Experiment No (7 from Syllabus List)

Experiment Title:

Pronounce and classify selected Sanskrit sounds into vowels and consonants using a simple sound chart, group them according to articulation patterns, and analyze how this systematic sound organization supports pronunciation training, language learning, and speech-processing applications.

Individual activity

Sanskrit Phonetics & Computational Linguistics Experiment

Part 1: Core Definitions

To write rules for human or artificial speech, we must break sounds down into three physical parameters:

1. Mouth Position

- **Throat (Velar):** Sound clicks deep at the back of a relaxed tongue. (e.g., *ka*)
- **Hard Palate (Palatal):** The flat body of the tongue seals against the roof. (e.g., *ca*)
- **Roof Dome (Retroflex):** The tongue tip curls backward like a spoon into the top ceiling. (e.g., *ṭa*)
- **Teeth (Dental):** The tongue tip presses flat against the back of your top front teeth. (e.g., *ta*)
- **Lips (Labial):** Formed entirely by popping your lips open. No tongue allowed. (e.g., *pa*)

2. Vibration / Voicing (The Vocal Cord Toggle)

- **Unvoiced:** Vocal cords stay relaxed and open. Air flows through freely.
- **Voiced:** Vocal cords draw tight and vibrate rapidly like a guitar string, creating a deep buzz.
- *The Finger Test:* Place your index finger flat against the very center of your throat (on the hard cartilage bump halfway down your neck). Say *"sssss"* (Unvoiced = no vibration). Now say *"zzzzz"* (Voiced = physical vibration).

3. Air Volume / Aspiration (The Lung Air Toggle)

- **Unaspirated:** You release just enough air to make a sharp, clean sound pop out.
- **Aspirated:** You deliberately push an explosive, secondary blast of air out of your lungs right as you release the sound (like a built-in heavy sigh).
- *The Palm Test:* Hold your hand 2 inches away from your lips. Say **"ka"** (Unaspirated = no air). Now say **"kha"** (Aspirated = sudden warm blast of air on your palm).

Part 2: Practical Session Roadmap

Phase 1: Bio-Acoustic Calibration (25 Minutes)

1. **The Pencil Drill:** Place a pencil horizontally between your molars. Pronounce the sequence **त (ta), थ (tha), द (da)**. Your tongue hits the teeth *in front* of the pencil. Now say ट **(ṭa),** ठ **(ṭha),** ड **(ḍa)**. Your tongue must curl *behind* the pencil into the upper dome.
2. **The Matrix Check:** Put your hand in front of your mouth and your fingers on your throat. Verbally cycle through:

   ka→→ **kha**→→ **ga**→→ **gha**. Physically feel the toggles switch on and off.

Phase 2: Cardboard Data Matrix (30 Minutes)

1. Cut your paper sheet into 25 equal squares. Write one sound on the front of each card.
2. Flip the card over and write its exact logical attributes based on the Master Chart on the board.
    - *Example Front:* **gha**
    - *Example Back:* `[Throat, Voiced=True, Aspirated=True]`

Phase 3: The Sandhi Compiler Game

Your team will receive combined phrase inputs from the instructor. You must use your cards to apply phonetic rules, calculate horizontal/vertical grid movements, and display the correct final word combination on your desk!

Phase 4: Test & Scoring (30 Minutes)

Compete against other teams to process complex linguistic inputs under a 2-minute time limit.

SECTION 2: THE WHITEBOARD REFERENCE CHART

The Master Varṇamālā Speech Engine

Mouth Position	Unvoiced Unaspirated	Unvoiced Aspirated	Voiced Unaspirated	Voiced Aspirated	Nasal (Nose Sound)
Throat *(Velar)*	**ka** (क)	**kha** (ख)	**ga** (ग)	**gha** (घ)	**ṅa** (ङ)
Hard Palate *(Palatal)*	**ca** (च)	**cha** (छ)	**ja** (ज)	**jha** (झ)	**ña** (ञ)
Roof Dome *(Retroflex)*	**ṭa** (ट)	**ṭha** (ठ)	**ḍa** (ड)	**ḍha** (ढ)	**ṇa** (ण)
Teeth *(Dental)*	**ta** (त)	**tha** (थ)	**da** (द)	**dha** (ध)	**na** (न)
Lips *(Labial)*	**pa** (प)	**pha** (फ)	**ba** (ब)	**bha** (भ)	**ma** (म)

- **Modifier Row (Semi-Vowels): ya** (Palate), **ra** (Roof), **la** (Teeth), **va** (Lips+Teeth)
- **Modifier Row (Sibilants): śa** (Palate), **ṣa** (Roof), **sa** (Teeth), **ha** (Throat)

SECTION 3: INSTRUCTOR PHASING & TESTING GAMEPLAY

(Use these exact scenarios, explanations, and keys to run Phase 3 and Phase 4.)

