.

Further readings on this section:

- Chapter 1 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapters 2 and 3 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)
- Online sources:
  - https://www.slideshare.net/ClariceCagay/vowel-sounds-71318643
  - https://linguistics.stackexchange.com/questions/2538/difference-between-production-of-vowels-diphthongs-and-semi-vowels

Lesson-07

PHONEMIC AND PHONETIC TRANSCRIPTION-I

At the end of this section, the students will be able to:

- INTRODICE and EXPLAIN IPA and USE IPA symbols in the transcription of different words.

Topic-037: Why Transcribe?

Transcription is an important tool in phonetics and phonology. Based on a specific set of symbols, transcription is the writing down of a spoken utterance. In its original meaning, the implied word is converted from one representation (e.g. written text) into another (e.g. phonetic symbols). Transcription exercises are a long-established exercise for teaching phonetics. There are many different types of transcription: the most fundamental division that can be made is between phonemic (broad) and phonetic (narrow) transcription. In the case of the former, the only symbols that may be used are those which represent one of the phonemes of the language, and extra symbols are excluded. In a phonetic transcription the transcriber may use the full range of phonetic symbols if these are required; a narrow phonetic transcription is one which carries a lot of fine detail about the precise phonetic quality of sounds, while a broad phonetic transcription gives a more limited amount of phonetic information. Transcription is an important part of the present course based on the objective to understand the sound-symbol correspondence. Transcription is a useful technique for highlighting the phonemes of a language during documentation and description.

Topic-038: Introduction to IPA

Established in 1886, the International Phonetic Association (IPA) is a forum for teachers and practitioners who were inspired by the idea of using phonetics to improve the teaching of the spoken language to foreign learners. As well as laying the foundations for the modern science of phonetics, the IPA had a revolutionary impact on the language classroom in the early decades of its existence, where previously the concentration had been on proficiency in the written form of the language being learned. The association is still a major international learned society, though the crusading spirit of the pronunciation teachers of the early part of the century is not so evident nowadays. The association only rarely holds official meetings, but contact among the members is maintained by its research journal, which has been in publication more or less continuously since the foundation of the association with occasional changes of name. The IPA is also maintaining a vibrant website (https://www.internationalphoneticassociation.org/) where tools for phonetic study and language teaching are available. It also maintains its specific set of alphabets (also called IPA - International Phonetic Alphabets or IPA charts) for transcription.

Topic-039: Explaining IPA Chart

The International Phonetic Association, since its inception in 1886, has been continuously maintaining and updating the IPA charts (International Phonetic Alphabets) which is used as a useful tool for transcribing not only the segments (vowels and consonants) but the detailed phonetic variation (diacritics) and the suprasegmental features. The last revision of the IPA charts was carried out in 2015. The IPA chart for consonants is given below (for further detail on other charts, visit the IPA website. The link is given at the end of this lesson):

THE INTERNATIONAL PHONETIC ALPHABET (revised to 2015)

CONSONANTS (PULMONIC) © 2015 IPA

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k g	q ɢ		ʔ
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
Trill	ʙ			r					ʀ		
Tap or Flap		ⱱ		ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
Lateral approximant				l		ɭ	ʎ	ʟ			

Symbols to the right in a cell are voiced, to the left are voiceless. Shaded areas denote articulations judged impossible.

Topic-040: Transcription of Vowels

In order to learn the transcription of vowels, we need to start exploring the IPA chart for vowels (go to IPA website for detail). Once it is done, we can explore the particular vowel sounds of the BBC English and compare them with the IPA vowel chart. The BBC accent is generally described as having short vowels, long vowels and diphthongs. There are said to be seven short vowels, five long ones and eight diphthongs. Note down the following symbols and their examples:

Short vowels:	ɪ	e	æ	ʌ	ɒ	ʊ	ə	ə
	pit	pet	pat	putt	pot	put	another	
Long vowels:	iː	ɑː	ɔː	uː	ɜː			
	bean	barn	born	boon	burn			
Diphthongs:	eɪ	ai	ɔɪ	əʊ	aʊ	ɪə	eə	ʊə
	bay	buy	boy	no	now	peer	pair	poor

Topic-041: Transcription of Consonants

For the transcription of consonant sounds, the IPA chart as given above (Topic 39) may be used. This chart covers all languages of the world. For the consonant sounds of the BBC accent of English, remember the following (24) symbols:

Plosives (6):	p	b	t	d	k	g			
Affricates (2):	ʧ	ʤ							
Fricatives (9):	f	v	θ	ð	s	z	ʃ	ʒ	h
Nasals (3):	m	n	ŋ						
Approximants (4):	l	r	w	j					

Topic-042: Transcription of Consonants: Explanation

To supplement the above topic (41), the following examples are added to the consonants of English. Practice them and look for your own examples:

Plosives:	p	b	t	d	k	g			
	pin	bin	tin	din	kin	gum			
Affricates:	ʧ	ʤ							
	chain	Jane							
Fricatives:	f	v	θ	ð	s	z	ʃ	ʒ	h
	fine	vine	think	this	seal	zeal	sheep	measure	how
Nasals:	m	n	ŋ						
	sum	sun	sung						
Approximants:	l	r	w	j					
	light	right	wet	yet					

Further readings on this section:

- Chapter 2 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Introduction and chapter 1 of the additional reading book (**Transcribing the Sound of English - A Phonetics Workbook for Words and Discourse**) by Paul Tench
- Online sources: https://www.internationalphoneticassociation.org/

Lesson-08

PHONEMIC AND PHONETIC TRANSCRIPTION-II

At the end of this section, the students will be able to:

- EXPLAIN phonemic as well as phonetic transcription of the IPA story.

Topic-043: Broad and Narrow Transcription

Two main kinds of transcription are recognized: broad (phonemic) and narrow (phonetic). Conventionally, square brackets enclose phonetic transcription [k]; oblique lines enclose phonemic transcription /k/. In broad transcription, sounds are symbolized just on the basis of their linguistic functions (in a language) and without going into the detail of the physical features of an individual sound. Phonemic transcription looks the simplest of all. In phonemic transcription, only the units that account for differences of meaning are represented, e.g. /pin/, /pen/, /pæn/. On the other hand, in narrow transcription, the sounds are symbolized on the basis of their articulatory/auditory identity, regardless of their function in a language (sometimes called an impressionistic transcription). In a phonetic transcription, the aim is not to judge the functional significance of sounds, in the context of some languages, but to identify the sounds as such (phonetic variation).

Topic-044: IPA Resource: The North Wind and the Sun Story

The home page of the International Phonetics Association (The IPA) https://www.internationalphoneticassociation.org/ has many very helpful links including links to sound files illustrating the IPA and links to free and professional IPA fonts as well as information about how to join the IPA and get the IPA journal. The IPA also provides various tools for the phonetic study of human languages. One of such resources is 'The North Wind and the Sun' story. In order to create a uniform system for the description of the sounds of languages, this is a recommended text for transcription (both narrow and broad), especially for publishing the IPA illustrations of languages in the IPA journal. The story is given in the next topic.

Topic-045: IPA Resource: Explanation

The story 'The North Wind and the Sun' is given below. Carefully read it. You will be required to transcribe this story in the next topics:

The north wind and the sun were disputing which was the stronger when a traveler came along wrapped in a warm cloak. They agreed that the one who first succeeded in making the traveler take his cloak off should be considered stronger than the other. Then the north wind blew as hard as he could, but the more he blew the more closely did the traveler fold his cloak around him and at last the north wind gave up the attempt. Then the sun shined out warmly, and immediately the traveler took off his cloak. And so the north wind was obliged to confess that the sun was the stronger of the two.

Topic-046: IPA Story Practice

Now try transcribing the above story using the symbols of the BBC accent of English given in the topics 40-42 (Lecture 7). Following are the symbols which you will be using in your transcription:

Vowels:	ɪ	e	æ	ʌ	ɒ	ʊ	ə	ə	
	iː	ɑː	ɑː uː	ɜː					
	eɪ	ai	ɔɪ	əʊ	aʊ	ɪə	eə	ʊə	
Consonants:	p	b	t	d	k	g			
	f	v	θ	ð	s	z	ʃ	ʒ	h
	m	n	ŋ	l	r	w	j	ʧ	ʤ

Topic-047: IPA Story: Broad Transcription

Using the above symbols (given in Topic 46), you are required to phonemically transcribe the 'The North Wind and the Sun' story (see the text as given in Topic 45). Start practicing it carefully (but don't worry if you make mistakes at this stage). It is an important activity and you are required to learn transcription as a part of this course. While transcribing the text phonemically, you are required to take care of (1) using oblique lines/slashes at the beginning and ending of the transcription (which enclose phonemic transcription) and (2) transcribing broadly without going into the detail of the physical features (phonetic) of individual sounds (it is the simplest kind of transcription). The first sentence of the text is transcribed for you (follow this example):

/ðə norθ wɪnd ən ðə sʌn wər dɪspjutɪŋ/

Topic-048: IPA Story-Phonetic Transcription

In this topic you are required to learn the principles of 'narrow' or 'detailed' transcription (also called phonetic transcription). Remember that (based on various objectives) we, at times, need to give a complete detail of individual sounds by giving phonetic transcription. In this type of transcription, as mentioned earlier, the sounds are symbolized on the basis of their articulatory/auditory features (phonetic variation). Now, practice the same text (The North Wind and the Sun story) for your phonetic transcription by using square brackets (i.e., [k]) and covering as many aspects of a specific pronunciation as possible by making very subtle distinctions between sounds (use diacritics and other symbols provided in the IPA). The following sentence is hereby done for you:

[ðə ˈnɔɹθ ˌwɪnd ən ə ˈsʌn wə˞ dɪsˈpjuɾɪŋ]

Further readings on this section:
- Chapter 2 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Introduction and chapter 1 of the additional reading book (**Transcribing the Sound of English - A Phonetics Workbook for Words and Discourse**) by Paul Tench.

Lesson-09

PHONEMIC AND PHONETIC TRANSCRIPTION-III

At the end of this section, the students will be able to:

- EXPLAIN and RECOGNIZE the transcription of the suprasegmental features (beyond words).

Topic-049: Transcription Beyond Words

In the last few topics, we covered the transcription of segments (sounds) at word level. But we also need to know the features of connected speech (beyond words) at suprasegmental level. This type of transcription is required when a spoken language is analyzed as a continuous sequence, as in normal utterances and conversations. It is now realized by experts that important changes happen to sound units when they are used in a connected speech e.g., *and* becoming /n/ in such phrases as *boys and girls*. One more example is /n/ becoming /m/ in the phrase *green bus*. The features of connected speech are: assimilation, rhythm, stress, elision, linking, tone and intonation.

Topic-050: Transcription Beyond Words: Word Stress

In phonetics, stress refers to the degree of force used in producing a syllable. The usual distinction is between stressed and unstressed syllables, the former being more prominent than the latter (and marked in transcription with a raised vertical line, [ˈ]). The prominence is usually due to an increase in loudness of the stressed syllable, but increases in length and often pitch may contribute to the overall impression of prominence. In other words, a syllable is stressed when it is made more prominent than others in a multisyllabic word. The IPA symbol for stress is:

- Primary stress: symbol [ˈ] above the line and before the stressed syllable such as /ˈsnɪp. ɪt/ /ɪgˈzɪst/ /prənʌnsiˈeiʃən/
- Secondary stress: symbol [ˌ] below the line before the stressed syllable /ˌmɪnɪmaɪˈzeɪʃən/

Topic-051: Transcription Beyond Words: Accent

The community identification (based on specific features in pronunciation) is reflected in language. There are many Englishes today with many national and regional varieties based on the typical way (called accent) of pronunciation (e.g., BBC, American or Chinese English). Accent difference must be realized while transcribing for a specific accent (e.g., British vs. US accent) as one language can have many possible transcriptions. So, in order to realize the differences based on a typical accent, we need to know four types of variations among various accents of a language:

a. Difference in phonological inventories. Compare /strʌt/ vs. /strʊt/.
b. Difference in phonetic features such as pronouncing /t/ as [ʔ].
c. Phonological distribution e.g., *rhotic* vs. *non-rhotic* accents.

d. Lexical distribution e.g., /θ/ and /ð/ differences (as England and Wales have /ð/ and Scottish accents have /θ/).

Topic-052: Transcription Beyond Words: Phrases

Words are always put together in phrases creating many transitions and changes in the pronunciation. For example, in the phrase *ten green bottles* (when spoken in a connected speech), the pronunciation of *ten* and *green* changes because of the contact and *ten* would probably be pronounced with its /n/ changing to /ŋ/ in anticipation of its contact with the /g/ of green; and green would probably be pronounced with its /n/ changing to /m/ in anticipation of its contact with the /b/ of bottles. These kinds of change reflect a process known as simplification or economy of effort. In these cases, the two /n/ sounds have changed to suit their contexts by becoming a little bit more similar to the consonants that follow in the next word. This type of phrase level change is called 'assimilation'. Other changes of such types are called elision, linking, epenthesis and liaison.

Topic-053: Transcription Beyond Words: Rhythm and Beyond

While transcribing, it is also important to take care of the noticeable events at regular intervals as part of the connected speech. These regularities (of rhythmicality) may be stated in terms of the patterns of stressed vs. unstressed syllables, syllable length (long vs. short) or pitch (high vs. low) – or some combinations of these variables. Maximally regular patterns which are encountered in any kind of poetry are referred to as 'metrical'. Analyze the following poem and think, how the rhythmic and other features of connected speech are taken care of while transcribing:

Ten green bottles	ˈtɛŋ ˈgriːm ˈbɒtl̩ z
Hanging on the **wall**	ˈhæŋɪŋ ˈɒn ðə ˈwɔːl
And if **one green bott**le	ən ɪf ˈwʌŋ ˈgriːm ˈbɒtl̩
Should acci**den**tally **fall**	ʃəd ˈæksɪˈdɛntli ˈfɔːl
There'd be **nine green bott**les	ðə b bi ˈnaɪŋ ˈgrɪːm ˈbɒtl̩ z
Hanging on the **wall**	ˈhæŋɪŋ ˈɒn ðə ˈwɔːl

Further readings on this section:

- Chapter 2 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapters 3 to 7 of the additional reading book (**Transcribing the Sound of English - A Phonetics Workbook for Words and Discourse**) by Paul Tench

Lesson-10

THE CONSONANTS OF ENGLISH-I

At the end of this section, the students will be able to:

- EXPLAIN the features (Voicing, MoA and PoA) of English consonants.

Topic-054: The Consonants of English

There are 24 consonants in the RP accent of English. These consonants are described in terms of (1) voicing, (2) manners and (3) places of articulation. Explore the following table:

	Bilabial	Labiodental	Dental	Alveolar	Post-alveolar	Palato-alveolar	Palatal	Velar	glottal
Plosive	p b			t d				k g	
fricative		f v	θ ð	s z		ʃ ʒ			h
Affricate						tʃ dʒ			
Nasal	m			n				ŋ	
Lateral				l					
Frictionless Continuant	w				r		j		

For detail, see page 62 of your additional textbook by Peter Roach and remember that the consonants in the right side of the column are voiced and in the left are voiceless.

Topic-055: Stop Consonants

'Stop' is often used as if synonymous with plosive. However, some phoneticians use it to refer to the class of sounds in which there is complete closure specifically in the oral cavity. In this case, sounds such as m, n are also stops. More precisely, they are nasal stops. In English, there are nine stops (six oral and three nasal):

	bilabial	**alveolar**	**velar**
- Voiced	p	t	k
+Voiced	b	d	g

(nasal) +Voiced m n ŋ

Apart from the above stops, in some varieties of English, the glottal stop /ʔ/ is found as in *beaten* [ˈbɪʔn̩]. English voiceless stops (p, t, k) are also aspirated in the beginning of the words such as [p^{h}a**I**, t^{h}a**I**, k^{h}a**I**].

Topic-056: Fricatives

It refers to a sound made with two articulators coming so close to each other that the air moving between them produces audible friction (or frication). Remember that there is no complete closure between the articulators and there is a very simple stricture (or narrowing of the air passage). In BBC English, we have several fricatives (both voiced and voiceless), as in fin [f], van [v], thin [θ], this [ð], sin [s], zoo [z], ship [ʃ], measure [ʒ], hoop [h]. Other fricatives may be heard in some forms of English (or in restricted contexts or speech styles, such as the palatal fricative [ç]), and several other fricatives may also be heard in other languages, e.g., a voiceless velar fricative [x] in Urdu, Pashto and Sindhi, a voiceless pharyngeal fricative [ħ] in Arabic, a voiced bilabial fricative [β] in Spanish. The fricative manner of articulation produces a wider range of speech sounds than any other.

Very common fricative sounds are /f, v, s, z, θ, ʃ, ð, h/ whereas [ʒ] is a less common fricative sound. English fricatives are also divided into two categories (this distinction is made on the basis of energy made in their production); fortis: /f, s, θ, ʃ, h/ and lenis: /v, z, ð, ʒ/. Stops and fricatives are together called 'obstruents' and they are similar in three ways: (1) they influence vowel length (vowels are shorter before voiceless obstruents), (2) voiceless obstruents at final position are longer than their voiced counterparts (e.g., race vs. rays), and (3) obstruents are voiced only if the adjacent segments are also voiced (e.g., dogs).

Topic-057: Affricates

An affricate sound is a type of consonant which is made of a plosive followed by a fricative with the same place of articulation (so, it is a mixture of two steps or gestures). For example, /tʃ/ (the voiceless affricate) has /t/ and /ʃ/ as a sound at the beginning and end of the English words *church* /tʃɜːtʃ/. Remember that although it is very strange to call the combination of a plosive and a fricative a single sound (an affricate) (as it has been deliberated for quite some time) yet experts argue that an affricate is a single segment and accordingly it should be treated as a single unit. There are two affricates in English: /tʃ/ and /dʒ/ (the first of these is voiceless, the second voiced) sounds as at the beginning and end of the English words *church* and *judge*. Both of them are post alveolar sounds by their place of articulation.

Topic-058: Nasals

Nasals are the consonantal sounds in which the air escapes through the nose (the soft palate i.e., velum is lowered). For nasal sounds, two articulatory actions are necessary; (1) the soft palate (or velum) must be lowered to allow air to escape through nose, and (2) a closure must be made in the oral tract (in order to prevent air from escaping through it). This closure may be created at any place in the oral cavity (such as at lips position, for bilabial /m/ sound; at alveolar, for /n/ or at soft palate (velum) for /ŋ/ sound.

English has these three nasal sounds (m, n and ŋ) which are very commonly found. All of them are nasal stops and they are voiced sounds.

Topic-059: Approximants

The consonants which make very little obstruction to the airflow are called approximants. These have traditionally been divided into two main groups: *semivowels* (such as /w/ in 'wet' and /j/ in 'yet') which are very similar to close vowels ([u] and [i]) but are produced as a rapid glide; and *liquid* sounds which have an identifiable constriction of the airflow (but they do not obstruct sufficiently to produce fricative noise, compression or the diversion of airflow) - this category includes lateral sound i.e., /l/ as in 'lead' and /r/ sound as in 'read'. Approximant sounds; therefore, are not fricative and never contain interruptions to the flow of air.

The BBC accent of English has four approximant sounds:

Bilabial: /w/ as in *whack*
Alveolar: /l/ and /r/ as in *lack* and *rack*
Palatal: /j/ as in *yak*

Sometimes, experts need to differentiate among various kinds of /r/ approximant (tap, flap and trill).

Further readings on this section:

- Chapter 3 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapters 4, 6 to 7 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)

Lesson-11

THE CONSONANTS OF ENGLISH-II

At the end of this section, the students will be able to:

- RECOGNIZE and EXPLAIN the phenomena of overlapping, co-articulation and rules for English consonant allophones.

Topic-060: Overlapping Gestures

Speech sounds are produced with the movements of the articulators and sounds are often described in terms of their articulatory gestures. Remember that sounds are not static; they are movements. This idea makes it easier to understand the overlapping of sounds in terms of their articulatory gestures. Try saying words *twice, dwindle, quick* and analyze the rounding of your lips for sound /w/. In each of these three words, the first stop sounds are slightly rounded (when they are clustered with /w/ - /tw/, /dw/ and /kw/ respectively). In these words, there is a tendency for gestures to overlap with those for adjacent sounds (stops with bilabial /w/ in this case). This kind of gestural overlapping, in which a second gesture starts during the first gesture, is sometimes also called anticipatory co-articulation. The articulatory gesture for the approximant sound is anticipated during the articulatory gesture for the stop. The same kind of anticipatory overlapping takes place in words like *tree* and *dream* (compare them with *tea* and *deem*). In phonology, overlapping refers to the possibility when a phone may be assigned to more than one phoneme (phonemic overlapping). As a notion, overlapping was introduced by American structural linguists in the 1940s.

