



# Swaranjali Music School

## स्वरांजली संगीत शाला

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## Visharad Poorna Theory

2006 Syllabus: Akhil Bharatiya Gandharva Mahavidyalay Mandal – India

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## Theory: Written Exam Paper # 1:

### Chapter 8: Theories from Western Music

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Vibration (Aandolan), Frequency (Kampan), Duration (Antar), Interval (Antaraal), Natural Scale-Tempered Scale (Various swar Saptak), Major Tone, Minor Tone, semitone

Note: Unit of Frequency (Kampan): Hz = Vibrations/second

#### 1. Vibration (Aandolan)

When a string on Veena or Taanpuraa is plucked, it vibrates and produces naad. Number of vibrations per second is called frequency in Hz. When frequency is higher for a naad, the pitch is also higher. Measurement of frequency can be done using today's technology. Frequency for middle Sa is 240 Hz (240 vibrations per second) and the length of string that will produce this swar SA with frequency 240 Hz is 36 inches. Taar Shadja's frequency is 480 Hz.

#### 2. Frequency (Kampan)

Vibrations per second are called frequency. Limit of audibility for human ear is minimum 20 Hz – 20,000 Hz. Sounds with lower or higher frequencies are not heard by humans. Sound is produced by several means: plucking a string, striking a drum or metal object. They all produce sounds with different fixed frequencies that are characteristics of the material and shape.

#### 3. Duration (Kaal or Antar)

When there are several naad, the time between the naad is called duration. Volume, Tonal Quality, Vibration, Frequencies, Pitch are inter-related. The time how long the naad lasts is duration.

#### 4. Interval (Swar antar - Ratio)

Difference between the frequencies of two naad is called 'Interval'.

Different types of intervals are:

1. **Unison Interval:** Interval between two naad with same frequency. Ratio of frequencies is 1:1

2. **Octave Interval:** When ratio between the frequencies of two naad are 1:2, there is a difference of a saptak between them. Hence it is called an octave interval. If a Madhya Saptak Rishabh swar has frequency 270 Hz, a Taar Saptak Rishabh will have frequency  $270 \times 2 = 540$  Hz.
3. **Fifth Interval:** When the ratio of frequencies between two naad is 2:3, it is called fifth interval. Example: Madhya Shadja has frequency 240 Hz and Pancham, which is a fifth swar from Sa, has a frequency of 360 Hz and it is called fifth interval. Similarly there are other intervals: e.g. –
4. **Fourth Interval:**  $3:4 = 240:320$  Hz:
5. **Major Third Interval:**  $4:5 = 240:300$  Hz
6. **Minor Third Interval:**  $5:6 = 240:288$  Hz
7. **Major Tone Interval:**  $8:9 = 240:270$  Hz
8. **Minor Tone Interval:**  $9:10 = 270:300$  Hz
9. **Semi Tone Interval:**  $15:16 = 240:400$  Hz
10. **Perfect Interval:** Sa-Ma (C – F), Sa-Pa (C – G) and Sa-Sa (C – C) pairs are called perfect intervals.

## 5. Tone

There are three types of tones:

1. Major Tone (Guru Swar), 2. Minor Tone: Laghuswar, 3. Semi-Half Tone: Ardhaswar.
- You can find frequency of western swar by the ratio calculations.

Indian Swar	S <sub>a</sub>	R <sub>e</sub>	G <sub>a</sub>	M <sub>a</sub>	P <sub>a</sub>	D <sub>h</sub> <sub>a</sub>	Ni
Indian Shruti Interval Shruti Antar (or Shrutyantar)	4	3	2	4	4	3	2
Western Swar	Do	Re	Mi	Fa	Sol	La	Ti (Si)
Western Swar (Do fixed on C)	C	D	E	F	G	A	B
Western Shruti Interval Shruti Antar (or Shrutyantar)	4	3	2	4	3	4	2
Tone	Major	Minor	Semi	Major	Minor	Major	Semi
Tone Division Number							
Tone Division Number	1	2	3	4	5	6	7
Western	C-D	D-E	E-F	F-G	G-A	A-B	B-C
Indian Swar	S <sub>a</sub> R <sub>e</sub>	R <sub>e</sub> G <sub>a</sub>	G <sub>a</sub> M <sub>a</sub>	M <sub>a</sub> P <sub>a</sub>	P <sub>a</sub> D <sub>h</sub> <sub>a</sub>	D <sub>h</sub> <sub>a</sub> Ni	Ni S <sub>a</sub>
Ratio (Swrantar)	9:8	10:9	16:15	9:8	10:9	9:8	16:15
Tone	Major	Minor	Semi	Major	Minor	Major	Semi
Tone Division Number							
Tone Division Number	1	2	3	4	5	6	7
Western	C-D	D-E	E-F	F-G	G-A	A-B	B-C
Indian Swar	S <sub>a</sub> R <sub>e</sub>	R <sub>e</sub> G <sub>a</sub>	G <sub>a</sub> M <sub>a</sub>	M <sub>a</sub> P <sub>a</sub>	P <sub>a</sub> D <sub>h</sub> <sub>a</sub>	D <sub>h</sub> <sub>a</sub> Ni	Ni S <sub>a</sub>
Ratio (Swrantar)	9:8	10:9	16:15	9:8	10:9	9:8	16:15
Tone	Major	Minor	Semi	Major	Minor	Major	Semi