Example 1: vāk + īśa

- **What to write on the board:** `vāk + īśa`
- **The Rule:** If an unvoiced sound (Column 1) meets a voiced vowel (`ī`), it slides horizontally across its own mouth row to its **Voiced** equivalent (Column 3) to prevent the vocal cords from glitching.
- **The Matrix Mechanics:** Look up the **ka** card → Row: `Throat` → Change `Voiced=False` to `Voiced=True` → The card becomes **ga**.

Example 2: sat + cit

- **What to write on the board:** `sat + cit`
- **The Rule:** If a word ends in a Teeth sound (`ta`) and meets a Hard Palate sound (`ca`), the tongue cannot change positions that fast. The Teeth sound drops its position and adopts the **Hard Palate** position entirely, keeping its column attributes.
- **The Matrix Mechanics:** Look up **ta** `[Teeth, Unvoiced, Unaspirated]` → Shift row to `Hard Palate` → Maintain Unvoiced/Unaspirated column → The card becomes **ca**.
- **Meaning:** *Sat* (Truth) + *Cit* (Consciousness) = **Saccit** (Pure Awareness).

Example 3: vāk + maya

- **What to write on the board:** `vāk + maya`
- **The Rule:** When an abrupt, unvoiced stop meets a continuous nasal sound (`ma`), the first letter slides entirely to the final **Nasal column** of its own row to smooth out air distribution.
- **The Matrix Mechanics:** Look up **ka** → Row: `Throat` → Slide all the way to the rightmost column → The card becomes **ṅa** (pronounced like the "ng" in *sing*).
- **Meaning:** *Vāk* (Word) + *Maya* (Full of) = **Vāṅmaya** (Literature / Manifested Speech).

Level 1: Horizontal Sliding Rules (Voicing Shifts)

Rule: An unvoiced stop (Column 1) slides across its own mouth row to Column 3 (Voiced) when meeting a voiced vowel or consonant.

1. dik + ambara

- **Matrix Logic:** Locate **ka** `[Throat, Unvoiced]`. Slide horizontally to Column 3 on the same row → becomes **ga**.
- **Meaning:** *Dik* (Direction/Space) + *Ambara* (Garment) = **Digambara** (Clad in space / Sky-clad).
- **Desk Answer:** `digambara`

2. jagat + īśa

- **Matrix Logic:** Locate **ta** `[Teeth, Unvoiced]`. Slide horizontally to Column 3 on the same row → becomes **da**.
- **Meaning:** *Jagat* (World) + *Īśa* (Lord) = **Jagadīśa** (Lord of the Universe).
- **Desk Answer:** `jagadīśa`

3. ac + anta

- **Matrix Logic:** Locate **ca** `[Hard Palate, Unvoiced]`. Slide horizontally to Column 3 on the same row → becomes **ja**.
- **Meaning:** *Ac* (Vowel) + *Anta* (Ending) = **Ajanta** (Words ending in a vowel).
- **Desk Answer:** `ajanta`

Level 2: Vertical Row-Jumping Rules (Assimilation)

Rule: A sound drops its own mouth position and jumps vertically to match the row of the incoming sound, keeping its original column attributes.

4. ut + carana

- **Matrix Logic:** Locate **ta** `[Teeth, Unvoiced, Unaspirated]`. The incoming sound is **ca** `[Hard Palate]`. Jump vertically from the Teeth row to the Hard Palate row → becomes **ca**.
- **Meaning:** *Ut* (Up/Out) + *Carana* (Moving) = **Uccarana** (Pronunciation / Utterance).

- **Desk Answer:** `uccarana`

5. sat + jana

- **Matrix Logic:** Locate **ta** `[Teeth, Unvoiced, Unaspirated]`. The incoming sound is **ja** `[Hard Palate, Voiced]`. The target row is Hard Palate. Because **ja** is voiced, **ta** must also drop its unvoiced nature and match it → becomes **ja**.
- **Meaning:** *Sat* (Good/True) + *Jana* (Person) = **Sajjana** (A good/virtuous person).
- **Desk Answer:** `sajjana`

6. ut + jvala

- **Matrix Logic:** Locate **ta** `[Teeth]`. The incoming sound is **ja** `[Hard Palate]`. Jump vertically from the Teeth row to the Hard Palate row and match the voicing → becomes **ja**.
- **Meaning:** *Ut* (Up/Intense) + *Jvala* (Light/Flame) = **Ujjvala** (Bright / Radiant).
- **Desk Answer:** `ujjvala`

Level 3: Extreme Right Sliding Rules (Nasalization)

Rule: When meeting a nasal letter (Column 5, like **ma** or **na**), a Column 1 sound slides completely to the far right column of its *own* row.