Topic-061: Aspects of Connected Speech

Overlapping is a common feature of connected speech. In a rapid (connected) speech, overlapping between sounds results in the positions of some parts of the vocal tract being influenced quite a lot by neighboring targets thus creating various forms (allophones) for one phoneme. Keeping in mind this possibility of overlapping, a phoneme is an abstract unit that may be realized in several different ways (forms - allophones). Similarly, the differences between various allophones of a phoneme can be explained in terms of targets and overlapping gestures. The difference between two different forms of /k/ sound (as the [k] in *key* and the [k] in *caw*) may be simply due to their overlapping with different vowels in context. Similarly, the alveolar [n] in *ten* is different than the dental [n̪] in *tenth*. Both are the result of aiming at the same target, but in *tenth*, the realization of the phoneme /n/ is influenced by the dental target required for the following sound.

Topic-062: Co-articulation

An articulation is an articulatory phenomenon which involves a simultaneous overlapping of more than one points in the vocal tract as in the co-ordinate stops (/pk/, /bg/, /pt/ and /bd/) often heard in some languages from West Africa. Co-articulation, at times, leads to create a difference between two allophones (which is actually the result of aiming at different targets). In experimental phonetics, co-

articulation is a way of finding out how the brain controls the production of speech sounds. When we speak, many muscles are active at the same time and sometimes the brain tries to make them do things at a time that they are not capable of. For example, in the word *mum* /mʌm/, the vowel phoneme is one that is normally pronounced with the soft palate (velum) raised to prevent the escape of air through the nose, while the two m phonemes must have the soft palate lowered. Thus, the soft palate cannot be possibly raised so quickly, and, as a result, the vowel is most likely to be pronounced with the soft palate (velum) still lowered – making the vowel a nasalised one. Thus, in this case, the nasalization is a co-articulation effect which is caused by the nasal consonants in context (environment). Another example is the lip-rounding as discussed in Topic 60 above.

Topic-063: Rules for English Consonant Allophones (ECA)

Based on the above discussion on overlapping and co-articulatory gestures, the rules for English consonantal allophones are summarized here in this topic. Remember that it is just a list of a set of formal statements simply describing the behavior of a language. These are not the kind of prescriptive grammar rules that people are expected to abide by.

1. Consonants are longer when at the end of a phrase (e.g., *bib, did, don* and *nod*).

2. Voiceless stops (e.g., p, t, k) are aspirated when they are syllable initial (*pip, test, kick*).

3. Voiced obstruents (b, d, g, v, ð, z, ʒ) are voiced only when they occur at the end of an utterance or before a voiceless sound.

4. Voiced stops (b, d, g) and affricate (dʒ) are voiceless when they are syllable initial (except when immediately preceded by a voiced sound – compare *a day* with *this day*).

5. Voiceless stops (p, t, k) are unaspirated after /s/ in words such as *spew, stew* and *skew*.

6. Voiceless obstruents (p, t, k, tʃ, f, θ, s, ʃ) are longer than their voiced counterparts (b, d, g, dʒ, v, ð, z, ʒ) at the end of a syllable (e.g., *cap - cab* and *back – bag*).

7. Approximants (w, r, j, l) are at least partially voiceless when they occur after initial voiceless stop sounds (e.g., *play, twin, cue*).

8. The gestures for consecutive stops overlap, so that stops are unexploded when they occur before another stop (e.g., *apt* and *rubbed*).

9. In many accents of English, syllable final voiceless stops /p, t, k/ are accompanied by an overlapping glottal stop gesture (e.g., *tip, pit, kick*).

10. /t/ is replaced by a glottal stop when it occurs before an alveolar nasal (e.g., *beaten*).

    Nasals are syllabic at the end of a word - after an obstruent (e.g., *leaden, chasm*).

12. The lateral /l/ is syllabic at the end of a word - a consonant (e.g., *paddle, whistle*).

Topic-064: Rules for English Consonant Allophones (ECA): Explanation

1. An alveolar stop becomes a voiced tap when it occurs between two vowels the second of which is unstressed (*winter – winner*)

2. An alveolar consonant becomes dental before dental consonant (*eighth, tenth, wealth*).

3. Alveolar stops are reduced or omitted when between two consonants (/moʊst p**I**pl/ - /moʊs p**I**pl/).

4. A homorganic voiceless stop may occur after a nasal before a voiceless fricative followed by an unstressed vowel in the same word (e.g., hearing /t/ in in both *agency* and *grievances*).

5. A consonant is shortened when it is before an identical consonant (e.g., /k/ in *cap and kept*).

6. Velar stops become more frontal before more frontal vowels. (e.g., *clap* and *talc*).

7. The lateral /l/ is velarized after a vowel or before a consonant at the end of a word.

Further readings on this section:

- Chapter 3 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapters 4, 6 to 7 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)

Lesson-12

THE CONSONANTS OF ENGLISH-III

At the end of this section, the students will be able to:

- RECOGNIZE and EXPLAIN various diacritic symbols and other resources such as ipatypeit.org and IPA charts.

Topic-065: Introduction to Diacritics

While transcribing (accurately and in detail), a small mark is added to a phonetic symbol to show the way it is spoken. Diacritics include various marks such as accent marks (´ ` ^), the signs of devoicing [o] and nasalization [~]. The diacritic marks may be placed over a symbol, under it, before it, after it, or through it. The International Phonetic Association (IPA) recognizes a wide range of such marks (diacritics) for both vowels and consonants. In the case of vowels, diacritics indicate differences in frontness, backness, closeness or openness, and lip-rounding or unrounding, nasalization and centralization. On the other hand, in the case of consonants, diacritics are used for voicing or voicelessness, for advanced or retracted place of articulation, aspiration and many other aspects. These small marks are very important for detailed (narrow) transcription.

Topic-066: Diacritics and Detailed Transcription

For a detailed transcription, diacritics are used to a symbol in order to narrow its meaning. The following six diacritics are quite important for attempting the detailed transcription exercises:

S. No:	Feature	Symbol		Examples	Transcription
1.	Voiceless	◌̥	(small circle below)	quick	/kw̥ɪk/
2.	Aspirated	◌ʰ	(small /h/ above)	kiss	/kʰɪs/
3.	Dental	◌̪	(dental sign below)	health	/hə l̪θ/
4.	Nasalized	◌̃	(tilde symbol above)	man	/mæ̃n/
5.	Velarized	◌̴	(tilde symbol through)	pill	/pʰɪɬʰ
6.	Syllabic n	◌̩	(small vertical line below)	mitten	/mɪʔn̩ɪ

Learn these symbols and use them in your assignments.

Topic-067: Aspiration

Aspiration is a puff of noise made when a consonantal constriction is released and air is allowed to escape relatively freely (e.g., in English /p t k/ at the beginning of a syllable are aspirated). Phonetically, aspiration is the result of the vocal cords being widely parted at the time of the articulatory release. Is some languages (such as English) aspiration is allophonic while in others (such as Urdu) it is phonemic. Pronunciation teachers used to make learners of English practice aspirated plosives by seeing if they could blow out a candle flame with the rush of air after p t k – this can, of course, lead to a rather

exaggerated pronunciation (and superficial burns). A rather different articulation is used for the so-called voiced aspirated plosives found in many Indian languages (often spelt as 'bh', 'dh', 'gh') where after the release of the constriction the vocal folds vibrate to produce voicing, but are not firmly pressed together; the result is that a large amount of air escapes at the same time, producing a "breathy" quality. It is not necessarily only stops that are aspirated as both unaspirated and aspirated affricates also exist in Urdu.

Topic-068: Nasalization

Nasalization is an articulatory process whereby a sound is made 'nasal' (when the air is passing through the nasal cavity) due its adjacent nasal sound (it is an articulatory influence of an adjacent nasal consonant, as in words like *mat* or *hand*). A vowel can also be nasalised in words like *man* (when /a/ may be articulated with the soft palate lowered throughout), because of the nasal consonants' influence (this is called anticipatory coarticulation). Remember that there is a difference between a 'nasal' and a 'nasalised' sound. A sound is nasalized when the nasality comes from other sounds (such as above where the vowel would be referred to as a 'nasalized' vowel) whereas the 'nasal' term suggests that the nasality is an essential identifying feature of a sound (in Urdu there are many nasal sounds). A 'nasalized consonant', on the other hand, is a consonant which, though normally oral, is articulated in a nasal manner because of some adjacent (nasal) sound.

Topic-069: Velarisation

In co-articulation, velarisation is a process whereby a constriction in the vocal tract is added to the primary constriction which gives a consonant its place of articulation. More specifically, velarisation is an example of secondary articulation. In the case of English "dark /l/", the /l/ phoneme is produced with its usual primary constriction in the alveolar region (try speaking this sound). It is like the back of the tongue is raised for an /u/ vowel sound creating a secondary (articulation) constriction. There are more examples, life vs. file (/laɪf/ /faɪɬ/) clap vs. talc (/klæp/ /tælk/). It is a very common feature of Arabic and is quite important and interesting for acoustic analysis.

Further readings on this section:

- Chapter 3 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapters 4 to 6 of the additional reading book (**Transcribing the Sound of English - A Phonetics Workbook for Words and Discourse**) by Paul Tench
- Online sources: www.ipatypeit.org

Lesson-13

ENGLISH VOWELS-I

At the end of this section, the students will be able to:

- EXPLAIN the fundamental features of English vowels.

Topic-070: Introduction to English Vowels

Although the RP accent of English has 20 vowel sounds (including monophthongs – short and long vowels and diphthongs) yet there is a discrepancy about the number of vowels in other varieties of English. As a result, the vowels of English can be transcribed in many different ways because accents of English differ greatly in the vowels they use, and because there is no one (single) right way of transcribing even a single accent of English. There are different sets of symbols used for the transcription of English vowels depending on the accent of the language and the reason for making the transcription. The difference in English vowels is not only related to the number of vowels but it is also found in the 'length' and 'quality' of vowel sounds. In order to fully understand the nature of English vowels, we need not only to examine various varieties of English but also the vowel quality and vowel space.

Topic-071: Vowel Quality

Quality is a term used in auditory phonetics and phonology to refer to the characteristic resonance, or timbre of a sound, which is the result of the range of frequencies constituting the sound's identity. Variations in vowels are describable in terms of quality, (e.g. the distinction between [i] and [e] vowels etc.) would be called a qualitative difference. One of the major problems describing vowels is the difficulty to describe precisely the tongue position (during the production of a vowel) as people cannot determine appropriately for themselves where their tongues are. So it is important for you to remember that the terms we are using (for the description of vowels) are simply labels that describe how vowels sound in relation to one another. They are not absolute descriptions of the position of the body of the tongue. The reason is that it is perfectly possible to make a vowel sound that is halfway between a high-vowel and a mid-vowel and even it is possible to make a vowel at any specified distance between any two other vowels. This is because of the fact that vowels form a continuum (try gliding from one vowel to another -from /æ/ in *had* to /i/ as in *he* (try to stay as long as possible on the sounds between them). The result you can see is the difference in vowel quality.

Topic-072: Auditory Vowel Space

Vowel sounds are tricky to be described phonetically accurately because they are points, or rather areas, within a continuous space. A language has a certain finite number of contrasting vowels, each of which may be represented with a discrete alphabetic symbol but phonetically each will correspond to a range of typical values, and between any two actual vowel sounds there is a gradient continuum which determines the dimensions of auditory vowel space. Phonetically, the four vowels [i, æ, ɑ, u] (as given in the cardinal vowel system) give us something like the four corners of a space showing the auditory

qualities (or possibilities) of auditory vowel space. Phoneticians often use terms like high, low, back, and front when they simply label the auditory qualities of vowels and do not describe tongue positions.

Topic-073: American and British Vowels

Many of the American vowels are essentially different than those of British – and that is why it is a different English (compare Standard American Newscaster English with British English as spoken by BBC newscasters). When you carefully listen to American vowels [i, ɪ, ɛ, æ] as in words *heed, hid, head, had* (spoken by a native speaker of English) these vowels sound as if they differ by a series of equal steps. Even some Eastern American speakers would make a distinct diphthong in *heed* so that their [i] is really a glide (diphthong) starting from almost the same vowel as that in hid. Similarly, the back vowels also vary considerably in both forms of English (e.g., many Californians do not distinguish between the vowels in words *father and author*). Similarly, the vowels [ʊ, u] as in *good* and *food* also vary considerably as they have a very unrounded vowel in *good* and a rounded but central vowel in *food*. In short, American English in ways is distinct from the British English and as the students of phonetics and phonology we should try to explore these differences.

Further readings on this section:

- Chapter 4 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapters 2 and 3 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)

Lesson-14

ENGLISH VOWELS-II

At the end of this section, the students will be able to:

- EXPLAIN the fundamental features of English vowels and diphthongs.

Topic-074: Diphthongs

Diphthong is a single vowel consisting of the features of two vowels. Its most important feature is the glide from one vowel quality to another one (so basically it is a glide). The BBC accent of English contains a large number (eight in total) of diphthongs including three ending at /ɪ/ (eɪ, aɪ, ɔɪ – as in words *bay*, *buy* and *boy*), two ending at /ʊ/ (əʊ, aʊ – as in words *no* and *now*) and three ending at /ə/ (ɪə, eə, ʊə - as in words *peer*, *pair* and *poor*). There had been a point of difference whether a diphthong should be treated as a single phoneme (in its own right) or it is a combination of two phonemes.

On the basis of phonetic classification of vowel sounds and manners of articulation, we need to compare diphthongs with monophthongs and triphthongs;

- a monophthong is a vowel with no qualitative change in it
- a diphthong is a vowel where there is a single (perceptual) noticeable change in quality during a syllable (as in English words *beer*, *time* and *loud*)
- a triphthong is a vowel where two such changes can be heard.

Diphthongs, or 'gliding vowels', are usually classified into phonetic types depending on one of the two elements that is the more sonorous: 'falling' (or 'descending') diphthongs have the first element stressed. In the English examples: 'rising' (or 'ascending') diphthongs have the second element stressed.

Topic-075: Rhotic Vowels

This term is used to describe some varieties of English (e.g., American) pronunciation in which the /r/ phoneme is found in all its phonological contexts. Remember that in the BBC accent of English, /r/ is only found before vowels (as in 'red' /red/, 'around' /əraʊnd/), but never before consonants or before a pause. In rhotic (e.g., some American) accents, on the other hand, /r/ may occur before consonants (as in 'cart' /ka:rt/) and before a pause (as in 'car' /kɑ:r/). While the BBC accent is non-rhotic, many accents of the British Isles are rhotic (including most of the south and west of England, much of Wales, and all of Scotland and Ireland). Similarly, most speakers of American English speak with a rhotic accent, but there are non-rhotic areas including the Boston area, lower-class New York and the Deep South. From English language teaching point of view, foreign learners encounter a lot of difficulty in learning not to pronounce /r/ in the wrong places.

Topic-076: Unstressed Syllables

A vowel may take one out of three forms: stressed, unstressed and reduced. Most of the time a vowel is completely pronounced when it is in a stressed syllable but the same vowel is different in quality (allophonic form) when it takes place in an unstressed syllable, and, of course, it is reduced to another form when it is in a reduced syllable. Remember that in most cases, various reduced vowels are taking the shape of a schwa vowel /ə/. The symbol /ə/ may be used to show many types of vowels with a central, reduced vowel quality. A vowel in an unstressed syllable does not necessarily have a completely reduced quality. All the English vowels can occur in unstressed syllables in their full, unreduced forms and not all but many of them can occur in all possible three forms.

Further readings on this section:

- Chapter 4 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapter 3 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)

© Virtual University of Pakistan

Lesson-15

ENGLISH VOWELS-III

At the end of this section, the students will be able to:

- EXPLAIN the fundamental features of Tense and Lax vowels (and their consonantal counterparts as Fortis and Lenis) along with the rules for English vowel allophones.

Topic-077: Tense and Lax Vowels

Tense and Lax are the labels of 'strong' and 'weak' given to vowels on the basis of their behavior. This is one of the comparative features of sound set up by Jakobson and Halle in their distinctive feature theory of phonology to show variations in the manner of articulation for vowels. Lax sounds are produced with less muscular effort and movement, and are relatively short and indistinct vowel sounds (e.g., i, e, ɒ, æ, ʌ, ʊ, ə vowels articulated near the center of the vowel area) compared to tense sounds (e.g., u:, i:, ɜ:, a:, ʊə, iə). In other words, a lax vowel is said to be the one produced with relatively little articulatory energy. Since there is no established standard for measuring articulatory energy, this concept only has meaning if it is used in relation to some other sounds that are articulated with a comparatively greater amount of energy (the term tense is used for this). It is mainly American phonologists who use the terms lax and tense in describing English vowels. The terms can also be used for consonants as equivalent to fortis (tense) and lenis (lax), though this is not commonly done in present-day description.

Topic-078: Fortis and Lenis Consonants

These are the terms used in the phonetic classification of consonantal sounds on the basis of their manners of articulation. Fortis refers to a sound made with a relatively strong degree of muscular effort and breath force compared with the other sound (known as lenis). The distinction between tense and lax is used for vowels on the similar lines. The labels 'strong' and 'weak' are sometimes used for the contrast involved, but these are more prone to ambiguity. In English, these are the voiceless consonants ([p], [t], [f], [s], etc.) which tend to be produced with fortis articulation (their voiced counterparts being relatively weak i.e., lenis), and often, when the voicing distinction is reduced, it is only the degree of articulatory strength which maintains a contrast between sounds. The term 'fortis' is sometimes used loosely to refer to strong vowel articulation also, but this is not a standard practice.

Topic-079: Rules for English Vowel Allophones

Following is the list of statements regarding the rules for English vowel allophones:

1. Other things being equal, a given vowel is longest in an open syllable, next longest in a syllable closed by a voiced consonant, and shortest in a syllable closed by a voiceless consonant (e.g., compare sea, seed, seat or sigh, side, site).

2. Other things being equal, vowels are longer in the stressed syllables (e.g., compare below and billow).

3. Other things being equal, vowels are longest in monosyllabic words, next longest in words with two syllables, and shortest in the words with more than two syllables (e.g., speed, speedy, speedily).

4. A reduced vowel may be voiceless when it is after a voiceless stop (and before a voiceless stop. Compare *potato* with *catastrophe*.

5. Vowels are nasalized in syllables closed by a nasal consonant (e.g., /man/).

6. Vowels are retracted before syllable final [ɧ] (as in words *peel, pail, pal*). Compare your pronunciation of /i:/ in heed and heel, of /eɪ/ in paid and pail, and [æ] in pad and pal.

Further readings on this section:

- Chapter 4 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapters 3 and 4 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)

Lesson-16

ENGLISH WORDS AND SENTENCES-I

At the end of this section, the students will be able to:

- EXPLAIN the fundamental features of connected speech.

Topic-080: English Words and Sentences

There is a lot of difference between words spoken in isolation than in a connected speech. The key difference between citation speech (where a word is in its complete form) and connected speech is the variable degree of emphasis placed on different words in the connected speech. This "degree of emphasis" is probably related to the amount of information that a word conveys in a particular utterance (in conversation). For example, the citation speech/conversational speech difference is particularly noticeable for the closed class of words. This class of words such as determiners (a, an, the), conjunctions (and, or), and prepositions (of, in, with)—the grammatical words—are very rarely emphasized in the connected speech, and thus their normal pronunciation in the connected speech is quite different from their citation speech forms. But remember that, as with other words, closed-class words show a strong form, which occurs when the word is emphasized, as in sentences such as: *He wanted pie **and** ice cream, not pie **or** ice cream*. There is also a weak form which occurs when the word is in an unstressed position.

Topic-081: Words in Connected Speech

Words can have two possible forms: weak and strong. In other words, one of the two possible pronunciations for a word in the context of connected speech is 'strong' and the other is 'weak'. The 'strong' form is the result of a word being stressed (e.g., I want bacon and eggs vs. I want bacon **and** eggs – where the stress is on AND in order to emphasize it). The notion is also used for syntactically conditioned alternatives, such as your *book* vs. the book is *yours*. On the other hand, the weak form is that which is the result of a word being unstressed as in the normal pronunciation of OF in *cup of tea*, and in most other grammatical (closed form of) words. Several (closed class/function) words in English have more than one weak form (e.g. and [ænd] can be [ənd], [ən], [n], etc.

Topic-082: Stress

Stress is a term used in phonetics to refer to the degree of force (for making it louder and longer) used in producing a syllable. The usual distinction is between stressed and unstressed syllables, the former being more prominent than the latter (and marked in transcription with a raised vertical line, [ˈ]. This prominence is usually due to an increase in loudness of the stressed syllable, but increases in length and often pitch may also contribute to the overall impression of prominence. Stressed syllables are produced with *greater effort* (force) than unstressed and stressed syllables tend to be longer than the unstressed. In terms of its linguistic function, stress is often treated under two different headings: word stress (lexical stress) and sentence stress (emphatic stress).

Topic-083: Degree of Stress

The analysis of the degree of stress is another interesting area. It has attracted a great deal of attention in the middle decades of the twentieth century. The point is how many degrees of stress need to be recognized in order to account for all such contrasts, and show the inter-relationships between words derived from a common root, such as *telegraph*, *telegraphic* and *telegraphy*. In the American structuralist tradition, four such degrees are usually distinguished, and analyzed as stress phonemes, namely (from strongest to weakest) (1) 'primary', (2) 'secondary', (3) 'tertiary' and (4) 'weak'. These contrasts are, however, demonstrable only on words in isolation as in the compound *elevator operator*. In phonological analysis, most of the experts only distinguish among three degrees of stress namely 'primary', 'secondary' and 'weak' or 'unstressed' (e.g., ɪg.ˌzæm.ɪ.ˈneɪ.ʃən).