## 6. Scale (Swar Saptak)

When Naad were realized and they were placed one after another according to their increasing frequencies, 'Swar Saptak' or 'Scale' were formed. Placing Swar in sequential fixed order is called a scale.

Western music has several different types of scales or Saptak.

1. Natural Scale, 2. Tempered Scale, 3. Pythagorean, 4. Chromatic, 5. Diatonic, 6. Major Scale, 7. Minor Scale etc.

### 1. Natural Scale:

In different parts of the world, according to local conditions and preferences in various countries, Natural scale was constructed. It can be called 'Shuddha Thaata'. In Indian and western music, Shadja swar has frequency of 240 Hz.

Swar	Ṣa	Rḡ	Gḡ	Ga	Ma	Pa	Dha	Ni	Ni	Ṣa <sup>1</sup>
Western Frequency Hz	240	270	288	300	320	360	400	432	450	480
Indian Frequency Hz	240	270	288	$301\frac{17}{43}$	320	360	405	432	$454\frac{4}{83}$	480

Indian swar (Ṣa Rḡ Gḡ Ma Pa Ni Ṣa<sup>1</sup>) scale is like Raag Kaafee without Dhaivat. In both styles, this Saptak is pleasant and entertaining. However because of differences in other swar frequencies, western compositions sound a little different, faster and challenging than Indian songs.

### 2. Tempered Scale

The difficulties in Natural scale are smoothed over in tempered scale by changing frequencies into whole numbers and dividing the frequencies of 12 swar of an octave into 12 equal parts by making the ratio between each consecutive swar pair to be  $2^{1/12} = 1.059463$  (Twelfth root of two).

Pitch intervals are measured in units of Savart and Cent. Smallest musical interval used in western music is a semitone or half tone (half step). In Indian music, semitone interval is equivalent to interval between Ṣa - Rḡ and Rḡ - Rḡ etc. A method devised by Felix Savart was later modified by Alexander Wood to divide the octave between 300 Savarts with 25 Savarts allocated to each semitone.

Savarts are now mostly replaced by Cents.

Swar	Ṣa	Rḡ	Rḡ	Gḡ	Ga	Ma	Ma <sup>1</sup>	Pa	Dha	Dha	Ni	Ni	Ṣa <sup>1</sup>
Savarts	0	25	50	75	100	125	150	175	200	225	250	275	300
Cents	0	100	200	300	400	500	600	700	800	900	1000	1100	1200

<b>Name</b>	<b>Exact value</b>	<b>Cents</b>	<b>Savarts</b>
Unison ( <u>C</u> )	$2^{0/12} = 1$	0	0
Minor second ( <u>C#</u> / <u>Db</u> )	$2^{1/12} = 1.059463$	100	25
Major second ( <u>D</u> )	$2^{2/12} = 1.122462$	200	50
Minor third ( <u>D#</u> / <u>Eb</u> )	$2^{3/12} = 1.189207$	300	75
Major third ( <u>E</u> )	$2^{4/12} = 1.259921$	400	100
Perfect fourth ( <u>F</u> )	$2^{5/12} = 1.334840$	500	125
Tritone ( <u>F#</u> / <u>Gb</u> )	$2^{6/12} = 1.414214$	600	150
Perfect fifth ( <u>G</u> )	$2^{7/12} = 1.498307$	700	175
Minor sixth ( <u>G#</u> / <u>Ab</u> )	$2^{8/12} = 1.587401$	800	200
Major sixth ( <u>A</u> )	$2^{9/12} = 1.681793$	900	225
Minor seventh ( <u>A#</u> / <u>Bb</u> )	$2^{10/12} = 1.781797$	1000	250
Major seventh ( <u>B</u> )	$2^{11/12} = 1.887749$	1100	275
Octave ( <u>C</u> )	$2^{12/12} = 2$	1200	300