7. jagat + nātha

- **Matrix Logic:** Locate **ta** `[Teeth]`. It meets **na** (a nasal sound). Slide all the way to the rightmost column of the Teeth row → becomes **na**.
- **Meaning:** *Jagat* (World) + *Nātha* (Protector) = **Jagannātha** (Lord of the World).
- **Desk Answer:** `jagannātha`

8. cit + maya

- **Matrix Logic:** Locate **ta** `[Teeth]`. It meets **ma** (a nasal sound). Slide all the way to the rightmost column of the Teeth row → becomes **na**.
- **Meaning:** *Cit* (Consciousness) + *Maya* (Filled with) = **Cinmaya** (Purely spiritual / Filled with consciousness).

- **Desk Answer:** `cinmaya`

9. ṣaṭ + mākha

- **Matrix Logic:** Locate **ṭa** `[Roof Dome / Retroflex]`. It meets **ma** (nasal). Slide all the way to the rightmost column of the Roof Dome row → becomes **ṇa**.
- **Meaning:** *Ṣaṭ* (Six) + *Mukha* (Faces) = **Ṣaṇmukha** (The six-faced one).
- **Desk Answer:** ṣaṇmukha

Level 4: Double-Collision Script

Rule: Both sounds hit each other and transform simultaneously to create a completely new acoustic blend.

10. ut + hāra

- **Matrix Logic:** A combination of a soft Teeth sound (**ta**) meeting a deep throat air-sound (**ha**).
    1. The **t** slides horizontally to Column 3 to become **d** (`da`).
    2. The **h** gets pulled forward into the Teeth row and takes on a heavy voiced-aspirated quality to become **dh** (`dha`).
- **Meaning:** *Ut* (Up/Forward) + *Hāra* (Taking/Bringing) = **Uddhāra** (Upliftment / Rescue).
- **Desk Answer:** `uddhāra`

Rule 1: The Horizontal Voicing Shift (Jaśtva)

- **The Rule:** If an unvoiced sound (**Column 1**) meets any voiced vowel or voiced consonant, it slides horizontally across its own mouth row to its **Voiced equivalent (Column 3)** to prevent the vocal cords from glitching during the sudden transition.
- **The Math:**
    - `ka` → `ga` (Throat Row)
    - `ca` → `ja` (Palate Row)
    - ṭa → ḍa (Roof Dome Row)

    - `ta` → `da` (Teeth Row)
    - `pa` → `ba` (Lips Row)
- **Classroom Prompt:** `dik + ambara` → **`digambara`**

Rule 2: The Extreme-Right Nasal Slide (Anunāsika)

- **The Rule:** If an unvoiced sound (**Column 1**) meets a nose sound (**Column 5**, like *ma* or *na*), it bypasses the standard voicing shift and slides completely to the far right of its own mouth row to its **Nasal equivalent (Column 5)** so the air volume can exit fluidly through the nose without a harsh break.
- **The Math:**
    - `ka` → `ṅa`
    - `ca` → `ña`
    - `ṭa` → `ṇa`
    - `ta` → `na`
    - `pa` → `ma`
- **Classroom Prompt:** `cit + maya` → **`cinmaya`**

Rule 3: The Teeth-to-Palate Jump (Ścutva)

- **The Rule:** If a soft teeth sound (**ta** or **da**) meets any hard palate sound (**ca, cha, ja, jha,** or **śa**), it drops its native dental position and jumps vertically to the **Hard Palate row** while keeping its original column attributes, preventing the tongue from having to make an impossible, clunky backward leap.
- **The Math:**
    - `ta` + `ca` → `ca` (Unvoiced, Unaspirated stays the same, row jumps)
    - `ta` + `ja` → `ja` (Unvoiced shifts to Voiced to match incoming sound, row jumps)
- **Classroom Prompt:** `sat + jana` → **`sajjana`**

Rule 4: The Teeth-to-Roof Jump (Ṣṭutva)