Topic-084: Stress Explanation

Stress is a large topic and despite the fact that it has been extensively studied for a very long time, there remain many areas of disagreement or lack of understanding. So, it is important to consider what factors make a syllable count as stressed. Stress is basically a prominence of syllable in terms of loudness, length, pitch and quality and all of them work together in order to make a syllable stressed. As discussed above, two types of stress are important. Firstly, stress on a syllable within a word (the lexical stress) which changes the grammatical category of a word (compare **in**sult with in**sult**) and also change meaning among other things. On the other hand, stress on a word or certain words in a phrase or sentence. This type of stress (on word(s) within sentences) is called sentence level or prosodic stress. This is, in fact, a change or modification to word level stress in a sentence which is basically a change of 'beat' on certain words in a sentence. Remember that, we create 'rhythm' in spoken language on the basis of stress. Analyze the following examples (stressed words are shown in bold):

Mary's *younger* ***brother*** *wanted* ***fifty*** *chocolate* ***peanuts.***

So, what is happening here in this sentence is about the distinguishing degree of emphasis which is used for creating contrast in sentences or lines of verse. The question is: why do we create this difference? This takes place in order to differentiate in environment – superimposition of intonation (degree of prominence) and it is also the part of the formality of a language.

Further readings on this section:

- Chapter 5 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapters 10, 11 and 14 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)

Lesson-17

ENGLISH WORDS AND SENTENCES-II

At the end of this section, the students will be able to:

- RECOGNIZE and EXPLAIN sentence rhythm, intonation and target tones.

Topic-085: Sentence Rhythm

Sentence rhythm is another feature of a connected speech. Actually, speech is perceived as a sequence of events in time, and the word rhythm is used to refer to the way events are distributed in time. Obvious example of vocal rhythms is chanting as part of games (for example, children calling words while skipping or cricket crowds calling their favorite team's name). In conversational speech, the sentence rhythm is a bit complicated, but it is clear that the timing of speech is not random. An extreme view (though a quite common one) is that English speech has a rhythm that allows us to divide it up into more or less equal intervals of time called feet, each of which begins with a stressed syllable: this is called the stress-timed rhythm hypothesis (and languages are divided on the basis of this phenomenon into stress-timed and syllable-timed languages). Languages where the length of each syllable remains more or less the same as that of its neighbors whether or not it is stressed are called syllable-timed languages. Most evidence from the study of real speech suggests that such rhythms only exist in a very careful and controlled speech, but it appears from psychological research that listeners' brains tend to hear timing regularities even where there is little or no physical regularity found.

Topic-086: Intonation

Intonation refers (very) simply to the variations in the pitch of a speaker's voice (f_0) used to convey or alter meaning but in its broader and more popular sense intonation covers much of the same field as 'prosody' where variations in such things as voice quality, tempo and loudness are included. It is certainly possible to analyze pitch movement (or its acoustic counterpart, fundamental frequency) and find regular patterns that can be described and tabulated. Some experts look for an underlying basic pitch melody (or a small number of melodies) and then describe the factors that cause deviations from these basic melodies. On the other hand, there are experts who have tried to break down these pitch patterns into small constituent units such as "pitch phonemes" and "pitch morphemes". The approach most widely used in Britain takes the tone unit as its basic unit and looks at the different pitch possibilities of the various components of the tone unit (the pre-head, head, tonic syllable/nucleus, tail, etc.). Intonation is said to convey emotions and attitudes. Other linguistic functions have also been claimed (e.g., grammatical structure and new information – the effect of prominence). Interesting relationships exist in English between intonation and grammar; for example, in a few extreme cases a perceived difference in grammatical meaning may depend on the pitch movement.

Topic-087: Explaining Intonation

'Intonation' is pitch variation at sentence level and it could be described in terms of intonational phrase. In order to describe intonation, we need to analyze the role of a 'stressed syllable' (i.e., pitch change of one syllable) which further creates a major change 'tonic accent' (marked with an asterisk) to create the pitch peak in an intonational phrase. Similarly, a formal category of intonational phrase is also sometimes recognized (an utterance span dominated by boundary tones). As the part of suprasegmental phonology, intonation refers to the distinctive use of patterns of pitch, or melody. There are several ways for analyzing intonation. In some approaches, pitch patterns are described as contours and analyzed in terms of levels of pitch as pitch phonemes and morphemes; in others, the patterns are described as tone units or tone groups, analyzed further as contrasts of nuclear tone, tonicity, etc. This is important to note that intonation performs several functions in a language - the most important function is as a signal of grammatical structure, where it performs a role similar to punctuation in writing. The marking of sentence, clause and other boundaries, and the contrast between some grammatical structures, such as questions and statements, may be made using intonation. For example, the change in meaning illustrated by 'Are you asking me or telling me?' is regularly signaled by a contrast between 'rising' and 'falling' pitch, e.g., 'He's going, isn't he?' (= I'm asking you) opposed to 'He's going, isn't he!' (= I'm telling you). A second important role of intonation is in the communication of personal attitude (e.g., sarcasm, puzzlement, anger, etc.) which can all be signaled by contrasts in pitch along with other prosodic and paralinguistic features. Other roles of intonation in language have been suggested (e.g., as one of the ways of signaling social background).

Topic-088: Target Tones

Although 'tone' as a word has a very wide range of meanings and uses in ordinary languages, its meaning in phonetics and phonology is quite restricted. It refers to an identifiable movement or level of pitch that is used in a linguistically contrastive way. In typical 'tone' languages, the linguistic function of tone is to change the meaning of a word. For example, in Mandarin (Chinese), / ́ma/ said with high pitch means 'mother' while / ̌ma/ spoken on a low rising tone means 'hemp'. In other (non-tonal) languages, tone forms the central part of intonation, and the difference between, for example, a rising and a falling tone on a particular word may cause a different interpretation of the sentence in which it occurs. In the case of tone languages, it is usual to identify tones as being a property of individual syllables, whereas an intonational tone may be spread over many syllables. Similarly, in the analysis of English intonation, tone refers to one of the pitch possibilities for the tonic (or nuclear) syllable, a set usually including fall, rise, fall–rise and rise–fall, though others are also suggested by various experts.

Topic-089: Explaining Target Tones

There are several ways for analyzing intonation. In some approaches, the pitch patterns are described as contours and are further analyzed in terms of levels of pitch as pitch phonemes and morphemes. In others, the patterns are described as tone units or tone groups, analyzed further as contrasts of nuclear tone, tonicity, etc. The three variables (1) pitch range, (2) height and (3) direction are generally distinguished. Some approaches (especially within pragmatics), operate with a much broader notion than that of the tone unit (i.e., intonational phrasing is a structured hierarchy of the intonational

constituents in conversation). A formal category of intonational phrase is also sometimes recognized (i.e., an utterance span dominated by boundary tones). One of the most recently developed methods is called the 'tone and break indices' (ToBI). This method is used for the description of intonation (H/L) representing pitch changes and showing pitch accent – phrase accent and boundary by showing tone and break indices. This is based on describing High (H) and Low (L) pitches in a sentence representing pitch changes and showing pitch accent – phrase accent and boundary (of the phrase).

Further readings on this section:

- Chapter 5 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapters 14 to 19 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)

Lesson-18

AIRSTREAM MECHANISMS

At the end of this section, the students will be able to:

- EXPLAIN the airstream mechanisms involved in the production of speech sounds as a source of energy.

Topic-090: Airstream Mechanisms

All human speech sounds are produced by making the air move (in oral and nasal cavity) thus creating the airstream. Now the study of how and what type of air move is involved is called the airstream mechanism. Most commonly, the air is moved outwards from the body (creating an egressive airstream) but more rarely, speech sounds are also made by drawing air inward (into the body – an ingressive airstream). In other words, 'airstream' is a term used in phonetics for a physiological process which provides a source of energy capable of being used in speech sound production. There are various forms and mechanisms for initiating the air move. The most common is when the air is moved inwards or outwards by initiating air movement involving 'lungs' (the pulmonic airstream), which is used for producing the majority of human speech sounds. The 'glottalic' airstream mechanism, as its name suggests, uses the movement of the glottis - the aperture between the vocal folds as the source of energy. The third one is the 'velaric' airstream mechanism which involves an airflow produced by a movement of the back of the tongue against the velum.

Topic-091: Pulmonic Airstream Mechanism

Pulmonic airstream mechanism is the most commonly used mechanism for speech production by human beings. Almost all the sounds we produce in speaking are created with the help of air compressed by the lungs. The adjective used for this lung-created airstream is 'pulmonic': the pulmonic airstream may be ingressive (as in breathing in) but for speaking practically, it is always egressive (speech sounds are produced while pushing the air out). In order to understand this mechanism, we'll have to analyze the human respiratory system. Under this system, the respiratory muscles set the air in motion. Lungs – the sponge like tissues – contained within air cage called the diaphragm – contract and enlarge lung cavity thus creating the egressive – ingressive actions. This mechanism set an air flow for speech production and human beings produce speech sounds while pushing the air out.

Topic-092: Glottalic Airstream Mechanism

This mechanism involves 'glottis' as the adjective could be used to refer to anything pertaining to the glottis. A glottalic airstream is produced by making a tight closure of the vocal folds and then moving the larynx up or down thus raising of the larynx pushes the air outwards causing an egressive glottalic airstream. Similarly, while lowering, the larynx pulls air into the vocal tract and it is called an ingressive glottalic airstream. Sounds of this type found in human language are called ejective or implosive

respectively. Glottalization as a process is used for any articulation involving a simultaneous glottal constriction (e.g., a glottal stop). In English, glottal stops are often used in this way to reinforce a voiceless plosive at the end of a word as in *what*. Such sounds, made while the glottis is closed, are produced without the direct involvement of air from the lungs. Air is compressed in the mouth or pharynx above the glottal closure, and released while the breath is still held thus the resultant sounds produced in this glottalic airstream mechanism are known as ejective sounds. They are also called 'glottalic' or glottalized sounds (though the latter term is often restricted to sounds where the glottal feature is a secondary articulation). In languages like Quechua and Hausa ejective consonants are used as phonemes. A further category of sounds involving a glottalic airstream mechanism is known as implosive.

Topic-093: Velaric Airstream Mechanism

In addition to pulmonic and glottalic airstream mechanisms, there is a third possibility involving velum. Under this mechanism, speech sounds are made by sucking the air (see airstream). This sucking mechanism is used first by babies for feeding and by adult humans in later stages of life for such things as sucking liquid through a straw or drawing smoke from a cigarette (using the back of the tongue against the velum). The basic mechanism for this is the air-tight closure between the back of the tongue and the soft palate, just as if the tongue is then retracted, and the pressure in the oral cavity is lowered and suction takes place. Consonants produced with this mechanism are called clicks. These sounds have a distinctive role in some languages such as Zulu. In English, they may be heard in the 'tut tut' (or tsk tsk) sounds, and in a few other contexts.

Topic-094: Summary of the Airstream Mechanisms

There are three possible mechanisms involved in human speech production. The most common one is the moving of air by compression of the lungs so that the air is expelled through the vocal tract (this is called a pulmonic airstream - usually an egressive pulmonic one, but occasionally speech is produced while breathing in). The second one is the glottalic (produced by the larynx with closed vocal folds - it is moved up and down like the plunger of a bicycle pump) and the last one is called velaric (where the back of the tongue is pressed against the soft palate or velum - making an air-tight seal, and then drawn backwards or forwards to produce an airstream). The ingressive glottalic consonants (often called implosives) and egressive ones (ejectives) are found in many non-European languages. On the other hand, click sounds (ingressive velaric) are much rarer, but occur in a number of southern African languages such as Nàmá, Xhosa (or Hausa) and Zulu. Speakers of other languages including English use click sounds for non-linguistic communication as in the case of the "tut-tut" (equal to the American "tsk-tsk") known as the sounds of disapproval.

Further readings on this section:

- Chapter 6 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapter 2 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)

Lesson-19

PHONATION

At the end of this section, the students will be able to:

- EXPLAIN various aspects of phonation and states of the glottis during the production of speech sounds.

Topic-095: Introduction to Phonation

The position of larynx (also known as sound box) and the vocal folds inside larynx are very important in the description of speech sounds. 'Phonation' is a technical term used for describing the forms of vibration of the vocal folds (or vocal cords) and the process is more commonly known as voicing. The glottis (which is defined as the space between the vocal folds) can assume a number of shapes (such as voiced, voiceless, murmuring and creaky positions). The most common positions of vocal folds are used to describe the two possible features of consonant sounds by considering sounds to be either voiceless with the vocal folds apart (such as /p/ and /t/) or voiced with the folds nearly together so that they will vibrate when air passes between them (such as /b/ and /g/). These glottal states are important in the description of speech sounds in particular languages and in the description of pathological voices. The process of phonation is also known as 'voicing' and laryngeal activity.

Topic-096: Phonation Explanation

'Phonation' is a general term used in phonetics to refer to any vocal activity in the larynx (i.e., sound box). The possibilities of various kinds of vocal-fold vibration (voicing or phonation) are the main phonatory activities, and the study of phonation types is aimed at accounting for the various laryngeal possibilities (such as voiced, voiceless, breathy and creaky voice). Some phoneticians also include the modifications in phonation under this heading which stem from variations in length, thickness and tension of the vocal folds as displayed in the various registers of speech. Actually during the phonation process, what happens is that the air passes between the vocal folds and modification to the air passage takes place in the laryngeal area thus creating variation in intensity, frequency and quality of the sound. This has an important role in speech including the voicing of sounds and murmuring.

Topic-097: States of the Glottis

As discussed earlier, the space between the vocal folds (glottis - inside the larynx) can assume a number of positions thus modifying the form of speech sounds and changing the features of it. When brought into light this contact of vocal folds with each other, the shape of vibration (of air passage) is forced to produce phonation or voicing. So, based on the possibilities of the nature of vibration, the states of glottis are determined thus the vibration can be made to vary in many ways, resulting in differences in such things as pitch, loudness and voice quality. If a narrow opening is made between the vocal folds, friction noise can result and this is found in whispering and in the glottal fricative /h/. A more widely

open glottis is found in most voiceless consonants. In Table 6.6 (chapter six of your course book), four possible states of the glottis are given. Go through them and explore further.

Topic-098: Phonation Types

In order to further explain the nature of the phonation as a process, we need to know the possible phonation types and its description. There are mainly four possible glottis/larynx settings or types of phonation:

- Voiceless – when the folds are open apart and the air passing through the glottis freely (/t/ or /p/).
- Voiced – when the folds are tight together and there is vibration during the air passage though the glottis (e.g., /b/ or /d/).
- Creaky voice – when there is a slight opening in the front and the arytenoid cartilages are tight together, so that the vocal folds can vibrate only at the anterior end (the small opening at the top).
- Breathy or murmuring sound – when the vocal folds are apart but still they are vibrating - a breathy voice is like a whisper except voice.

Topic-099: Voicing and Consonants

Voicing is an important feature of speech sounds which is used not only as a feature but also as a distinction for describing sounds. There are sounds (such as vowels, nasals and approximants i.e., sonorants) which are usually voiced (though in particular contexts the voicing may be weak or absent). On the other hand, there are sounds which may be voiced or voiceless such as fricatives and plosives (together called obstruents). Obstruents are the most frequently found sounds that have both voicing and voicelessness. Remember that voiced and voiceless can make a phonemic distinction (in languages such as English) thus the meaning of a word can change if one uses a voiceless sound instead of a voiced sound. A glottal stop is only an allophonic variation and is used in RP before /p, t, k/. In some dialects these three can even be replaced by a glottal stop altogether. The symbol for a glottal stop is like a question mark [ʔ].

Further readings on this section:

- Chapter 6 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapter 4 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)
- Online sources: http://renu-voice.com/my-voice/
  https://mybookfile.wordpress.com/2016/01/02/phonetics-101-1/

Lesson-20

VOICE ONSET TIME (VOT)

At the end of this section, the students will be able to:

- EXPLAIN and think about analyzing VOT in various languages.

Topic-100: Voice Onset Time (VOT)

All human languages distinguish between voiced and voiceless consonants, and plosives (stops) are the most common consonants to be distinguished using the voicing feature. However, this is not a simple matter of a plosive being either completely voiced or completely voiceless. The timing of the voicing in relation to the consonant articulation is also very important. In one particular case this is so noticeable that it has for a long time been given its own name: aspiration, in which the beginning of full voicing does not happen until for some time after the release of the plosive (usually voiceless). This delay (or lag), has been the subject of much experimental investigation which has led to the development of a scientific measure of voice timing called voice onset time (or VOT). In simple words, the onset of voicing in a plosive may lag behind the plosive release, or it may precede ("lead") contrarily, resulting in a fully or partially voiced plosive. Both can be represented on the VOT scale, one case having positive values and the other negative values (and the third possibility is zero VOT).

Topic-101: VOT Explanation

Voice Onset Time (VOT) is a term used in phonetics referring to the point in time at which vocal-fold vibration starts in relation to the release of a closure (during the production of plosive sounds). In order to understand VOT, the three types of plosive sounds are to be explained – voiced, voiceless and a voiceless aspirated sound. For example, during the production of a fully voiced plosive (e.g., /b/ or /g/), the vocal folds vibrate throughout; in a voiceless unaspirated plosive (such as /p/ or /t/), there is a delay (or lag) before voicing starts; and, in a voiceless aspirated plosive (e.g., /p^h/ or /t^h/), the delay is much longer, depending on the amount of aspiration. The amount of this delay is called Voice Onset Time (VOT) which in relation to the types of plosive varies from language to language.

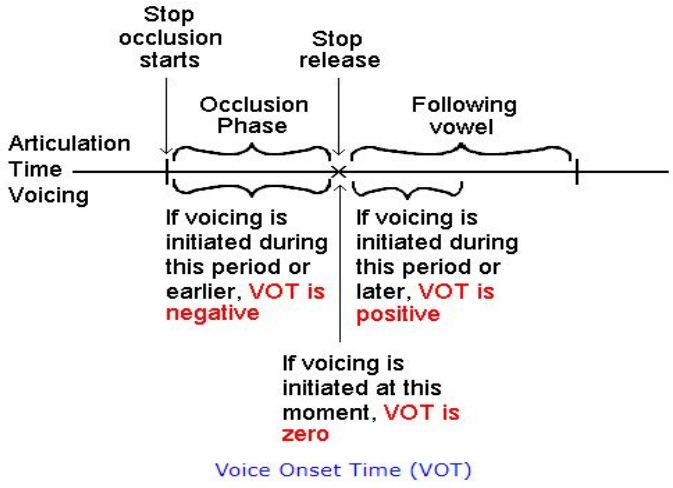
Topic-102: Importance of VOT

VOT is an important feature in experimental phonology and it is used in order to analyze the nature of different languages and their stop sounds. Languages vary in terms of VOT and the delay (lag or VOT) is an important feature to be explored for the comparison of languages. It also provides an important insight regarding the perception of VOT by bilingual learners. Language specific VOT values are further important to be considered by language experts. The VOT values can also provide information regarding the phonemic contrast of appropriate sound production by the learners. Moreover, it also gives an insight regarding the three different possibilities (types of VOTs). VOT is calculated through a specific methodology and important contrastive features are to be taken into account.

Remember that different languages choose different points along the VOT continuum in forming oppositions among stop consonants. Different possibilities that occur in different languages are shown with reference to a scale going from most aspirated (largest positive VOT) at the top to most voiced (largest negative VOT) at the bottom. The Navajo aspirated stops have a very large VOT value that is quite exceptional (150 MS). On the other hand, the normal value for the VOT of English stressed initial /p/ would be between 50 and 60 MS.

Topic-103. Types of VOT

There are three possible types of VOT based on the nature of stop sounds. Firstly, simple unaspirated voiceless stops have a voice onset time at or near zero. This means that the voicing of a following vowel begins at or near to when the stop is released. The second possibility is when aspirated stops are followed by a vowel: voice onset time is greater than zero called a positive VOT. The length of the VOT in such cases is based on the practical measure of aspiration – the longer the VOT, the stronger the aspiration (Navajo, for example, has strongly aspirated stops where, the aspiration (and therefore the VOT) lasts twice as long as that of English - 150ms). The third possibility is when voiced stops have a VOT noticeably less than zero called "negative VOT". This would simply mean that the vocal cords start vibrating before the stop is released. Analyze the following figure taken from (http://clas.mq.edu.au/speech /phonetics/phonetics/airstream_laryngeal/vot.html):



Further readings on this section:

- Chapter 6 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Online sources:

http://savethevowels.org/posts/scuse_me.html

Lesson-21

CONSONANTAL GESTURES - I

At the end of this section, the students will be able to:

- EXPLAIN and DISTINGUISH among various types of articulatory gestures used during the production of English consonants.

Topic-104: Consonantal Gestures

In phonetics and phonology, speech sounds (segments) using basic units of contrast are defined as gestures – they are treated as the abstract characterizations of articulatory events with an intrinsic time dimension. Thus sounds (segments) are used to describe the phonological structure of specific languages and account for phonological variation. In this type of description in phonetics and phonology, sounds are the underlying units which are represented by classes of functionally equivalent movement patterns (gestures). Basically, the idea is to review the speech sounds involving their gestural movements and the purpose is to enhance the ability of the experts to describe unfamiliar sounds (of various languages –as an appropriate description of unknown sounds is considered impossible) just in order to clarify the variation between varieties (of a language such as English) and among various languages and language families. So involving the place of articulation and manners of articulation, sounds are treated as gestures rather than exact locations and manners.

Topic-105: Articulatory Targets

A number of the possible places of articulation that are used in the languages of the world have been defined so far (in this course). The traditional terms which are used for all the places of articulation are not just names for particular locations (on the roof of the mouth). They should be thought of as names for articulatory targets. A large number of non-English sounds are to be found in other languages (such as Iranian and African languages). Many of them involve using gestures in which the target or the place of articulation is different from any similar sound found in English. For others it is the type of gesture or the manner of articulation that is different. Experts illustrate these different types of targets by considering how each place of articulation is used in English and in other languages for making stops, nasals, and fricatives (and treating them all as articulatory targets).

Topic-106: Types of Articulatory Gestures

Based on the definition of gesture as a possibility of the articulation of various speech sounds in contrast with English ones, the possible types of articulatory gestures are given here:

Bilabial gesture – very common in English (e.g., stops and nasal: p, b, m), In some languages (such as Ewe of West Africa), bilabial fricatives contrast with labiodental fricatives. The symbols for the voiceless and voiced bilabial fricatives are [ɸβ]. These sounds are pronounced by bringing the two lips nearly

together, so that there is only a slit between them. Ewe also contrasts voiceless bilabial and labiodental fricatives.

Labiodental fricatives – many languages (including English) have the labiodental fricatives [f, v]. But probably no language has labiodental stops or nasals except as allophones of the corresponding bilabial sounds. In English, a labiodental nasal, [ɱ], may occur when /m/ occurs before /f/, as in *emphasis* or *symphony*.

Dental sounds are present both in British and American English, e.g. dental fricatives [θ, ð] but there are no dental stops, nasals, or laterals except allophonically realized (before [θ, ð] as in *eighth, tenth, wealth).* Many speakers of French, Italian, and other languages (such as Urdu, Pashto and Sindhi) typically have dental stops such as [t̪ d̪]. However, there is a great deal of individual variation in the pronunciation of these consonants in all these languages.

Alveolar are very common targets and stops, nasals, and fricatives all occur in English and in many other languages at alveolar as a target of articulatory gestures (e.g., t, d, n, l, r., etc.).

Retroflex is very common sound in many Pakistani languages which is made by curling the tip of the tongue up and back so that the tongue tip moves during the retroflex sounds such as [ɳ, ŋ, ɲ, ʈ, ɽ]. These sounds are also the feature of Indian English.

Palato-alveolar and **palatal** are also possible articulatory gestures commonly found in world languages. Similarly, velar sounds found in Urdu and other Pakistani languages need to be mentioned here including [x, ɣ] which are velar fricatives. The gestures for pharyngeal (such as Arabic pharyngeal fricative [ʕ]) and epiglottal sounds (such as epiglottal fricative [ʢ] involve pulling the root of the tongue or the epiglottis back toward the back wall of the pharynx. Many people cannot make a stop gesture at this position. But these sounds are found in Arabic and other Semitic languages.

Topic-107: Stops

Typical stop sounds are found in English and other languages of the world but there are some other interesting types of stops which are found in languages other than English. Note the following table and see how rich are the stop sounds found in various languages:

Description	Symbol	Language
1. Voiced	b	English and other languages
2. Voiceless unaspirated	p	-do-
3. Aspirated	p^h	Sindhi and many other Pakistani languages
4. Murmured (breathy)	$b^ɦ$	Sindhi
5. Implosive	ɓ	Sindhi
6. Laryngealized (creaky)	b̰	Hausa
7. Ejective	k’	Hausa
8. Nasal release	dn	Russian

9. Prenasalized	nd	Swahili
10. Lateral release	tɬ	Navajo
11. Ejective lateral release	tɬ’	Navajo
12. Affricate	ts	German
13. Ejective affricate	ts’	Navajo

Topic-108: Nasals

Nasal manners of articulation are commonly found in the languages of the world. Like stops, nasal can also occur voiced or voiceless (for example, in Burmese, Ukrainian and French) though in English and other most languages nasals are voiced. As voiceless nasals are comparatively rare, they are symbolized simply by adding the voiceless diacritic [̥] under the symbol for the voiced sound. There are no special symbols for voiceless nasals and it is written as /m̥/ - a combination of the letter for the voiced bilabial nasal and a diacritic indicating voicelessness.

Topic-109: Fricatives

Fricative as an articulatory gesture may be divided into voiced or voiceless sounds but we can also subdivide fricatives in accordance with other aspects of the gestures that produce them. For example, some authorities have divided fricatives into sounds such as [s], in which the tongue is grooved so that the airstream comes out through a narrow channel, and those such as [θ], in which the tongue is flat and forms a wide slit through which the air flows. On the other hand, a slightly better way of dividing fricatives is to separate them into groups on a purely auditory basis. Say the English voiceless fricatives [f, θ, s, ʃ]. Which two have the loudest high pitches? You should be able to hear that [s, ʃ] differ from [f, θ] in this way. The same kind of difference occurs between the voiced fricatives [z, ʒ] and [v, ð]. The fricatives [s, z, ʒ, ʃ] are called sibilant sounds. They have more acoustic energy—that is, greater loudness—at a higher pitch than the other fricative sounds.

Further readings on this section:

- Chapter 7 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapter 6 and 7 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)

Lesson-22

CONSONANTAL GESTURES-II

At the end of this section, the students will be able to:

- EXPLAIN and DISTINGUISH among various types of articulatory gestures used during the production of English consonants.

Topic-110: Trills, Taps and Flaps

In approximants, trills, taps and flaps are also commonly found with different articulatory gestures in the world languages. These languages vary not only in terms of the nature of the sounds (such as making it a usual /r/ approximant or unusual rhotic approximate [ɹ] found in American English but they also vary in terms of the length of the sound (some making it a short trill, other a long one). The following table covers various types of these approximant sounds found in the world languages:

Voiced alveolar trill	r	Spanish
Voiced alveolar tap	ɾ	Spanish
Voiced retroflex flap	ɽ	Hausa
Voiced alveolar approximant	ɹ	English
Voiced alveolar fricative trill	ɻ	Czech
Voiced uvular trill	ʀ	French
Voiced uvular fricative or approximant	ʁ	Parisian French
Voiced bilabial trill	ʙ	Kele
Voiced labiodental flap	*	Margi

Topic-111: Laterals

As an important articulatory gesture, the central–lateral opposition can be applied to all these manners of articulation producing a lateral stop and a lateral fricative as well as a lateral approximant, which is by far the most common form of lateral sound. The only English lateral phoneme, at least in British English, is /l/ with allophones [l] as in led [lɛd] and [ɬ] as in bell [bɛɬ]. In most forms of American English, initial [l] has more velarization than is typically heard in British English initial [l]. In all forms of English, the air flows freely without audible friction, making this sound a voiced alveolar lateral approximant. It may be compared with the sound [ɹ] in red [ɹɛd], which is for many people a voiced alveolar central approximant. Laterals are usually presumed to be voiced approximants unless a specific statement to the contrary is made.

Topic-112: Summary of the Articulatory Gestures

A number of sounds share various features of speech production in which the underlying units are represented by classes of functionally equivalent movement patterns (gestures). A particular gesture

gradually increases its influence on the shape of the vocal tract thus making many sounds similar in terms of articulatory features. Speech segments are modeled as sets of gestures that have their own intrinsic temporal structure allowing them to overlap one way or the other. In the sections on various stop sounds in world languages, we studied 13 types of stop sounds (i.e., b, p, pʰ, bʱ, ɓ, ɓ̥, k', dn, nd, tɬ, tɬ', ts, ts') and nine types of trill, tap and flap (together one category of approximants) sounds (i.e., r, ɾ, ɽ, ɹ, ɻ, ʁ, ʁ, ʙ, *) with a range of similarities in terms of their articulatory gestures. These examples show that the articulatory gestures for consonants have a wide range of possibilities of similar sounds in world languages.

Topic-113: Explaining the Summary of the Articulatory Gestures

Based on a matrix of features specifying a particular characteristic of a segment and relating that particular characteristic to other similar sounds has made possible a range of similar sounds to be classified in the same class of segments. For example, an 'oral gesture' would specify all supraglottal characteristics (such as place and manner of articulation), and a 'laryngeal gesture' would specify characteristics of phonation. The notion is particularly used in dependency phonology, where 'categorical', 'articulatory' and 'initiatory' gestures are distinguished. Gestures, in turn, are analyzed into subgestures; for example, the initiatory gesture is analyzed into the subgestures of glottal stricture, airstream direction and airstream source. While discussing the articulatory gestures for consonants, it may be remembered that the case of consonants is even more complicated (than vowels). But still a wide range of sounds are put together to classify them mainly on the basis of the characteristics of their primary articulation. However, sounds may also be taken together on the basis of their secondary articulation (e.g., added lip rounding). Analyze the summarizing table of articulatory gestures for the major categories of consonant sounds in the following table:

TABLE 7.8 Manners of articulation.

Phonetic Term	Brief Description	Symbols
Nasal (stop)	Soft palate lowered so that air flows out through the nose; complete closure of two articulators	m, n, ŋ, etc.
(Oral) stop	Soft palate raised, forming a velic closure; complete closure of two articulators	p, b, t, etc.
Fricative	Narrowing of two articulators so as to produce a turbulent airstream	f, v, θ, etc.
Approximant	Approximation of two articulators without producing a turbulent airstream	w, j, l, ɹ, etc.
Trill	An articulator set in vibration by the airstream	r, ʁ, ʙ
Tap	Tongue tip hitting the roof of the mouth; a single movement in a trill	ɾ
Flap	One articulator striking another in passing	ɽ, ɺ
Lateral	With a central obstruction, so that air passes out at the side	l, ɬ, ɮ, ɺ, ʎ, ‖
Central	Articulated so that air passes out the center	s, ɹ, w, etc.

Further readings on this section:

- Chapter 7 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)

Lesson-23

ACOUSTIC PHONETICS-I

At the end of this section, the students will be able to:

- EXPLAIN and DEFINE acoustic phonetics, source/filter theory and tube models.

Topic-114: Acoustic Phonetics

As an important part of phonetics, acoustics is the study of the physics of the speech signal (i.e., when speech sound travels through the air in a wave form) from the speaker's mouth to the hearer's ear through vibrations. In acoustics, it is possible to measure and analyze these vibrations (physical properties) by mathematical techniques usually by using specially-developed computer software to produce spectrograms of speech. Acoustic phonetics also studies the relationship between activity in the speaker's vocal tract and the resulting sounds by involving physics, computer, statistics and a number of experiments in lab. Thus, the analysis of speech using the expertise available in acoustic phonetics is claimed to be more objective and scientific than the traditional auditory method which mostly depends on the reliability of the trained human ear. It also involves advanced level speech software for analyzing sound differences (in terms of pitch, loudness and quality) and distinguishes largely among speech sounds by giving the detailed composition of energy (e.g., frequency on spectrum).

Topic-115: Explaining Acoustic Phonetics

Acoustics is a branch of phonetics which studies the physical properties of speech sound as transmitted between the mouth of a speaker and the ear of a listener. It is mainly devoted to the principles of physics involving the latest technology such as computer and software (e.g., Praat). It is the scientific study of speech sounds wholly dependent on the use of instrumental (lab based) techniques of investigation. It particularly involves electronics and some grounding in physics; however, mathematics is a prerequisite for the advanced study of the subject. In this course, we are going to learn mainly about the basic features of speech sounds (both consonants and vowels). Starting from the very beginning, we will particularly see the fundamental experiments of acoustics (such as recording of speech and annotating and ultimately distinguishing among various forms and features of speech sounds. This course will also introduce you to the mostly used software in acoustic phonetics (i.e., Praat) and its application in the phonetic analysis of human speech. Based on these introductory level experiments during this course, it is expected that the learners would be able to plan advanced level applications and experiments of acoustics.

Topic-116: Acoustic Analysis

According to the experts of speech sounds (phoneticians), acoustic analysis can provide a clear, objective datum for the investigation of speech – the physical 'facts' of utterance. In other words, acoustic evidence is often referred to when one wants to support an analysis being made in articulatory or auditory phonetics. However, it is important to note down that one should not be too reliant on acoustic analyses which are subject to many mechanical limitations (e.g. the need to calibrate measuring devices

accurately), and which are often themselves open to multiple interpretations. Acoustic analysis not only gives us the features of a sound but also tells us about the duration or length of a speech sound. For such an analysis, we need to carefully know about material and procedure of recording. Thus, acoustic analysis describes the durational characteristics, articulatory properties and phonetic differences through physiological measurement.

Topic-117: Acoustic Analysis of Vowels

The experts of phonetics are particularly interested in analyzing vowels acoustically. They describe vowels in terms of numbers (in a language that how many vowels are possible). It is also possible to analyze vowel sounds so that the measurement of the actual frequencies of the formants (the formant structure of the vowels of a language) is taken. Having taken these formants of vowel sounds, they can be represented graphically (plotting them on chart) as given for English vowels in your textbook. The figure (given in your textbook) gives the average of a number of authorities' values of the frequencies of the first three formants in eight American English vowels. The first three formants of the eight vowels of the American English words *heed, hid, head, had, hod, hawed, hood, who'd* have been taken. Explore the acoustic features of these vowels as recorded by the authors (Ladefoged and Johnson). Subsequently (after your Praat sessions, at the end of this course), you will be able to record your own vowels and try to see how your own vowels compare with these.

Topic-118: Source Filter Theory of Speech Production

Source-filter theory is an important concept in acoustic phonetics. It is a model of speech (e.g., vowel) production. According to this theory, source refers to the waveform of the vibrating larynx. Its spectrum is rich in harmonics, which gradually decrease in amplitude as their frequency increases. The various resonance chambers of the vocal tract, especially the movements of the tongue and lips, act on the laryngeal source in the manner of a filter (see filtered speech), reinforcing certain harmonics relative to others. Thus the combination of these two elements (larynx as source and cavity as filter) is known as the source-filter model of speech (e.g., vowel) production. We have already discussed that speech sounds can differ in pitch, loudness, and quality. Now if we understand the idea of source-filter we would be able to analyze these changes as possible variation in speech sounds. When discussing differences in quality, we noted that the quality of a vowel depends on its overtone structure (i.e., formants). Now putting this idea another way, we can say that a sound (e.g., vowel) contains a number of different pitches simultaneously. There is the pitch at which it is actually spoken, and there are the various overtone pitches that give it its distinctive quality. We distinguish one vowel from another by the differences in these overtones. The overtones are called formants, and the lowest three formants distinguish vowels from each other. This idea of vowel production is explained in the next topic.

Topic-119: Explaining Source – Filter Mechanism

In this theory, the tract is represented using a source-filter model and several devices have been devised to synthesize speech in this way. The idea is that the air in the vocal tract acts like the air in an organ pipe, or in a bottle. Sound travels from a noise-making source (i.e., the vocal fold vibration) to the lips. Then, at the lips, most of the sound energy radiates away from the lips for a listener to hear, while

some of the sound energy reflects back into the vocal tract. The addition of the reflected sound energy with the source energy tends to amplify energy at some frequencies and damp energy at others, depending on the length and shape of the vocal tract. The vocal folds (at larynx) are then a source of sound energy, and the cavity (vocal tract - due to the interaction of the reflected sound waves in it) is a frequency filter altering the timbre of the vocal fold sound. This idea can make it very easy for us to understand the formants of a vowel sound. Thus this same source-filter mechanism is at work in many musical instruments. In the brass instruments, for example, the noise source is the vibrating lips in the mouthpiece of the instrument, and the filter is provided by the long brass tube.

Further readings on this section:

- Chapter 8 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Online sources: http://www.phon.ox.ac.uk/jcoleman/tubes_practical.html

Lesson-24

ACOUSTIC PHONETICS-II

At the end of this section, the students will be able to:

- EXPLAIN and DEFINE perturbation theory and the acoustics of consonants.

Topic-120: Tube Models

Now in order to fully understand the concept of vowels and their formants, we introduce another idea which is the tube model of vocal tract. Actually, the formants that characterize different vowels are the result of the different shapes of the vocal tract. Any particle of air, such as that in the vocal tract or that in a bottle, will vibrate in a way that depends on its size and shape. Remember that the air in the vocal tract is set in vibration by the action of the vocal folds (in larynx). Every time the vocal folds open and close, there is a pulse of acoustic energy (activation). Irrespective of the rate of vibration at source (of the vocal folds), the air in the vocal tract will resonate at these frequencies as long as the position of the vocal organs remains the same. Because of the complex shape of the filter (tract), the air will vibrate in more than one way at once. So, the relationship between resonant frequencies and vocal tract shape is actually much more complicated than the air in the back part of the vocal tract vibrating in one way and the air in other parts vibrating in another. Here we will just remember the fact that in most voiced sounds, three formants are produced every time the vocal folds (source) vibrate. Note an interesting point here that the resonance in the vocal tract (filter) is independent of the rate of vibration of the vocal folds (source). In other words, the vocal folds may vibrate faster or slower, giving the sound a higher or lower pitch, but the formants will be the same as long as the position of the tube (vocal tract) is the same. This point is further explained in the next topic.

Topic-121: Explaining the Tube Models

Actually this is an old idea (initiated by the great German scientist Hermann Helmholtz) that a vowel is merely the rapid repetition of its peculiar note. Now it is said that a vowel is the rapid repetition (corresponding to the vibrations of the vocal folds) of its peculiar two or three notes (first two or three formants respectively). Actually, all voiced sounds are distinguishable from one another by their formant structure (frequencies). This idea could be understood by considering the vocal tract as a tube and thus the concept is when the vocal fold pulses have been produced at a steady rate, the “utterance” is on a monotone. In other words, what you hear as the changes in pitch are actually the changes in the overtones of this monotone “voice.” These overtone pitch variations convey a great deal of the quality of the voiced sounds. The rhythm of the sentence is apparent because the overtone pitches occur only when the vocal folds would have been vibrating. This tube model allows us to get an idea towards understanding of resonance, resonant frequencies (formants), the source-filter model and some other aspects of the relationship between articulatory configurations (of vocal tract) and their acoustic consequences.

Topic-122: Perturbation Theory

We have discussed that the vocal tract as a tube with a uniform diameter has simultaneous resonance frequencies—several different pitches at the same time. We have also discussed that these resonance frequencies change in a predictable way when the tube is squeezed at various locations. This means that we can model the acoustics of vowels in terms of perturbations of the uniform tube. For example, when the lips are rounded, the diameter of the vocal tract is smaller at the lips than at other locations in the vocal tract. The theory of perturbation says that with the acoustic effect of constriction at the lips, we can predict the formant frequency differences between rounded and unrounded vowels. Keeping in mind this modification in the size and nature of vocal tract (for specific vowel sounds), we can estimate how this perturbation theory works. So for each formant, there are locations in the vocal tract where constriction will cause the formant frequency to rise, and locations where constriction will cause the frequency to fall.

Topic-123: Explaining Perturbation Theory

According to perturbation theory, resonance occurs in a uniform tube where one end is closed and the other end is open (just remember the source filter idea). This theory tells us whether each resonance frequency increases or decreases when a small modification occurs in the diameter at a local region of the tube (tract). As a result:

-the resonance frequency of the particular resonance mode decreases when a constriction is located at an anti-node of that resonance mode; and
-the resonance frequency of the particular resonance mode increases when a constriction is located at a node of that resonance mode.

Keeping in mind this idea of perturbation theory, we can derive that the resonance frequencies will change (decrease or increase) as per the position (modification in the size and nature) of the vocal tract (tube).

Topic-124: Explaining Acoustic Analysis (Vowels)

Using computer programs, we can analyze vowel sounds by showing their components through the display (spectrogram). In spectrograms, time runs from left to right, the frequency of the components is shown on the vertical scale, and the intensity of each component is shown by the degree of darkness. It is thus a display that shows, roughly speaking, dark bands for concentrations of energy at particular frequencies—showing the source and filter characteristics of speech. Remember that the traditional articulatory descriptions of vowels are related to the formant frequencies. The first two frequencies are important here. The first formant (F1) is inversely related to the height of a vowel whereas the second formant (F2) is related to the frontness of a vowel sound. When the first two formants are taken, the vowels of a language can be plotted on a chart and the structure is very much related to the traditional description of vowel sounds.