- **The Rule:** If a soft teeth sound (**ta** or **da**) meets any curled roof sound (**ṭa, ṭha, ḍa, ḍha,** or **ṣa**), it drops its native dental position and jumps vertically to the **Roof Dome row** while keeping its column attributes, because the tongue cannot physically move from the teeth to a deep reverse-curl instantly.
- **The Math:**
    - `ta` + ṭa → ṭa
    - `ta` + ḍa → ḍa

- **Classroom Prompt:** `tat + ṭīkā` → **`taṭṭīkā`** (*Utterance/commentary on that*)

Rule 5: The Lateral Dental Collapse (Lattva)

- **The Rule:** If a teeth sound (**ta** or **da**) meets the liquid semi-vowel **la**, it completely collapses its stop mechanism and transforms entirely into **la**, allowing the tip of the tongue to stay flat and let the sound flow smoothly out of the sides of the mouth.
- **The Math:** `ta / da` + `la` → `lla`
- **Classroom Prompt:** `ut + lekha` → **`ullekha`**

Rule 6: The Unvoiced Hardening Reset (Cartva)

- **The Rule:** If a heavy voiced sound (**Column 3 or 4**) meets a harsh unvoiced sound (**Column 1 or 2**) at a boundary, it undergoes an immediate hardening reset and slides leftward to its **Unvoiced equivalent (Column 1)** because the vocal cords physically run out of time to maintain vibration before hitting the sudden silent sound.
- **The Math:**
  - `ga` → `ka`
  - `ja` → `ca`
  - `da` → `ta`
  - `ba` → `pa`
- **Classroom Prompt:** `sad + kāra` → **`satkāra`**

Rule 7: The Sibilant Air Flare (Chattva)

- **The Rule:** If a teeth sound (**ta**) hits the high-friction palate air-sound **śa**, a massive double collision happens: the **ta** jumps vertically to become a palate stop (**ca**), and the rush of air behind it compresses the **śa** into an explosive, heavy burst, turning it into **cha**.
- **The Math:** `ta` + `śa` → `ccha`
- **Classroom Prompt:** `tat + śiva` → **`tacchiva`**

Rule 8: The Deep Breath Compression (Pūrva-Savarṇa)

- **The Rule:** If a stop consonant meets the deep throat air-exhale **ha**, both sounds warp: the first sound slides horizontally to its voiced version (**Column 3**), and the heavy air sound **ha** drops its throat position, rushes forward to

match the mouth row of that first sound, and manifests as a heavy breath variant (**Column 4**).

- **The Math:** `ta` + `ha` → `ddha` (A Column 3 and Column 4 fusion)
- **Classroom Prompt:** `vāk + hari` → **`vāghari`**

Problem Statement:

Write a program in python to execute all these rules with input as two words and output as combining correct word

Program:

Output:

```
⌨️ Enter Word 1 (e.g., vāk): vak
⌨️ Enter Word 2 (e.g., īśa): nishchay
🎯 Consolidated Word Answer: vaṅnishchay

----------------------------------------
⌨️ Enter Word 1 (e.g., vāk): sat
⌨️ Enter Word 2 (e.g., īśa): achar
🎯 Consolidated Word Answer: sadachar

----------------------------------------
⌨️ Enter Word 1 (e.g., vāk): vak
⌨️ Enter Word 2 (e.g., īśa): hari
🎯 Consolidated Word Answer: vaghari

----------------------------------------
⌨️ Enter Word 1 (e.g., vāk): sad
⌨️ Enter Word 2 (e.g., īśa): kara
🎯 Consolidated Word Answer: satkara

----------------------------------------
⌨️ Enter Word 1 (e.g., vāk): sat
⌨️ Enter Word 2 (e.g., īśa): achar
🎯 Consolidated Word Answer: sadachar
```

Conclusion

You took a language designed thousands of years ago, mapped its physical sounds onto an architectural grid, and ran those exact rules live inside a working Python script. When you type two words into this program and watch it instantly output a perfect consolidated answer, you are seeing the exact intersection of human biology and computer science.Siri and Alexa do not think in letters; they think in parameters. They look at a vocal grid, toggle vocal vibrations on or off, adjust the blast of air volume, and execute the exact same horizontal and vertical matrix shifts that you just coded. Sanskrit is not a language of arbitrary rules or random spelling traps. It is an explicit, mathematical algorithm for the human mouth. By understanding its phonetic chart, you have unlocked the core logic used to power modern automatic speech recognition and ai.