Topic-125: Acoustics of Consonants

The acoustic properties (structure) of consonantal sounds are usually more complicated than that of vowels. Usually, a consonant can be said to be a particular way of beginning or ending a vowel sound because during the production of a consonant there is no distinguishing feature prominently visible. There is virtually no difference in the sounds during the actual closures of voiced stops [b, d, g], and absolutely none during the closures of voiceless stops [p, t, k], because there is only silence at these points. Each of the stop sounds conveys its quality by its effect on the adjacent vowel. We have seen that during a vowel such as [u], there will be formants corresponding to the particular shape of the vocal tract. In the case of consonants, these changes are not really distinguishable (particularly for obstruents). Although there are some consonantal sounds which have vowel like structure; therefore, their acoustic features are somehow similar to vowels (in the case of nasal consonants, approximants and glides) but most of the consonants have totally different acoustic features. These differences in the nature of consonant sounds give us a pretty easy opportunity to distinguish consonants from vowels (e.g., in the case of stops, the complete closure is easily visible as there is just a simple thin line on the spectrogram (explore some spectrogram of consonant sounds and confirm this feature).

In order to analyze the acoustic features of consonants, use the instructions given in Chapter 8 of your course book as rough guides. Also remember that particular combinations (of various sounds) are important as neighboring vowels help a lot in guessing the exact consonant sounds. There is a list of hints and ideas given in the next topic to predict consonantal sounds on the basis of their acoustic features.

Further readings on this section:

- Chapter 8 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Online sources: http://www.splab.net/APD/G400/index-e.html
  http://www.phon.ox.ac.uk/jcoleman/tubes_practical.html

Lesson-25

ACOUSTIC PHONETICS-III

At the end of this section, the students will be able to:

- EXPLAIN and INTERPRET spectrograms of speech sounds and think about some individual differences.

Topic-126: Explaining the Acoustics of Consonants

In addition to the above given features of consonant sounds (in Topic-125), following hints and ideas are important to be remembered for interpreting the spectrograms of consonants:

Voiced - vertical striations corresponding to the vibrations of the vocal folds
Bilabial - locus of both second and third formants comparatively low
Alveolar - locus of second formant about 1700–1800 Hz.
Velar - usually high locus of the second formant
Retroflex - general lowering of the third and fourth formants
Stop - gap in pattern (with burst for voiceless and sharp formant beginning for voiced stops)
Fricative - random noise pattern in higher frequency regions
Nasal - formant structure similar to that of vowels (with formants at 250, 2500, and 3250)
Lateral - formant structure similar to that of vowels (with formants at 250, 1200, and 2400)
Approximant - formant structure similar to that in vowels, usually changing

Topic-127: Interpreting Spectrograms

Words recorded in isolation are easy to be interpreted through spectrogram but interpreting the spectrogram of connected speech is certainly a more difficult challenge. But the question is: Why should the students of phonetics and phonology learn spectrogram? So, before learning how to interpret spectrograms, the importance of learning and using spectrogram is given here:

1. Using Praat (or any other software) and spectrogram is particularly useful when a researcher is working on a problem related to the nature (physical properties) of a sound (e.g., is it a phoneme or allophone?).
2. It increases our understanding of the speech sounds and their behavior in different forms (in isolation or as the part of connected speech).
3. Practice on spectrogram gives us the opportunity to learn about the characteristics of speech sounds.
4. It is also important for experts who are working on phonetic aspects of speech as signal processing.
   These are also used as the part of techniques in speech recognition.

6. Spectrograms enable us to explore the complex nature of speech structure (as the part of spoken language).
7. Spectrograms are the part of techniques used in machine translation.

In the light of the above points (and many more indeed), it is advisable to learn these techniques related to spectrograms and increase your expertise as there are various resources available online for the purpose.

Topic-128: Useful Techniques for Interpreting Spectrograms

There are certain useful points to be remembered for interpreting segments in the connected speech. We can start exploring them by looking at the segments one by one. In addition to the points mentioned above (in Topic-126), following are the helpful points to use in interpreting spectrograms:

1. Start analyzing sounds one by one by keeping in mind the individual characteristics (as given in Topic-126) of sounds as a class.
2. Carefully see the overall structure, especially the frequency scale.
3. While interpreting consonants, also analyze the behavior of the adjacent vowels.
4. Pay more attention to the first two formants (especially for vowels).
5. Watch for a burst and aspiration in stop sounds.
6. Remember that in vowels the first formant is inversely related to the height of a vowel (the lower is F1, the higher is the vowel) and F2 is related to the degree of backness of the vowel.
7. It is, of course, also possible to tell many other things about the manner of articulation from the spectrograms of various sounds (e.g., one can usually see whether a stop has been weakened to a fricative, or even to an approximant in some cases). Similarly, the process of affrication (of a stop) can also be seen on many occasions. Trills can be separated from taps and flaps, and voiced sounds from voiceless ones.

Topic-129: Individual Differences

Regarding the individual characteristics of sounds, we need to know some further useful points because, at times, we need to know about the idiosyncratic features of speech (when we are to distinguish it from a typical speech community). We also need to discount, at times, the purely individual features of linguistically significant speech. Moreover, for other particular reasons (such as used in forensic investigations), we need to discuss the validity of the identification of a particular speaker. Now the question is how to study individual variation. Following points are important in this regard:

1. Spectrograms show relative quality (e.g., a particular speaker may have a higher level of vowels).
2. The formant plots (of an average speaker) may be compared with the formant plots of a particular speaker.
3. Similarly, when two different speakers record their sets of vowels with the same phonetic quality, their relative positions on a formant chart will be similar, but the absolute values of the formant frequencies will differ.

4. In such case, the absolute values of the vowels will be important. But remember that it is a complex issue and no simple (or single) technique is useful.
5. One very important strategy may be to use the values of F4 (which may be the indicator of individual head size). Thus F4 may be studied in connection with first three formants for further evaluation. Remember that F4 for other sounds will also be required for such a comparison.

Topic-130: Analyzing Individual Differences

Further on individual differences, as an alternate method, a complete range of a speaker's vowel qualities may be considered as representative of the speaker's personal features which, in turn, may be compared with the formant frequency of each vowel (with the total range of that formant in that speaker's voice). But this is true that the phoneticians are still working with comparing the acoustic data of one individual with the other and improve further the system of speech recognition. Experts of applied phonetics and computer speech technology are trying to understand the complexity of speech – synthesis systems and improve it. Areas such as intonation and rhythm are being further explored for the purpose. For correct estimates, they are considering working with syntax, pragmatics, rhythmic structure and individual segmental influences together to develop computer programs capable to be used for speech recognition. But it is also true that such topics are the areas of computer engineers but, yes, phoneticians (as well as speech therapist and the experts of hearing sciences) can also play an important role in it. Secondly, speech identification is also directly needed by the legal experts for their court proceedings and 'voice-prints' are now largely used by lawyers. Spectrograms, although with a limited application at this stage, are potential area for future research studies.

Further readings on this section:

- Chapter 8 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)

Lesson-26

VOWELS AND VOWEL-LIKE ARTICULATIONS-I

At the end of this section, the students will be able to:

- DEFINE and EXPLAIN vowels and vowel-like articulations with the help of primary and secondary cardinal vowel systems.

Topic-131: Vowels and Vowel-like Articulation

The fundamental distinction between consonant and vowel sounds is that vowels make the least obstruction to the flow of air. In addition to this, vowels are almost always found at the center of a syllable, and it is very rare to find any sound, other than a vowel which can stand alone as a whole syllable. Phonetically, each vowel has a number of features (properties) that distinguish it from other vowels. These include; firstly, the shape of the lips (lip-rounding), rounded (for sounds like /u:/ vowel), neutral (as for ə - schwa sound) or spread (as in /i:/ sound in word like sea or – when photographers traditionally ask you to say "cheese" /ʧi:z/ in order to make you look smiling. Secondly, part of the tongue - the front, the middle or the back of the tongue may be raised, giving different vowel qualities: compare /æ/ vowel (as in word 'cat') as a front vowel, with the /ɑ:/ vowel (as in 'cart') which is a back vowel. Thirdly, the tongue (and the lower jaw) may be raised 'close' to the roof of the mouth (for close vowels. e.g. /i:/ or /u:/), or the tongue may be left 'low' in the mouth with the jaw comparatively 'open' (as for open vowels e.g., /a:/ and /æ/. In British phonetics, terms such as 'close' and 'open' are used for vowels, whereas in American phonetics 'high' and 'low' are used for vowel description. So, generally, these three aspects are described in the case of vowels; lip-rounding, the part of the tongue and the height of the tongue. In addition to these three features, some other characteristics of vowels are also used in various languages of the world (e.g., nasality – whether a vowel is nasal or not).

Topic-132: Cardinal Vowels

In order to classify vowels (independent of the vowel system of a particular language), the English phonetician Daniel Jones introduced a system in early 20th century and worked out on a set of vowels called the "cardinal vowels" comprising of eight vowels to be used as reference points (so that other vowels could be related to them like the corners and sides of a map). Jones' idea of cardinal vowels became a success and it is still used by experts and students for vowel description. He was strongly influenced by the French phonetician Paul Passy, and it has been claimed that the set of 'cardinal vowels' is quite similar to the vowels of educated Parisian French of his time. Cardinal vowel system is a chart or four-sided figure (the exact shape of which has been changed from time to time), with eight corners as can be seen on the IPA chart from IPA website. It is a diagram to be used both for rounded and unrounded vowels, and Jones proposed that there should be a primary and a secondary set of cardinal vowels. The primary set includes eight vowels in total (from 1 to 8); the front unrounded vowels [i, e, ɛ, a], the back unrounded vowel [ɑ] and the rounded back vowels [ɔ, o, u].

Topic-133: Secondary Cardinal Vowels

Further on explaining vowels (particularly, the vowels of Non-European languages), a set of secondary cardinal vowels (as a precise set of references) was introduced by the same British phonetician Danial Jones (1881-1967). Secondary cardinal vowels are easy to understand in connection with the primary cardinal vowel system. The main difference between primary and secondary cardinal vowels is related to lip-rounding as in some languages the feature of lip-rounding is possible for front vowels. By reversing the lip position (in comparison with primary cardinal vowels), the secondary series of vowel types is produced (e.g., rounding the lips for the front vowels). In addition to the primary cardinal vowels (from vowel 1 to 8), following are the secondary cardinal vowels (their numerical codes and features) as pointed out Danial Jones:

9. Close (high) front rounded vowel [y]
10. Close-mid front rounded vowel [ø]
11. Open-mid front rounded vowel [œ]
12. Open (low) front rounded vowel [ɶ]
13. Open (low) back rounded vowel [ɒ]
14. Open-mid back unrounded vowel [ʌ]
15. Close-mid back unrounded vowel [ɤ]
16. Close (high) back unrounded vowel [ɯ]

There are two more vowels representing the highest possible position at the center of the tongue. These are secondary cardinal vowels with numerical codes 17 and 18 represented with symbols [ɨ] and [ʉ] respectively.

Topic-134: Comparing Primary VS Secondary Cardinal Vowels

As discussed in Topic 133, the secondary cardinal vowels are easy to understand in connection with primary cardinal vowel system. Remember that secondary cardinal vowels from 9 to 13 [y, ø, œ, ɶ, ɒ] are the rounded counterparts of primary cardinal vowels from 1 to 5 [i, e, ɛ, a, ɑ]. Similarly, secondary cardinal vowels from 14 to 16 (ʌ, ɤ, ɯ) are the unrounded equivalents of primary cardinal vowels from 6 to 8 [ɔ, o, u] respectively. Two further cardinal vowels (17 and 18 symbolized by [ɨ] and [ʉ]) represent the highest point at the center where the tongue can possibly reach. The entire vowel system (of human languages) is usually shown in the form of the cardinal vowel diagram (resembling human tongue and divided into eight corners) or cardinal vowel quadrilateral. The aim is to give an approximate configuration of the degree and direction of tongue movement involved in the vowel production. These diagrams have been successfully used for the description of vowel system available in the dialect and languages of the world.

Further readings on this section:

- Chapter 9 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Online sources: https://www.internationalphoneticassociation.org/

Lesson-27

VOWELS AND VOWEL-LIKE ARTICULATIONS-II

At the end of this section, the students will be able to:

- DEFINE and EXPLAIN various types of vowels in different languages (including British English and other accents of English).

Topic-135: Vowels in Other Accents of English

Vowel sounds in various accents of English are interesting for a number of reasons. They provide solid basis for comparisons and contrasts. Researchers have explored this aspect in various Englishes (the term has been frequently used in recent times) and have published descriptions of the auditory quality of the vowels in a number of accents of English language. Spectral structure of these vowels (by referring to the average formant frequencies of vowel systems in these accents) provides interesting comparisons. For example, the accent of American (newscasters) English has represented fairly conservative difference (in the first two formants) with Californian English. The Californian English does not maintain a contrast between the vowels in cot and caught (they are both spoken as the same [ɑ]). Moreover, the Californians have a higher vowel (lower first formant) in [eɪ] than in [ɪ]. Their high back vowels seem more towards front as they have a higher second formant. Among other differences, vowel /ʊ/ is often pronounced with spread lips in this variety of English. Similarly, in a number of northern cities in the United States (e.g., Pittsburgh and Detroit), [æ] is spoken very close to [ɛ] (as raised with decreased F1). These are some of the examples of differences found in various varieties of English.

Topic-136: Vowels in BBC English

While discussing vowels in English, we can explore vowels in BBC accent for a number of reasons. The first and the foremost comparison may be with the American English (or varieties of American English). Both of the varieties have been discussed by linguists and politicians alike (from both sides). The vowels of BBC accent are different in both number (20 in total – both pure vowels and diphthongs) and quality. British English speakers distinguish the vowel [ʌ] in cut from the vowel [ɜ] in curt. It does not have any r-coloring (rhotacization) mainly by the frequency of the first formant. Moreover, as the main feature of BBC English (to be noted here) is the distinction between the three back vowels [a] as in father and cart, [ɑ] as in bother and cot, and [ɔ] as in author and caught. BBC vowels are really interesting in making it a standard variety of English.

Topic-137: Vowels in Other Languages

Vowels in languages other than English are important to be explored here in connection with the on-going discussion. Variations among human languages are not limited only to the number of vowels but also to the quality and features. The vowel systems of some of the major languages are briefly mentioned here. Spanish has a very simple system contrasting only five vowel sounds [i, e, a, o, u]. It is important to

remember that these symbols do not have the same values as English or their descriptions of cardinal vowels. Japanese also has a set of five vowels [i, e, a, o, u] but very different in a narrower transcription than that of Spanish. Similarly, Danish has different vowels and their qualities as it contrasts three front rounded vowels which may occur both in long or short forms. Focusing on Pakistani regional languages, Urdu and Punjabi have very different nasal vowels (the nasality is phonemic here). Urdu has some seven nasal vowels such as /he/ vs. /hẽ/ or /hiː/ vs. /hĩː/ as in word /nahĩː/ meaning 'no'. Nasalization in vowels is a common feature of Indo Aryan languages.

Topic-138: Advanced Tongue Root (ATR)

Normally, while discussing the degree of variation in vowel sounds, three types of features are given (i.e., height of tongue, backness of tongue and lip rounding) which cover the major variation in world's languages. But this description does not cover all types of variation in vowel quality. One out of such variations is advanced tongue root (ATR) which is found in Akan language spoken in Ghana. Actually, vowels produced with ATR involve the furthest-back part of the tongue, opposite to the pharyngeal wall, which is not normally involved in the production of speech sounds - also called the radix (articulations of this type may, therefore, be described as radical). ATR (a kind of articulation in which the movement of the root of tongue expands the front–back diameter of the pharynx) is used phonologically in Akan (and some other African languages) as a factor in contrast of vowel harmony. The opposite direction of movement is called retracted tongue root (RTR). ATR is thus related to the size of pharynx – making the pharyngeal cavity different: creating comparatively large (+ATR: root forward and larynx lowered) and small pharyngeal cavity (-ATR: no advanced tongue root). Akan contrasts between two sets of vowels +ATR and –ATR.

Topic-139: Rhotacized Vowels

In the description of vowel quality, rhotacization (or rhotacized vowel) is a term which is used in English phonology referring to dialects or accents where /r/ is pronounced following a vowel, as in words 'car' and 'cart'. Thus varieties of English are divided on the basis of this feature - varieties having this feature are rhotic (in which /r/ is found in all phonological contexts) while others (not having this feature) are non-rhotic (such as Received Pronunciation where /r/ is only found before vowels as in 'red' and 'around'). Similarly, vowels which occur after retroflex consonants are sometimes called rhotacized vowels (they display rhotacization). It is important to mention that while BBC pronunciation is non-rhotic, many accents of the British Isles are rhotic, including most of the south and west of England, much of Wales, and all of Scotland and Ireland. Most American English speakers speak with a rhotic accent, but there are non-rhotic areas (e.g., the Boston area, lower-class of New York and the Deep South).

Further readings on this section:

- Chapter 9 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapter 3 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)

Lesson-28

VOWELS AND VOWEL-LIKE ARTICULATIONS-III

At the end of this section, the students will be able to:

- DEFINE and EXPLAIN nasalization, semivowels and secondary articulatory gestures involved with vowels.

Topic-140: Nasalization in Vowels

In the description of vowels, nasalization is another feature which is not covered by the traditional method of description as it is not found in all languages of the world. The speakers of Urdu, Punjabi and many other Pakistani regional languages learn to produce a variety of nasal vowels as the part of their mother tongue and face no issue in learning nasalization in vowels. However, for the speakers of other languages (such as English which does not have nasal vowels) have to learn this feature of vowels by starting saying the low vowel /æ/ as in man and by keeping the soft palate lowered. Many languages have contrasts between nasal and oral vowels including French and Urdu. Urdu and Punjabi have many nasal vowels. Urdu has seven nasal vowels such as /he/ (meaning 'is') vs. /hẽ/ (meaning 'are'). Nasalization in vowels is a common feature of Indo Aryan languages. In IPA chart, the diacritic used for nasalization is the symbol [˜] called tilde (used above the phonetic symbol to show the nasality).

Topic-141: Summary of Vowel Quality

In this course, we have discussed many features related to the description of vowel sounds. In this topic, we provide a summary of all these features related to vowels. There are two features of vowel quality (i.e., height and backness of the tongue) that are used to contrast one vowel with another in nearly all languages of the world. But there are four other features that are used less frequently and not all languages exhibit them. They include 'lip-rounding', rhotacization, nasalization and advanced tongue root (ATR). The following are the acoustic correlates of all these six features:

- Height - frequency of formant one (inversely related to F1)
- Backness - difference between frequencies of F2 and F1
- Rhotacization - frequency of formant three
- Rounding - lip position (rounded, half rounded or neutral)
- ATR - width of the pharynx (ATR or RTR)
- Nasalization - position of the soft palate

Topic-142: Semivowels

Most of the world languages contain a class of sounds that functions in a way similar to consonants but is phonetically similar to vowels (e.g., in English, /w/ and /j/ as in 'wet' and 'yet'). When they are used in the first part of syllables (at onset), they function as consonants. But if they are

pronounced slowly, they resemble (in quality) with the vowels [u] and [i] respectively. These sounds are called semivowels which are also termed as approximants today. In French there are three semivowels (i.e., in addition to j and w there is another sound symbolized /ɥ/ and is found in initial position in the word like 'huit' /ɥit/ (eight) and in consonant clusters such as /frɥ/ in /frɥi/ ('fruit'). The IPA chart also lists a semivowel corresponding to the back close unrounded vowel /ɯ/. Like the others, this is classed as an approximant.

Topic-143: Secondary Articulatory Gestures (SAG)

While discussing vowels, we need to highlight some of the secondary articulation related to vowels. Remember that 'secondary' articulation is an articulatory gesture with a lesser degree of closure occurring at approximately the same time as another (primary) gesture. It is different than co-articulation which is at the same time and of the same value (taking place as an equal level gesture). Thus it is appropriate to consider four types of secondary articulations in conjunction with vowels because they can usually be described as added vowel-like articulations including; 'palatalization' (adding a high front tongue gesture as in sound /i/), velarization (raising of the back of the tongue), pharyngealization (it is the superimposition of the narrowing of the larynx) and labialization (the addition of lip-rounding).

Topic-144: SAGs Discussion

The four types of possible secondary articulatory gestures related to vowel quality are described here for understanding and further detailed exploration. Palatalization is the addition of a high front tongue gesture (as in sound like [i]) to another main (primary) gesture. The diacritic used for palatalization is the small [ʲ] superimposed above another symbol (for primary gesture). The terms palatalization (a process whereby the place of an articulation is shifted nearer to the center of the hard palate) and palatalized (when the front of the tongue is raised close to the palate while an articulatory closure is made at another point in the vocal tract) are sometimes used in a slightly different way. A palatalized consonant has a typical /j/-like (similar to /i/ vowel) quality.

Velarization involves raising the back of the tongue (adding the /u/ vowel like quality). It can be considered as the addition of an [u]-like tongue position (but remember that it is without the addition of the lip rounding). A typical English example of velarization is the /l/ sound at the end of a syllable (as in words like kill, pill, sell and will) called velarized or dark /l/ and may be written as [ɫ]. The diacritics for velarization are both [ˠ] and [˞].

Another secondary gesture of vowel quality is pharyngealization which is the superimposition of narrowing of the pharynx. The IPA diacritics for symbolizing pharyngealization are [˞] (as for velarization) and [ˤ] (the superimposition of the symbol for pharyngeal sound).

The last secondary articulatory gesture for vowel quality to be noted here is labialization which is the addition of lip rounding (written as [ʷ]) to other primary articulation such as Arabic /tʷ/ and /sʷ/. Remember that nearly all kinds of consonants can have added lip rounding, including those that already have one of the other secondary articulations (such as velarization and palatalization).

Topic-145: Summary of the SAGs

The secondary gestures for vowel quality are hereby summarized for further clarification. A sound may or may not have any of the four secondary articulations such palatalization, velarization, pharyngealization and labialization. Labialization may also have (at the same time) any of the three secondary articulatory gestures (and even if the sound is itself labial such as [mʷ]). The main features of these secondary articulatory gestures for vowel sounds are briefly mentioned here for your understanding:

1. Palatalization [ʲ] is the raising of the front of the tongue such as for /i/ vowel).

2. Velarization (written as [ˠ] and [˜]) is the raising of the back of the tongue (such as [u]-like sound.

3. Pharyngealization [ˤ] is the retracting of the root of the tongue.

4. Labialization [ʷ] is the rounding of the lips such as Arabic [sʷ] and [tʷ].

Further readings on this section:

- Chapter 9 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapters 3 and 14 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)

Lesson-29

SUPRASEGMENTAL FEATURES-I

At the end of this section, the students will be able to:

- DEFINE, EXAMINE and EVALUATE suprasegmental features such as syllables and stress.

Topic-146: Introduction to Suprasegmental (SS) Features

Supra means 'above' or 'beyond' and segments are sounds (phonemes). Suprasegmental is a term used in phonetics and phonology to refer to a vocal effect (such as tone, intonation, stress, etc.) which extends over more than one sound (segment) in an utterance. Major suprasegmental features include pitch, stress, tone, intonation or juncture. Remember that these features are meaningful when they are applied above segmental level (on more than one segment). Phonological studies can be divided into two fields: segmental phonology and suprasegmental phonology. Suprasegmental features have been extensively explored in the recent decades and many theories have been constituted related to the application and description of these features.

Topic-147: Syllable

The 'syllable' is a fundamentally important unit both in the fields of phonetics and phonology. Experts normally keep the phonetic notions of the syllable separate from the phonological ones. It is easy to understand but very difficult to define the syllable. In a simple way of defining the term, syllables are the parts of word (in which a word is further divided into parts), for example, *mi-ni-mi-za-tion* or *sup-re-seg-men-tal*. Phonetically, we can observe that the flow of speech typically consists of an alternation between vowel-like states (where the vocal tract is comparatively open and unobstructed) and consonant-like states where some obstruction to the airflow is made (thus altering speech between the two natural kinds of sounds). So, from the speech production point of view, a syllable consists of a movement from a constricted or silent state to a vowel-like state and then back to constricted or silent state. From the acoustic point of view, this means that the speech signal shows a series of peaks of energy corresponding to vowel-like states separated by troughs of lower energy (sonority).

Topic-148: Explaining Syllable

Phonologists are interested in the structure of a syllable. It can be divided into three possible parts as phonemes may occur at the beginning (onset), in the middle (nucleus or peak) and at the end (coda) of syllables - the combination of nucleus (peak) and coda is called the rhyme. The beginning (onset) and ending (coda) are optional while a syllable must have a nucleus (at least one phoneme). Thus, the study of the sequences of phonemes is called phonotactics, and it seems that the phonotactic possibilities of a language are determined by its syllabic structure (sequences of sounds that a native speaker produces can be broken down into syllables). Syllables are claimed to be the most basic units in speech (in a language – a sound system) meaning that an utterance must contain at least one syllable. Similarly, every language

has syllables, and children learn to produce syllables before they can manage to say a word of their native language. It is important to note that syllable structure could be of three types: 'simple' (CV), 'moderate' (CVC) and 'complex' (with consonant clusters at edges) such as CCVCC and CCCVCC (where V means vowel and C stands for consonant). Moreover, words can have one syllable (monosyllabic), two syllables (bisyllabic or disyllabic), three syllables (trisyllabic) or many syllables (polysyllabic).

Topic-149: Stress as a Suprasegmental Feature

Stress is basically a suprasegmental feature applied to a whole syllable when it is made prominent by adding factors such as loudness, rise in pitch, length of duration and vowel quality (in contrast with other syllables). For example, in mi-ni-mi-**ZA**-tion, the second last (penultimate) syllable is prominent (as greater amount of energy is applied to it) as it is louder and longer than the rest of the syllables in the word. Similarly, its quality and pitch are different than that of others. All these factors make it stressed (compare: **IN**-sult vs. in**SULT** and be-**LOW** vs. **BILL**-ow). Stress is an important feature both in phonetics and phonology. Despite the fact that it has been extensively studied, there remain many areas of disagreement among the experts. To begin with a basic point, it is almost certainly true that in all languages some syllables are in some sense stronger than other syllables; these are syllables that have the potential to be described as stressed. Stress plays an important role in conveying (and changing) meaning.

Topic-150: Types and Categories of Stress

One of the areas in which a little agreement is found is related to the levels of stress. Some descriptions of languages manage with just two levels (stressed and unstressed), while others use more than two. In English, one can argue that if one takes the word 'in-di-ca-tor' as an example, the first syllable is the most strongly (primarily) stressed one, the third syllable is the next most strongly (secondarily) stressed and the second and fourth syllables are weakly stressed or unstressed accordingly. This gives us three levels (primary, secondary and tertiary) and it is possible to argue for more, though this rarely seems to give any practical benefit. Remember that the primary stress is very important in languages like English as it has the ability to change meaning e.g., in two-syllabic words like record or insult, meanings and the category of the words are changed depending upon the prominence (stress) given to the syllables: INsult (noun) vs. inSULT (verb); whereas in long words (such as minimization), one syllable receives primary stress while other (one or more than one syllable) has the secondary stress. Secondary stress is just for better pronunciation (not changing the meaning). Another division is made between lexical stress (phonemic in nature) and sentence level (emphatic) stress. This is the subject of the next topic.

Topic-151: Lexical and Emphatic Stress

In terms of its linguistic function, stress is often treated under two different headings: word (lexical) stress and sentence (emphatic) stress. Lexical stress is basically related to the primary stress applied at syllable level (when only one syllable is stressed) that has the ability to change the meaning and the grammatical category of a word as in the case of 'IMport' (noun) and 'imPORT' (verb). Sentence level stress, on the other hand, is applied on one word (rather than a syllable) in a sentence thus making that word more prominent (stressed) than the rest of the words in the sentence. This type of stress has its

role in intonation patterns and rhythmic features of the language showing specific emphasis on the stressed word (which may be highlighting some information in the typical context). In order to perceive the nature of sentence level stress, read the following sentences with shifting the stress accordingly and judge the shift in emphasis (and its role in the context):

- Did **YOU** drive to Peshawar last weekend?
- Did you **DRIVE** to Peshawar last weekend?
- Did you drive to **PESHAWAR** last weekend?
- Did you drive to Peshawar **LAST** weekend?

Further readings on this section:

- Chapter 10 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapters 8 to 11 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)
- Online sources: https://en.wikipedia.org/wiki/Syllable
  http://educationcing.blogspot.com/2012/09/Constituent-of-syllable.html

Lesson-30

SUPRASEGMENTAL FEATURES-II

At the end of this section, the students will be able to:

- Define syllable-timed and stress-timed languages.

Topic-152: Stress Timed Languages

It is sometimes claimed by the experts that different languages (and dialects) have different types of rhythmic patterns. Languages of the world are; therefore, divided into two broad categories: stress timed language and syllable timed languages. But this is basically the division of languages on the basis of their modes of timing (i.e., stress vs. syllable timed languages). Stress timed languages have stress as their dominating rhythmic feature meaning that these languages seem to be timed according to the stressed patterns (the division among the syllables is made on the basis of stressed and unstressed patterns e.g., English and German languages). In other words, in stress timed languages, stressed syllables occur with regular intervals and their units of timing are perceived accordingly. Stress-timed rhythm is one of these rhythmical types, and is said to be characterized by a tendency for stressed syllables to occur at equal intervals of time. This idea is further clarified in the next topic.

Topic-153: Explaining Stress Timed Languages

'Stress timed languages' is a very general phrase used in phonetics to characterize the pronunciation of languages displaying a particular type of rhythmic pattern that is opposed to that of syllable-timed languages. In stress-timed languages, it is claimed that the stressed syllables recur at regular intervals of time (stress-timing) regardless of the number of intervening unstressed syllables as in English. This characteristic is sometimes also referred to as 'isochronism', or isochrony. However, it is clear that this regularity is the case only under certain conditions, and the extent to which the tendency towards regularity in English is similar to that in, say, other Germanic languages remains unclear. In short, the division among the syllables is made on the basis of stress and unstressed patterns. In such languages, stress is realized both at word and sentence levels approximately changing the rhythmic patterns (particularly at sentence level).

Topic-154: Syllable Timed Languages

In syllable timed languages, all syllables tend to have an equal time value (for example, their length or duration) and the rhythm of the language is said to be syllable-timed. In these languages, syllables tend to occur at regular intervals of time with fixed word stress. A classic example is Japanese in which all morae have approximately the same duration. This tendency is contrasted with stress-timing where the time between stressed syllables is said to tend to be equal irrespective of the number of unstressed syllables in between. Czech, Polish, Swahili and Romance languages (e.g., Spanish and

French) are often claimed to be syllable-timed. Many phoneticians; however, doubt whether any language is truly syllable-timed.

Topic-155: Explaining Syllable Timed Languages

Syllable timed is a very general term used in phonetics to characterize the pronunciation of languages displaying a particular type of rhythmic pattern. It is opposed to stress-timed languages. In syllable-timed languages, the syllables are said to occur at regular intervals of time, (e.g., in French) this characteristic is sometimes referred to as isosyllabism or isosyllabicity. However, very little work has been done on the accuracy or general applicability of such properties, and the usefulness of the typology has been questioned. So it is important to remember that the division of languages in two categories (i.e., syllable vs. stress timed languages) is not based on strong concepts. Many phoneticians disagree with the basic idea of timing value. They are of the view that there are three dimensions: fixed word stress (mainly found in Romance languages), variable word stress (mainly found in languages such as English and German) and fixed phrase stress (phrase as a third possibility as exhibited by Japanese) and they want to categorize languages on the basis of these three patterns.

Topic-156: Pitch as a Suprasegmental Feature

As a suprasegmental feature, pitch is an auditory sensation - when we hear a regularly vibrating sound such as a note played on a musical instrument (or a vowel produced by the human voice), we hear a high pitch (when the rate of vibration is high) and a low pitch (when the rate of vibration is low). There are some speech sounds that are voiceless (e.g. /s/), and cannot give rise to a sensation of pitch in this way but the voiced sounds can. Thus the pitch sensation that we receive from a voiced sound corresponds quite closely to the frequency of vibration of the vocal folds. However, we usually refer to the vibration frequency as fundamental frequency in order to keep the two things distinct. In tonal languages, pitch is used as an essential component of the pronunciation of a word and a change of pitch may cause a change in meaning. In most languages (whether or not they are tone languages) pitch plays a central role in intonation. In very simple words, pitch is the variation in the vibration of vocal folds.

Further readings on this section:

- Chapter 10 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapters 15 to 19 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)

Online sources: http://slideplayer.com/slide/3885548/
https://www.slideshare.net/shassan573/pronunciation-39434371
http://ec-concord.ied.edu.hk/phonetics_and_phonology/wordpress/?page_id=443

Lesson-31

SUPRASEGMENTAL FEATURES-III

At the end of this section, the students will be able t*o:*

- DEFINE, EXAMINE and EVALUATE suprasegmental features such as intonation, tone and pitch.

Topic-157: Tone and Tonal Languages

Tone (in phonetics and phonology) as a suprasegmental feature refers to an identifiable movement (variation) or level of pitch that is used in a linguistically contrastive way. In tone (tonal) languages, the linguistic function of tone is to change the meaning of a word. For example, in Mandarin Chinese, [ma] said with a high pitch means 'mother' while [ma] said on a low rising tone means 'hemp'. In other (non-tonal) languages, tone forms the central part of intonation, and the difference between, for example, a rising and a falling tone on a particular word may cause a different interpretation of the sentence in which it occurs. In the case of tone languages, it is usual to identify tones as being a property of individual syllables, whereas an intonational tone may be spread over many syllables. In the analysis of English intonation, tone refers to one of the pitch possibilities for the tonic (or nuclear) syllable. For further analysis, a set of four types of tone is usually used (fall, rise, fall–rise and rise–fall) though others are also suggested by various experts.

Topic-158: Intonation as a Suprasegmental Feature

In simple sense, 'intonation' refers to the variations in the pitch of a speaker's voice used to convey or alter meaning (at sentence level). In its broader and more popular sense, it is used to cover much the same field as 'prosody', where various features such as voice quality, tempo and loudness are also included. It is a term frequently used in the study of suprasegmental phonology, referring to the distinctive use of patterns of pitch, or melody and the study of intonation is sometimes called intonology. Experts have suggested several ways of analyzing intonation. In some approaches, the pitch patterns are described as contours and analyzed in terms of levels of pitch as pitch phonemes and morphemes while in others, the patterns are described as tone units or tone groups which are further analyzed as contrasts of nuclear tone, tonicity, etc. The three variables of pitch range, height and direction are generally distinguished. Some approaches, especially within pragmatics, operate with a much broader notion than that of the tone unit: intonational phrasing is a structured hierarchy of the intonational constituents in conversation. A formal category of intonational phrase is also sometimes recognized which is an utterance span dominated by boundary tones.

Topic-159: Functions of Intonations

Intonation as a suprasegmental feature performs several functions in a language. Its most important function is to act as a signal of grammatical structure (e.g., creating patterns to distinguish among grammatical categories), where it performs a role similar to punctuation (in written language). It

may furnish far more contrasts (for conveying meaning). Intonation also gives an idea about the syntactic boundaries (sentence, clause and phrase level boundaries). It also provides the contrast between some grammatical structures (such as questions and statements). For example, the change in meaning illustrated by 'Are you asking me or telling me?' is regularly signaled by a contrast between rising and falling pitch. Note the role of intonation in sentences like 'He's going, isn't he?' (= I'm asking you) opposed to 'He's going, isn't he!' (= I'm telling you) (These examples are given by Peter Roach). The role of intonation in the communication is quite important as it also conveys personal attitude (e.g., sarcasm, puzzlement, anger, etc.). Finally, it can signal contrasts in pitch along with other prosodic and paralinguistic features. It can also bring variation in meaning and can prove an important signal of the social background of the speakers.

Topic-160: Explaining Functions of Intonation

While discussing the functions of intonation, another approach is to concentrate on its role in conversational discourse. This involves such aspects as indicating whether the particular thing being said constitutes new information or old (in sentence, for example). It further creates the regulation of turn-taking in conversation, the establishment of dominance and the elicitation of co-operative responses as well. As with the signaling of attitudes, it seems that though analysts concentrate on pitch movements there are many other prosodic factors being used to create these effects. It is also important to note here that much less work has been done on the intonation of languages other than English. It seems that all languages have something that can be identified as intonation (there can be many differences between among languages). It is, therefore, a potential area to be studied and explored further. One reason for intonation not being well explored is because of the different descriptive frameworks used by different analysts for studying intonation cross-linguistically. Even it is claimed that tone languages also have intonation and that it is superimposed upon the tones themselves. Such a claim creates especially difficult problems of analysis.

Further readings on this section:

- Chapter 10 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)
- Chapters 18 and 19 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)

Lesson-32

LINGUISTIC PHONETICS-I

At the end of this section, the students will be able to:

- DEFINE and EXPLAIN linguistic phonetics in the broader perspective of IPA.

Topic-161: Linguistic Phonetics

Linguistic phonetics is an approach which is embodied in the principles of the International Phonetic Association (IPA) and in a hierarchical phonetic descriptive framework that provides certain basis for formal phonological theory. Speech, being very complex phenomena and having multiple levels of organization, needs to be explored from different angles. Linguistic phonetics answers a number of questions related to the possible ways of articulatory unified phonetics and phonology and from the perspective of cognitive phonetics focusing on speech production and perception and how they shape languages as a sound systems. The idea is mainly related to the overall ability of human beings to produce sounds (as a community and irrespective of their specific languages) and then the representation of their shared knowledge (as considered by the IPA in its charts) for formal phonetic and phonological theories.

Topic-162: Phonetics of the Community and of the Individual

Linguistic phonetic descriptions (of speech sounds) are, by and large, descriptions of the phonetics of the community (excluding the individual properties and considering the shared properties of the sound system of a language by its native speakers). The representations that experts write and use in the IPA, and analyze in a formal phonological theory, are intended to show the community's shared knowledge of how to say the words of a language. It is important to note that this shared phonetic knowledge is perceptible to other speakers (and thus to the phonetician as well) and experts are mainly related to the aggregate behavior of linguistic group in the sense that it captures what community members accept as correct pronunciation system. So the focus of linguistic phonetic description is the phonetics of the community and the phonetics of the individual is considered only for specific purposes (when required).

Topic-163: Explaining Phonetics of the Community and of the Individual

The major reason why the phonetics of the community is considered for phonetic descriptions is that, firstly, individual speakers differ in interesting ways (two native speakers of a language will always speak with some variations). The description of the phonetics of the individual involves describing the phonetic knowledge and skills related to the performance of language. It is possible that certain aspects of the phonetics of the individual can be captured using IPA transcription but others are not compatible with it (such as his private knowledge and its performance and the role of memory and experience). Secondly, the phonetics of the individual is usually not the focus of the linguist in speech elicitation, and it is difficult to describe even with spectrograms of the person's speech. Although, the phonetics of the

individual is the focus of much of the explanatory power of phonetic theory but for general phonetic description we need to focus on the phonetics of the community.

Topic-164: The IPA

While discussing the key elements of linguistic phonetic description, we need to consider the International Phonetic Alphabet (abbreviated as IPA). IPA is the set of symbols and diacritics that have been officially approved by IPA. The association publishes a chart comprising of a number of separate charts. At the top inside the front cover, you will find the main consonant chart. Below it is a table showing the symbols for nonpulmonic consonants, and below that is the vowel chart. Inside the back cover is a list of diacritics and other symbols, and a set of symbols for suprasegmental features (events) such as tone, intonation, stress, and length. Remember that the IPA chart does not try to cover all possible types of phonetic descriptions (e.g., all the individual strategies for realizing linguistic phonological contrasts, or gradations in the degree of co-articulation between adjacent segments, etc.). Instead, it is limited to those possible sounds that can have linguistic significance in that they can change the meaning of a word in some languages. So the description of IPA is based on the linguistic phonetics of the community.

Topic-165: Explaining the IPA

One evidence that the IPA chart is based on linguistic phonetics is the description of the blank cells on the chart (those neither shaded nor containing a symbol) that indicate the combinations of categories that are humanly possible but have not been observed so far to be distinctive in any language (e.g., a voiceless retroflex lateral fricative is possible but has not been documented so far, so it is left blank). The shaded cells, on the other hand, exhibit the sounds not possible at these places. Further, below the consonant chart is a set of symbols for consonants made with different airstream mechanisms (clicks, voiced implosives, and ejectives). All these descriptions reflect the potentialities of human speech sounds (as a linguistic community) not only showing the possible segments but also the suprasegmental features and points related to the possible airstream mechanisms and even the diacritics for various types co-articulations and secondary articulatory gestures. The IPA chart is carefully documented (by experts) and is continuously revised and updated.

Further readings on this section:

- Chapter 11 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)

Lesson-33

LINGUISTIC PHONETICS-II

At the end of this section, the students will be able to:

- DEFINE and COMMENT on 'feature hierarchy' and problems with linguistic explanations.

Topic-166: Feature Hierarchy

The second way by which we will consider why the linguistic phonetic description is important is by considering a hierarchical organization of linguistic phonetic features. Feature hierarchy is an important concept in phonetics and phonology which is based on the properties and features of sounds. In a very general sense, a feature may be tied to a particular articulatory maneuver or acoustic property. For example, the feature [bilabial] indicates not only that the segment is produced with lips but also that it involves both of them. Such features (in phonetics and phonology) are listed in a hierarchy with nodes in the hierarchy defining ever more specific phonetic properties. For example, sounds are divided in terms of their supra-laryngeal and laryngeal characteristics, and their airstream mechanism. The supra-laryngeal characteristics can be further divided into those for place (of articulation), manner (of articulation), the possibility of nasality, and the possibility of being lateral. Thus, these features are used for classifying speech sounds and describing them formally.

Topic-167: Feature Hierarchy: Discussion

For dividing speech sounds through feature hierarchy, the first division is made on the basis of the major regions of the vocal tract, giving us the five features in total (i.e., Labial, Coronal, Dorsal, Radical, and Glottal). The first three of these features are related to tongue position whereas 'Radical' is a cover term for [pharyngeal] and [epiglottal] articulations made with the root of the tongue. The feature of 'Glottal', on the other hand, is based on being [glottal], to cover various articulations such as [h]. If we are to have a convenient grouping of the features for consonants, we have to recognize that Supra-Laryngeal features must allow for the dual nature of the actions of the larynx and include Glottal as a place of articulation. Remember that a sound may be articulated at more than one of the regions Labial, Coronal, Dorsal, Radical, and Glottal. Within the five general regions, 'Coronal' articulations can be split into three mutually exclusive possibilities: Laminal (i.e., blade of the tongue), Apical (i.e., tip of the tongue), and Sub-apical (i.e., the under part of the blade of the tongue). Thus the major regions may be subdivided into sub regions on the basis of their features.

Topic-168: Feature Hierarchy: Explanation

This grouping under feature hierarchy also reflects the fact that the four features (i.e., Stop, Fricative, Approximant, and Vowel) depend on the degree of closure of the articulators. In order to fully grasp the feature hierarchy, we need to explore the major divisions in this topic. The manner category 'Stop' has only one possible value (i.e., [stop]), but 'Fricative' has two (i.e., [sibilant] and [nonsibilant]).

Similarly, 'Approximant' and 'Vowel' have five principal features: Height, (with five possible values [high], [mid-high], [mid], [mid-low], and [low]), Backness (with three values, [front], [center], and [back]) and two kinds of 'Rounding' (i.e., Protrusion with possible values [protruded] and [retracted], and Compression, with possible values [compressed] and [separated]). The fourth feature for vowels and approximants is the 'Tongue Root' which has two possible values: [+ATR] and [−ATR]. Finally, the feature 'Rhotic' has only one possible value, [rhotacized]. It is also important to remember that the 'Laryngeal' possibilities involve mainly five features ([voiceless], [breathy voice], [modal voice], [creaky voice], and [closed] - forming a glottal stop). Airstream features have three values; Pulmonic, Velaric and Glottalic).

Topic-169: Problems with Linguistic Explanations

While discussing the phonetics of the individual, we need to consider that the linguistic phonetic explanation does not always satisfy all the topics of speech production and we at times need to consider the phonetics of the individual. There are current phonetic research trends and theories which focus on a large extent on topics such as speech motor control, the representation of speech in memory, and the interaction of speech perception and production and their roles in language change. More importantly, we find explanations for language sound patterns in these and other related topics. Take the example of the phenomenon of 'assimilation' where the adjacent sounds come to share some phonetic properties. But if we restrict ourselves to the terminology and knowledge base of linguistic phonetics (the phonetics of the community); we are restricted to descriptions of sound patterns and not their explanation. In fact, explanations that are restricted in this way often fall into the fallacy of reification (i.e., acting as if abstract things are concrete).

Topic-170: Explaining the Problem with Linguistic Explanations

The phonetics of the individual gives explanation to a number of such complex issues. For example, take the case of 'assimilation' - it happens because there is a tendency in pronunciation for adjacent sounds to share phonetic properties (at individual level). This "explanation" is even more impressive if we state it as a formal constraint (in Optimality theory) on sequences of sounds as the following:

AGREE(x): Adjacent output segments have the same value of the feature x.

It means that assimilation exists when adjacent segments share features. In simple words we can say that the adjacent sounds would influence the sounds in the neighborhood and that the tendency to assimilate (a cross-linguistic generalization) exists because there is a tendency to assimilate (reified as a specific "explanatory principle"). The private phonetic knowledge of the individual answers for a more satisfying way to explain language sound patterns.

Further readings on this section:

- Chapter 11 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)

Lesson-34

LINGUISTIC PHONETICS-III

At the end of this section, the students will be able to:

- KNOW about 'controlling articulatory movements', 'memory for speech' and 'the balance between phonetic forces'.

Topic-171: Controlling Articulatory Movements

Focusing on the phonetics of the individual we can explore the controlling of the articulatory movement. For example, while underlying our linguistic description of [p], as an example of speech motor control, an array of muscular complexity involving dozens of muscles in the chest, abdomen, larynx, tongue, throat, and face is in action. Interestingly, all of these are contracted with varying degrees of tension in specific sequence and duration of contraction. For this sound (i.e., [p]), in order to produce a lip closure movement, two main muscles (depressor labii inferior and incisivus inferior) are activated to create 'too much' and 'enough tension'. Then at the same time the jaw muscles are activated so that it may trade with the lip muscles (together with lower lip movement) for closing and the opening. This structure specifies an overall task "close the lips" at the top node, and subtasks such as "raise the lower lip" and "lower the upper lip" are coordinated with each other to accomplish the overall task. Some subtasks also require further reduction of the goal into smaller subtasks. In addition to create a voiceless bilabial (i.e. [p]), the glottis needs to be wide apart (for free air passage). So exploiting the air passage, keeping it voiceless at larynx and creating a closure by lips and jaws along with many subtasks are achieved for [p] mainly because of the controlling articulatory movements thus enabling us to understand the individual variation in the production of speech.

Topic-172: Memory for Speech

Speech is quite diverse and complex particularly when it comes to the phonetics of individual. It is understandable that different speakers of the same language will have somewhat different productions of speech depending upon their vocal tract physiology and their own habits of speech motor coordination and more importantly due to their memory of speech. Sociolinguistic features also influence; we are exposed to a variety of speech styles ranging from very careful pronunciations in various types of public speaking to the quite casual style that is typical between friends. All this leads to the lack of phonetic invariants (or the variability of invariability). This 'lack of phonetic invariance' provides us with many reasonable justifications as it has posed an important problem for phonetic theory as we try to reconcile the fact that shared phonetic knowledge can be described using the IPA symbols and phonological features with the fact that the individual phonetic forms that speakers produce and hear on a daily basis span a very great range (of varieties). This lack of invariance as a problem also has great practical significance for language engineers who try to get computers to produce and recognize speech. We have an answer to these issues facilitated by 'the phonetic implementation approach' that focuses on how

experiences are encoded in memory. As per the phonetic implementation view, words are stored in speech memory in their most basic phonetic form and used when needed.

Topic-173: Explaining Memory for Speech

The role of the memory for speech under the exemplar theory suggests that many instances of each word are stored in memory and their phonetic variability is memorized rather than computed. The main postulates of the concepts are given here:

- Language universal features: Broad phonetic classes (e.g., aspirated vs. unaspirated) derive from physiological constraints on speaking or hearing, but their detailed phonetic definitions are arbitrary—a matter of community norms.

- Speaking styles: No one style is basic (from which others are derived), because all are stored in memory. Bilingual speakers store two systems.

- Generalization and productivity: Exemplar theory says that generalization is also possible within productivity. Interestingly, productivity—the hallmark of linguistic knowledge in the phonetic implementation approach—is the least developed aspect of the exemplar theory.

- Sound change: Sound change is phonetically gradual and operates across the whole lexicon. It is a gradual shift as new instances keep on adding.

Topic-174: The Balance Between Phonetic Forces

In order to explain the sound patterns of a language, the views of both speaker and listener are considered. Both of them like to use the least possible articulatory effort (except when they are trying to produce very clear speech), and there are a large number of assimilations, with some segments left out, and other reduced to minimum. Thus a speaker uses language with an ease of articulation (e.g., co-articulation and secondary articulation). This tendency to use language sounds with maximum possible ease of articulation leads to change in the pronunciation of words. In co-articulations, for example, a change in the place of the nasal and the following stop occurred in words such as *improper* and *impossible* before these words came into English through Norman French. In words such as these, the [n] that occurs in the prefix in- (as in intolerable and indecent) has changed to [m]. These changes are even reflected in the spelling. In all this and in many similar historical changes, one or more segments are affected by adjacent segments so that there is an economy of articulation. These are historical cases of the phenomenon of assimilation. Similarly, articulation with the least possible effort enables us to speak by keeping the balance between phonetic forces ultimately leading to changes in the pronunciation of sounds. This idea is explained in the next topic.

Topic-175: Explaining the Balance Between Phonetic Forces: Explanation

While going for producing sounds with maximum ease of articulation, only similar sounds are affected. The focus of the speakers is always on maintaining a sufficient perceptual distance between the

sounds that occur in a contrasting set (e.g., vowels in stressed-monosyllabic words beat, bit, bet, and bat). This principle of perceptual separation does not usually result into one sound affecting an adjacent sound (as explained in the principle of maximum ease of articulation). Instead, perceptual separation affects the set of sounds that potentially can occur at a given position in a word, such as in the position that must be occupied by a vowel in a stressed monosyllable as in words *beat, bit, bet, bat* so that the perceptual separation is maximized. The principle of 'maximum perceptual separation' also accounts for some of the differences between languages. All these examples illustrate how languages maintain a balance between the requirements of the speaker and those of the listener. On the one hand, there is the pressure to make changes that would result in easier articulations from a speaker's point of view and, then, from the listener's point of view that there should be sufficient perceptual contrast between sounds that affect the meaning of an utterance.

Further readings on this section:

- Chapter 11 of the textbook (**A Course in Phonetics** by Peter Ladefoged and Keith Johnson)

Lesson-35

PHONOTACTICS AND SYLLABIC TEMPLATES

At the end of this section, the students will be able to:

- DEFINE and EXPLAIN phonotactics and syllabic templates.

Topic-176: Syllabic Templates and Syllabification

Syllable is the unit of pronunciation typically larger than a single sound and smaller than a word. A word maybe divided into parts such as in *ne-ver-the-less*, and a good dictionary will indicate where these syllabic divisions occur in writing, thus providing information about how a word may be hyphenated (separated into syllables). Syllabification, on the other hand, is the term which refers to the division of a word into syllables. Similarly, resyllabification refers to a reanalysis which alters the location of syllable boundaries. A word containing a single syllable is called a monosyllabic word; if it contains more than one, the term polysyllabic is used. Remember that the CV pattern (where one consonant is found at the onset followed by a vowel as its peak) of syllable is found in all languages of the world. It is the universal pattern of syllable (Max Onset C) and is encouraged by all human languages in abundance. There are languages which only allow CV templates of syllables (e.g., Honolulu - CVCVCVCV and Waikiki - CVCVCV). Interestingly, it is also found in the nicknames of the almost all languages of the world: *kami, nana, baba, papa, mani, rani, etc*. As a part of their L1 acquisition, children first acquire the CV pattern of their mother tongue.

Topic-177: Explaining Syllabification

When it comes to the internal structure of syllable, languages differ from each other as the syllabic patterns are different across languages and language families. There are different modes and structures for syllable structure and languages are labelled as per their syllabic templates. Consonant sequences are called clusters (e.g., CC – two consonants or CCC – three consonants). Most of the phonotactic analyses are based on the syllable structures and syllabic templates. On the basis of these consonant clusters, mainly three types of syllabic patterns are considered among languages; simple – moderate – complex (on the basis of consonants clusters at edges: onset and coda): Note the following examples:

Simple	CV
Moderate	CVC(G)(N) (G for Glide and N for Nasal – specific Cs)
Complex	CCVCC – CCCVCC (bipartite CC and tripartite CCC)

Topic-178: Phonotactics

The study of the phonemes and their order found in the syllables (the study of sound sequences) of a language is called the phonotactics. It has often been found that languages do not allow all phonemes to appear in any order (e.g., a native speaker of English can figure out fairly easily that the sequence of phonemes /streŋθs/ makes an English word ('strengths') and that the sequence /bleidg/ would be acceptable as an English word 'blage', although that word does not happen to exist, but the sequence /lvm/ could not possibly be the part of an English word). Phonotactic analyses of English come up with some interesting findings. For example, why should 'bump', 'lump', 'hump', 'rump', 'mump(s)', 'clump' and others all be associated with large blunt shapes? Why should there be a whole family of words ending with a plosive and a syllabic /l/ all having meanings to do with clumsy, awkward or difficult action (e.g., 'muddle', 'fumble', 'straddle', 'cuddle', 'fiddle', 'buckle', 'struggle', 'wriggle')? Why can't English syllables begin with /pw/, /bw/, /tl/, /dl/ when /pl/, /bl/, /tw/, /dw/ are acceptable? All such discussion is called the phonotactics of the language.

179. Explaining Phonotactics

Phonotactics is a term used in phonology to refer to the order (sequential arrangements or tactic behavior) of segments (sounds or phonological units) which occur in a language. It shows us what counts as a phonologically well-formed structure of a word. The allowed sound patterns and restricted sound patterns of language are found through phonotactics. For example, in English, consonant sequences such as /fs/ and /spm/ do not occur initially in an English word, and there are many other restrictions on the possible consonant+vowel combinations which may occur. By thoroughly analyzing the data, the 'sequential constraints' of a language can be stated in terms of phonotactic rules. According to the Generative phonotactics, no phonological principles can refer to morphological structure; and phonological patterns which are sensitive to morphology (e.g. affixation, etc.) are represented only in the morphological component of the grammar (not in the phonology). Some examples from the English phonotactics are given for your understanding:

One phoneme pattern	V	I, oh, owe
Two phoneme pattern	CV	to, be, see
Three phoneme pattern	CVC	cat, dog, run
Four phoneme pattern	CCVC	stick, click, brick
Five phoneme pattern	CCVCC	brisk, treats, speaks
Six phoneme pattern	CCCVCC	streets, strand, strips
Seven phoneme pattern	CCCVCCC	strengths

Also possible: CCV (try) CCCVC (stroke), CCCV (straw), VCC (eggs) CVCC (risk), CVCCC (risks).

Further readings on this section:

Online sources: http://people.umass.edu/scable/LING201-SP13/Slides-Handouts/Syllables-Phonotactics.pdf

https://en.wikipedia.org/wiki/Syllabification

Lesson-36

USING PRAAT-I

At the end of this section, the students will be able to:

- EXPLORE PRAAT software and USE some of its basic features.

Topic-180: Introduction to PRAAT

Nowadays most of the research works in phonetics and phonology are based on software like Praat and WaveSurfer. So it is appropriate to include some beginners' level introductory sessions to one of the mostly used software Praat. Praat is a freeware created by Paul Boersma and David Weenink at the Institute of Phonetics Sciences of the University of Amsterdam (Home page: http://www.praat.org or http://www.fon.hum.uva.nl/praat/). It is freely downloadable with improvised version and its guides and discussions are also available. One of the active platforms available for Praat related discussion and blogs is the yahoopraatgroup. There is an introductory tutorial also available at the homepage of Praat. In short, Praat is a computer program with which you can analyze, synthesize, and manipulate speech, and create high-quality pictures for your articles and thesis. You are advised to start going through the tutorial from its homepage.

Topic-181: Introduction to PRAAT Manual

The manual which we are going to use in this course was developed by the faculty (Sonya Bird and Qian Wang) at University of Victoria Canada. It is an excellent manual with worksheets and carefully designed ten labs. We will be conducting some of the important experiments from the first five labs from this lab manual. Having conducted some of the important experiments from the initial five labs, it is hoped that you will be able to carry on with the rest of the experiments by yourself. In case of any problem, you can write to the developers of Praat software.You can also drop queries on the 'yahoo Praat group'. Remember that Praat only requires a very modest experience of computer and you can easily conduct experiments if you are using personal computer at a very initial level. It is very important for learning phonetics and phonology in general and acoustic analysis of speech in particular and will help you a lot in your future research work in the area of phonetics and phonology especially acoustic phonetics.

Topic-182: Exploring PRAAT

Start exploring Praat and its very basic features by going to the homepage (www.praat.org) and by downloading the software as per the specification of your PC and windows (or Macintosh). We will be using Praat for speech analysis throughout the rest of your topics related to acoustics. You will learn to make recordings, bring up visual displays of these recordings (waveforms and spectrograms), segment and label various components of these recordings, and export the visual displays into a word document.

Having downloaded Praat, now start going through the two major pans and windows (object and picture windows) and explore various components of Praat.
Try to spend time and explore further. Now do the following:

- Open Praat: double click on the icon.
- Get to know the Praat layout (explore the buttons on the object windows, main menu, analysis and synthesis tools and the options on the picture window).

Topic-183: Recording and Displaying

This is now your first practical on Praat. We are going to learn how to record a new (mono) sound and display the recorded file in this experiment. We will also know about the good vs. clipped recordings and work on the object window and sound window and use the edit button (to analyze and synthesize from the tools panel).

- Go to NEW > RECORD mono-sound (with sampling rate – 44100 Hz)
- Make sure the volume bar is fluctuating as you record – if it isn't, you're not recording; if you don't see the volume bar at all, you're not speaking loudly enough.
- Watch out for clipping. If your recording level is too high and you go into the red on the volume bar, you'll end up with what is called a "clipped" signal; this is very bad for speech analysis!
- Give the recording a name (in the box below "Save to list").
- Save to list.

Congratulation! You have recorded your first sound file. Now in order to display it:

- Open the sound file in the Edit window.
- In the Objects window, highlight the sound file you've just recorded.
- Click Edit on the "Analysis and synthesis tools" panel.

As a final step of your Lab 1, you're now required to EXTRACT from this file, so:

- Select the portion that you want to study.
- File > Extract Selection (The extracted selection will show up as an entry ('sound untitled') in the Praat objects window).
- Close Edit window.

You have completed all the steps of the experiment I. While conducting these steps, you can also watch my recordings on these topics.

Topic-184: Segmenting and Labeling

'Segmenting and labelling' is our next experiment on Praat which is particularly helpful in acoustic analysis because we will be able to place segmental symbols (label and add the textgrids to spectrogram) and annotate the sound file. The sound file needs text for a number of reasons including

keeping the track record of your measurement from the file for annotating the textgrid tiers and by learning segmenting and labelling, we also learn how to open both files together and putting the phonetic symbols to our recordings. Follow the following steps for learning segmenting and labeling on Praat:

1. Create a textgrid:
   - In the Praat Objects window, highlight the subject (required) file.
   - Annotate > To TextGrid.
   - Create two tiers (this will be enough for our purposes). Write 'word segment' (these are two tiers) on the cell named 'All tier names' on the small window.

2. Open the sound file and textgrid together:
   - Hold down Ctrl and click on each file to highlight them both.
   - Edit (in your display you should now see the waveform (top), the spectrogram (middle) and the textgrid (bottom) corresponding to your sound file).

3. Segment the file:
   - Place the cursor at the beginning of the name on the spectrogram/waveform; a boundary line will show up.
   - Click in the little circle at the top of the word tier in the Textgrid to create a boundary.
   - To remove a boundary that you have made - Highlight the boundary - Go to **Boundary > Remove** OR click Alt+backspace.

4. Label the intervals:
   - Select/highlight the target interval by clicking between two boundaries; the selected interval should go yellow.
   - To input or change the text in an interval, edit in the Textbox above the spectrogram.
   - Give name to each interval you create ([first name] or [last name]).

Good! You're done with your 'Segmenting and labelling'. You can also add the phonetic symbols to the textgrid if required by going to the TextGrid editing window - go to Help > Phonetic symbols.

Topic-185: Exporting Visual Display to Word File

Exporting your visual displays to the Word document is the part of the 'write up' of the experiment. It is an important step as we need to report every experiment to our Word file for reporting purposes. There is quite an easy way to do it by maximizing the edit window and hitting the 'PrtScr' (print screen) button and, subsequently, pasting it into Word document.

1. Export your labeled waveform and spectrogram to Word:
   - Maximize the Edit window: click on the little square at the top right of your Edit window.
   - Hit PrtSc ("Print Screen") on your keyboard - nothing would happen on your screen at this point.
   - Open Word document and provide an introduction to the image as required.

- Hit Ctrl+V to paste the Praat image into your Word document.
- Give your Figure a number and title below the image.

Further readings on this section:

- Introduction and first chapter (Lab 1) of **Acoustic Phonetics Lab Manual** (developed by Sonya Bird and Qian Wang at University of Victoria)
- Online sources: http://www.praat.org or http://www.fon.hum.uva.nl/praat/

Lesson-37

USING PRAAT-II

At the end of this section, the students will be able to:

- EXPLAIN the Source-Filter model of speech
- RECOGNIZE and ANALYSE features such as fundamental frequency, harmonics and formants.

Topic-186: The Source-Filter Model of Speech

We have been theoretically discussing about the source-filter theory in this course where we also touched upon the theoretical aspects such as 'the tube model' (of the vocal tract) and 'the perturbation theory' on the formant structure of vowels. Source-filter theory is particularly important to understand the basic components of speech sounds and the nature of the acoustic signals (it is the physics of speech sounds). It is, therefore, very crucial to understand the acoustic analysis of speech sounds particularly the vowels and vowel-like (sonorous sounds). The major goal of this lab is to understand and explore the basic acoustic components of (sonorous) speech sounds such as fundamental frequency, harmonics, and formants. Basically, these components create the acoustic signals associated with speech – understanding them is crucial to understanding what we actually hear, when we hear speech sounds. The labs based on the source-filter theory are conducted in the next few sessions.

Topic-187: Measuring the Fundamental Frequency

Fundamental frequency (F0 or Pitch) is an important component of source-filter theory. It can be taken from the middle of the sound (e.g., vowel) using three techniques including displaying the Pitch track (automatically), measuring from Pitch track manually, and by looking at the waveform – by highlighting one cycle. Before measuring the fundamental frequency, we need to have a recorded file containing a vowel sound (e.g., [æ]). Let's learn all of the three methods one by one:

1. Displaying the pitch track and allowing Praat to measure the pitch automatically:
   - Display the pitch track: Pitch > Show pitch.
   - Place your cursor in the middle – a stable portion of the vowel.
   - Go to Pitch > Get pitch – a box will appear with the pitch value in it (note it down)

2. Displaying the pitch track and measuring pitch manually:
   - Display the pitch track - Pitch > Show pitch.
   - Click on the blue pitch track in the middle of the vowel.
   - A red horizontal bar should appear with the pitch value (in dark blue) on the right side of the window (take the measurement from here).

   By looking at the waveform (top of the display):

- Zoom into a small piece of the waveform in the middle of the vowel and measure the period by highlighting one complete cycle and noting the time associated with it (in the panel above the waveform).

Topic-188: Measuring the Harmonics

Harmonics are the multiple integers of the fundamental frequency which are basically the result of vocal fold vibration (complex wave). We need the 'narrow band spectrogram' for measuring the H (which we can set by fixing the spectrum setting at 0.025). By starting measuring the frequency of the first three harmonics, we will go to the H10 (H1, H2, H3 – H10). Finally, we will compare with pitch measurement already taken. It is important to note down that when our vocal folds vibrate, the result is a complex wave, consisting of the fundamental frequency (which you have measured in Topic 187) plus other higher frequencies, called harmonics. As already mentioned, to see harmonics, we need to look at a narrow-band spectrogram, which is more precise along the frequency domain than the default wide-band spectrogram. Let's now take the harmonics:

1. Display a narrow-band spectrogram:
   - Go to: Spectrum > Spectrogram settings.
   - Change the window length to 0.025s – the default window length is 0.005s (wide-band spectrogram) - this changes the spectrogram dramatically!
   - Looking at each vowel, notice the grey horizontal bands: these correspond to harmonics. For each vowel, measure the frequencies of the first 3 harmonics (H1-H3) and the 10^{th} harmonic (H10).
   - Click on the center (horizontally) of each harmonic in the center of each vowel.
   - A red horizontal bar should appear with the frequency value on the left side of the window in red.

Topic-189: Measuring the Formants

Formants are the overtone resonances. Acoustically, in order to plot vowels on chart, F1-F2 are very important. By now, we know that the narrow bands spectrograms are required for measuring harmonics whereas we need the wide bands for measuring the formants (which are the important characteristics of sonorant speech sounds – vowels). On spectrogram, formants are thick bands (darkness corresponds to loudness; i.e. the darkest harmonics are the ones that are the most amplified). These amplified harmonics form the formants that are characteristic of sonorant speech sounds. Now, let's measure the first and second formants (F1 and F2) from the middle of each vowel using the three techniques outlined below and note down your measurements:

1. Displaying the formants (red dots on the spectrogram) automatically:
   - Display the formant track: Formant > Show formants.
   - Place your cursor in the middle, stable portion of the vowel.
   - Go to Formant > Formant listing: a box will appear with the time point at which the measurement was taken, and the first four formants.

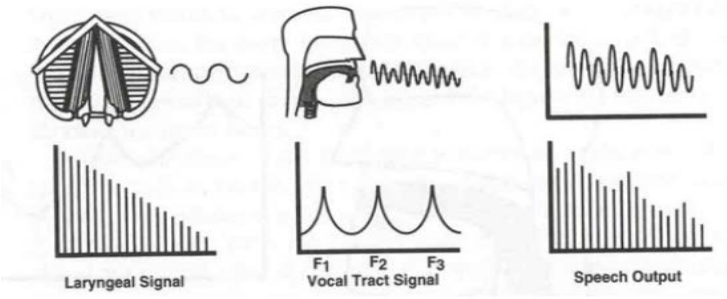
   Displaying the formants and measuring the frequency manually:
   - Display the pitch track: Formant > Show formants.

- Place your cursor in the center of each formant, in the middle of the vowel.
- A red horizontal bar should appear with the frequency value on the left side of the window in red.

3. Measuring the frequency without displaying Praat formants – the easiest way – if Praat's formant tracking goes wonky:
   - Get rid of Praat's formant tracking: Formant > Show formants (unclick).
   - Place your cursor in the center of each formant, in the middle of the vowel.
   - A red horizontal bar should appear with the frequency value on the left (in red).

Topic-190: Relationship Between Harmonics and Formants

In the last two topics, we measured the harmonics as well as the formants of the sonorant sounds (vowels). Having taken the measurements for both formants and harmonics, we need to compare them and explore a possible relationship between the two. Captured in the source-filter model of the speech, it is clear now (from the comparison of the two values – for formants and harmonics) that harmonic numbers are different for one type of sounds but the formants are the same. So, what observation is there for this pattern? What creates harmonics and formants? Actually, the relationship between the harmonics and the formants is captured in the source-filter model of speech production. The point is that harmonics are related to the laryngeal activity (source) and formants are the output of the vocal tract (filter). See the following figure for understanding:



(Taken from http://slideplayer.com/slide/4531126/)

Further readings on this section:

- Chapter 2 (Lab 2) of **Acoustic Phonetics Lab Manual** (developed by Sonya Bird and Qian Wang at University of Victoria)
- Online sources: http://www.praat.org or http://www.fon.hum.uva.nl/praat/
  http://slideplayer.com/slide/4531126/

Lesson-38

USING PRAAT-III

At the end of this section, the students will be able to:

- EXPLAIN vowel properties
- RECOGNIZE and ANALYSE features such as intrinsic pitch and spectral make-up (formant values).

Topic-191: Vowel Properties

For exploring the acoustics of vowels in this session, we need to record vowels and explore their properties. The eight vowels from American English (given in your book (Chapter 8) are to be recorded for the purpose (by now, you should know how to record them). These vowels are: heed, hid, head, had, hod, hawed, hood and who'd. When you are done with the recording, get ready for measuring the following three things: intrinsic pitch, spectral make up (formants) and plotting them in excel sheet (and finally exporting them to your Word document). Now, record yourself saying the words. Take a quick look at your vowels in the Edit window, and make sure you can clearly see the vowel formants. If you have trouble seeing them, you can go back to the previous labs and learn it again. While doing this, please make a note of it on your worksheet.

Topic-192: Intrinsic Pitch

Explore the eight vowels recorded in the last session and measure the pitch (F0) for each of them. You can measure pitch by using any of the three ways already discussed in the Topic-187. Having measured the pitch (F0) in each of the vowels (if your pitch values seem strange, try using another measurement method for confirmation; remember that measuring the waveform is the safest way). Note down your measurements. There is one more way to confirm your pitch measurement by looking at the spectral slice (which gives the component frequencies and their amplitudes).

- Select a portion of the vowel (70-80ms).
- Spectrum > View spectral slice.
- Click on the first (big) peak = H1 = F0 (Ignore any small spikes at the beginning; this might be noise). Now note down the frequency of this peak at the top of the vertical bar).

Use the confirmed pitch values and plot the pitch of each vowel on your excel sheet. Make sure you label your y-axis using a scale that allows you to spread out your measurements as much as you can. Now draw the cluster chart from the excel sheet and export to Word document and give the figure number and title.

Topic-193: Spectral Make-up (Formant Values)

In order to have the spectral make-up of the vowels, we need to take the formant values (for first two formants i.e., F1 and F2) of the eight vowels already recorded. Calculate the first two formants for each vowel. This you can do by using the automatic formant tracking or the manual measurement (trust your judgment than that of Praat). Having taken the values for all of the vowels, we will subsequently plot them on a chart. Remember that we need the default wide-band spectrogram for measuring the first and second formants (F1 and F2) of each vowel. You can also use Praat's automatic formant tracking to help you if you want. Also note and try to answer the following questions (for which you can revisit the chapters and lectures on acoustics):

a. Why do formants (F1 and F2) differ across vowels?
b. What does F1 seem to correspond to, in terms of articulation?
c. What about F2? To what does it correspond?

Topic-194. Plotting Vowels on Chart

Finally, we are at the last step related to spectral make-up of vowel sounds. We have already taken the measurement of the first two formants and we are going to plot those values on a chart using the Excel spreadsheet. By putting F1 and F2 in separate columns, write the formant values associated with different vowels (giving vowels in the first column, the difference between F2 and F1 in the second column and F1 in the third). After putting the data in Excel sheet, we will use the Scatter chart from the same spreadsheet. Further in order to make it corresponding with the required values for F1 and F2, we will reverse the values for both formants (on both axis – Y and X). Now the zero for both F1 and F2 is at the right corner. Watch the video and you will find how F1 is inversely related to the height of the vowel and the difference between F2 and F1 to the frontness of the vowels. Once completed, export the chart to your Word document and give it the number and title accordingly.

Further readings on this section:

- Chapter 3 (Lab 3) of **Acoustic Phonetics Lab Manual** (developed by Sonya Bird and Qian Wang at University of Victoria)

Lesson-39

USING PRAAT - IV

At the end of this section, the students will be able to:

- EXPLAIN sonorants in terms of acoustics.
- RECOGNIZE AND ANALYSE the features of nasals, glides and liquids acoustically.

Topic-195: Sonorants and Their Formants

Sonorants are vowel-like sounds (nasals and glides). These sounds are called sonorants because they have formants (remember their acoustic correlates). But they are different from vowels because they generally have lower amplitude; therefore, they behave like consonants. Record the following sequences for our experimentation on sonorant sounds /ama/ - /ana/ - /aɲa/ - /wi/ - /ju/. Having recorded these sequences, now start exploring the features of these sounds like the measurement of F1, F2, F3 and also try to compare them with vowels. Do you see any systematic patterns? Try to answer the question before moving to the next topic.

Topic-196: Nasal Formants

Formants for nasal sounds are also important for acoustic analysis. Measure the first three (F1, F2 and F3) formants of nasals from the file (use the already learnt way of measuring formants). Remember that nasals have very distinctive waveforms (different than that of vowels) as they have distinctive forms of anti-formants (bands of frequencies damped) and formant transition. When you are done with the measurement, try to answer the following questions:

1. Are there any systematic patterns across nasals?
2. Is there one formant with a similar frequency for all places of articulation?
3. Is there one formant that has much higher amplitude than the others across nasals?
4. Do you see any overall differences between the nasals on the one hand and [a] on the other?

Topic-197: Glide and Their Formants

Glides are also the sonorants (vowel-like) sounds as they have similar patterns (have formants). Read from our recorded file and take the first three formants (F1, F2 and F3) from the middle of the sounds for glides (both for /w/ and /j/) and explore their acoustic correlates. Carefully judge the center of these sounds (the midpoint of [w] and [j]). Analyze that how similar is the formant structure of glides with vowels and nasals. Draw lines to indicate F1, F2, F3 and compare with vowels. When you are done, try to answer the following questions:

1. Which vowel does each glide resemble?
2. Are there any differences between the contours, i.e. between the transitions out of the two glides?
3. What do you think may cause these differences (in terms of articulation)?

Further readings on this section:

- Chapter 4 (Lab 4) of **Acoustic Phonetics Lab Manual** (developed by Sonya Bird and Qian Wang at University of Victoria)

Lesson-40

USING PRAAT-V

At the end of this section, the students will be able to:

- EXPLAIN 'obstruents' in terms of acoustics
- RECOGNIZE and ANALYSE the features of stops, fricatives and affricates acoustically.

Topic-198: Stop Voicing on Spectrograph

There are three important acoustic correlates of voicing in stops: the voice bar, VOT, and the duration of the preceding vowel. Record /apa/, /aba/, /ata/, /ada/, /ap^{h}a/ and /at^{h}a/ and for each of the stops in the file, take the three measurements according to the following instructions: See the voicing or the voice bar by exploring features of stop. We can also explore the features related to the place of articulation (any bilabial feature for /p/ or /b/ in comparison with non-bilabial). Also check the duration of the preceding vowels. Note down the presence of voicing. Now try to answer the following questions:

1. Do you see the voice bar? If the voice bar is present at all, does it last through the duration of the closure? Why do you think it might go away?
2. Can you point out the features related to the place of articulation? Comment on them.
3. How about the duration of the preceding vowel? Is it affected by the voicing?

Topic-199: Measuring Voice Onset Time (VOT)

Another aspect of acoustic correlate of stops is the VOT which is the characteristic of voiced + voiceless + aspirates stop sounds and there are very easy steps to calculate the VOT. Record /apa/, /aba/ /ata/, /ada/, /ap^{h}a/ and /at^{h}a/. Zoom in through your stop sounds so that you can analyze the patterns of the stop sounds and find the difference among the three types of VOT (negative, zero and positive). Measure the VOT of each stop and compare voiced/voiceless counterparts (p/b, t/d, k/g). Similarly, zoom in so that you can clearly see the stop closure followed by the beginning of the vowel. You can measure the time between the end of the stop closure (the beginning of the release burst) and the onset of voicing in the following vowel (the onset of regular pitch pulses in the waveform). This is voice onset time or VOT. Once you are done, try to answer the following questions:

1. How does VOT differ in voiced and voiceless stops and what articulatory explanation can you come up with for this?
2. How does the duration of the preceding vowel differ depending on the voicing of the following consonant?

Further readings on this section:
- Chapter 5 (Lab 5) of **Acoustic Phonetics Lab Manual** (developed by Sonya Bird and Qian Wang at University of Victoria)

Lesson-41

FURTHER AREAS OF STUDY IN P&P

At the end of this section, the students will be able to:

- KNOW the recent research trends and future research areas in P&P.

Topic-200: P&P Research as the Part of ELT

Phonetics and phonology is a very potential area for research to be carried out in Pakistani context. In applied phonology, many areas can be explored; for example, issues faced by Pakistani learners of English may be studied. Similarly, the pronunciation issues of Pakistani learners are potential area through which the difficulties faced by Pakistani students may be addressed. Also, researchers can explore and document the features of Pakistani English based on their phonological features in order to get the Pakistani variety of English recognized. Other problematic areas may also include: segmental and supra segmental features (such as stress placement, intonation patterns and syllabification and resyllabification of English words by Pakistani learners. Contrastive analysis (between English phonology and the sound systems of the regional languages of Pakistan (Urdu, Punjabi, Sindhi, Balochi and Pashto) can also be carried out by the researchers. We can also think about exploring the consonant clusters and interlanguage phonology from second language acquisition point of view. While focusing on ELT as the part of applied linguistics, studies may also be carried out on Pakistani variety of English (development of its corpora, deviation from the standard variety (RP), its specific features, etc.). Moreover, IPA resources and their application on ELT in Pakistani context can also be studied.

Topic-201: Current Trends in P&P Research

It is also an appropriate time to point out some of the current trends (other than ELT) in research on phonetics and phonology for the students of this course. Regional languages of Pakistan may also be documented and studied. In this context, Pakistani researchers can get their work published (on the sounds – IPA illustrations) in international reputable journals such as the IPA Journal of Cambridge University. Pakistani regional languages are the part of the rich linguistic regions. (Himalaya Hindu Kush (HKH) region, one of the richest regions in the world linguistically and culturally) may be very potential area for research in the fields of areal and typological linguistics (description of linguistic features cross-linguistically). While working on Pakistani regional languages, one may apply for funding from international organizations (e.g., organization for endangered languages and UNISCO).

Topic-202: Distinctive Features

There are many other areas which may be explored. The distinctive features, for example, can be studied as the part of the phonetic studies of sounds (in applied phonology). Such a study would discover facts about the features of English pronunciation (and, of course, about the sounds of other languages). While working on this aspect of sound systems, the phonological analysis (theoretical) may include the

description of phoneme as a combination of different features (e.g., /d/ as a phoneme and its features – alveolar, stop, voiced, oral and central) in a binary (+ -) order which is an important component of phonology. Moreover, the feature analysis may also include aspects of the target language as the part of ELT (English Language Teaching learning point of view). Remember that we need to include three principles for feature analysis: contrastive function (how it is different), descriptive function (what it is) and classificatory function (based on broader classes of sounds). Features may also be studied further as a part of language universals and then their role as language specific sub sets.

Topic-203: Experimental Phonetics

In experimental phonetics and phonology, the studies of sounds include various latest experimental techniques and computer software that are used under carefully designed lab experimentation. It is an important aspect of the application of the latest technology by going beyond the simple acoustics and by working in sophisticated phonetic labs in order to discover the hidden aspects of human speech. For example, questions such as 'How speech is produced and processed?' are the focus of experimental phonetics (explore the speech chain as the beginning of experimental phonetics as mentioned in Chapter-20 by Peter Roach). The latest trends under experimental phonetics include brain functions in speech production and processing (by using the latest equipment – many special instruments such as x-ray techniques), speech errors, neurolinguistics and the topics related to the developments through computers – for speech analysis and synthesis.

Topic-204: The Study of Variety

The varieties of English (or many other major languages such as Urdu, Punjabi and Pashto, for that purpose) may also be viewed as potential areas of research in the domain of phonetics and phonology. Such a study would include comparisons and contrasts (similarities and differences) among the accent (varieties) of the subject language(s) – e.g., differences at phonetic and phonological levels and the study of segmental and suprasegmental features – in different varieties. Differences among accents of English have already been discussed in this course under various headings (such as vowels in other accents of English). Similarly, English dialectology has already been explored by a number of studies with particular focus on the geographic differences (in the recognition of various forms of English – or Englishes). There are now many well-known data gathering techniques used in field linguistics (such as the sociolinguistics of English varieties) like variations paradigm. Field workers are particularly trained for data gathering and their expertise are developed for large scale studies related to the studies of varieties.

Further readings on this section:

- Chapter 20 of the additional reading book (**English Phonetics and Phonology-A Practical Course** by Peter Roach)

Lesson-42

THE PEDAGOGY OF PHONETICS AND PHONOLOGY

At the end of this section, the students will be able to:

- IDENTIFY the best method for the teaching of P&P to Pakistani students.

Topic-205: The Relationship Between ELT and P&P

This course has many important pedagogical implications for the teachers of phonetics and phonology. Phonetics and phonology is an integral part of English Language Teaching (ELT). The teaching of phonetics and phonology further needs to be integrated in the teaching of ELT. For the purpose, the teachers are expected to work on their skills related to the pronunciation of English and sensitize their students related to the topic – they may use their self-initiated procedures for carrying out the phonological contrastive analysis (CA) (e.g., of their mother tongues and English) at segmental and suprasegmental levels for enhancing their skills and completing their researches. They are also expected to take part in the phonology based ELT activities from the TESOL Home Page (available online) and participate in the English Language Teaching Reforms (ELTR) projects of the Higher Education Commission (HEC) of Pakistan and activities planned and sponsored by British Council Pakistan. The students are also expected to be the part of these platforms through their social groups and online learning opportunities.

Topic-206: Developing Relevant Material

Developing relevant material for the teaching of phonetics and phonology is an important task for aspiring teachers of English language. Remember the specific needs of ELT activities in your own context and explore already developed material available online from various sources (such as British Council and other teacher resource centers); however, you must also be able to develop your own material (as specifically required by your students). For example, you can develop your material related to the pronunciation teaching to the learners of English. You can incorporate material related to the IPA text – transcription of the audio (listening) based activities – by involving students on using dictionaries (ideally the phonetic dictionaries) in the classroom.

Movies and documentaries (such as from BBC - CNN - National Geographic channels) may also serve as very effective resources for the teaching of pronunciation. Finally, the real life material (for listening) and writing interaction from everyday language may also yield tremendous results. The focus of material development should always be the enhancement of the proficiency level of students.

Topic-207: Conducting Classroom Research for ELT

As a part of the pedagogy of the phonetics and phonology, the teachers are expected to go for the action research which is an important aspect of ELT with significant pedagogical implications. Action research in this context means focusing on the issues faced by ELT instructors and looking for their

solution through research. Since English language learners in Pakistan face a lot of problems, you can find a number of ways to plan your research inside your classroom (e.g., problem solving, material development in addition to your course-books i.e., novels and dramas). Remember that classroom (action) research is always based on problem (related to teaching, for example) solving and such studies are mostly conducted by teachers themselves. Since they are serving in the field, they are expected to be well aware of the problems faced by teachers and learners; therefore, they are expected to plan authentic issues and their solutions through their researches.

Topic-208: Making Research Accessible to Teachers

Good teachers are expected to be active researchers and therefore busy in updating themselves about the latest researches and teaching methodologies around the world. It is also a pedagogical challenge for teachers to keep themselves updated by exploring pedagogical and technological challenges for ELT experts (in their own contexts and internationally). For example, the aspects of Task Based Learning and Teaching (TBLT) as a golden method for second language acquisition (SLA) may be effective in Pakistani context if explored by ELT practitioners. Teachers as the agents of change and they must be reading research studies and carry out research by and explore their issues and solutions. A good way is to keep reading teachers' digests and journals and participate in the online discussions by teaching associations.

Topic-209: Facilitating Action Research

As already discussed, teachers are expected to facilitate action research which is the most rewarding and productive for their own profession. For example, the phonetics of phonological speech errors if explored and shared by teachers (by investigating their own practices) may lead to a very positive discussion in the academic circles (of research into ELT – SLA). Similarly, topics such as learners' performance and development (e.g., what do good speakers do?) may yield useful results for teachers' fraternity. Having said this, it is required from teachers (and student teachers) to facilitate action research related to reading/listening issues, English reading strategies (e.g., in primary schools) – (and their effectiveness), impact on pronunciation and many more. Research in the fields of phonetic theory and the description with phonological, typological and broader implication may also be included in phonetics and phonology specific action research.

Further readings on this section:

- Online sources: http://slideplayer.com/slide/10210572/
  http://slideplayer.com/slide/6183258/