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अनन्ता

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Concept of divisibility in Paduka sahasram

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Abstract:
This research paper attempts to reveal one mathematical concept of divisibility interwoven in one of the Stanzas of Paduka Saharam written by Swāmi Śri Vedānta Deśikā, as a sample using the Ancient Vedic Numerical Code (or Katapaya Coding).

Keywords: Paduka sahasram, divisibility by 11, Ancient Vedic Numerical Code

Introduction
Ancient Sanskrit literature of India is a Treasure –House of Mathematical wisdom, which on exploring never gets exhausted, but abounds in newer findings. Paduka sahasram is the magnum-opus of Swāmi Śri Vedānta Deśikā, the unequalled versatile genius and greatly honoured poet of the 13th century, The Mathematical study of this particular composition has somehow eluded the scrutiny of the commentators and interpreters of this work. This research paper attempts to reveal one mathematical concept of divisibility interwoven in one of the Stanzas of Paduka Saharam written by Swāmi Śri Vedānta Deśikā, as a sample using the Ancient Vedic Numerical Code (or Katapaya Coding).

Vedic Numerical code (Katapaya code)
In this system,
i.   the consonants (vyanjanas) beginning with ka (क), ta (ट), pa (प) and ya (य) referred the digits from 1 to 9 (i.e. letters from ka (क) to jha (झ), from ṭa (ट) to dha (ध), denote 1 to 9;
ii.   pa (प) to ma (म) stand for 1 to 5;
iii. letters from ya (य) to ha (ह) represent the digits 1 to 8;
iv.   the nasals ña (ञ) and na (न) denote 0;
v.   in the case of conjunct consonants, the number denoted only by the last consonant is taken;
vi.   the vowels following consonants have no value;
vii. the vowels not preceded by any consonant represent 0;
viii. the arrangement of the digits is from right to left as per the rule ankānam vāmato gatiḥ (अङ्कानाम् वामतो गतिः);
ix.   The letter ḷa (ऴ), peculiar to the Dravidian languages, represent 9.

The rule is:
'kādi nava, ṭādi nava, pādi panca, yādyashtau'
1. 'Kādi nava' means ka and the following eight letters
2. 'Ṭādi nava' means ta and the following eight letters
3. 'Pādi pañca' means pa and the following four letters
4. 'Yādyashtau' means ya and the following seven letters
5. 'Ksha' represents zero.

To make this more clear and understandable, the notation is given by the following table:

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Table 1: Vedic Numerical Code (Katapayādi system)

Category	1	2	3	4	5	6	7	8	9	0
Kādinava	क	ख	ग	घ	ङ	च	छ	ज	झ	ञ
	ka	kha	ga	gha	ńa	ca	cha	ja	jha	ña
Tādinava	ट	ठ	ड	ढ	ण	त	थ	द	ध	न
	ta	ṭha	ḍa	ḍha	ṇa	ta	tha	da	dha	na
Pādipanca	प	फ	ब	भ	म					
	pa	pha	ba	bha	ma					
Yādyashtau	य	र	ल	व	श	ष	स	ह	ळ	क्ष
	ya	ra	la	va	śa	sha	sa	ha	ḷa	ksha

Hence
a) The Vowels are not included in the list.
b) They are exempted because, only the consonants with vowels are assigned numbers.
c) In conjunct consonants, the last consonant alone is to be coded.

Svāmī Śrī Vedānta Deśika applies this Vedic numerical code to reveal the algebraic concept of divisibility by eleven (11) in the following verse of his didactic lyric 'Subhāshitanīvī'.

Verse

धर्मसेतुनिविष्टाना
मचलानां गरीयसाम् ।
दक्षिणोत्तरवृतीनां
दृष्टि: पापनिवर्तनी ॥ (Chap 6 Verse 4)

Transliteration of the verse

Dharma setu nivishtānā

macalānām garīyasām।
dakshinottara vrttīnām
drishtiḥ pāpanivartanī ॥

One literary meaning of the verse
The noble men always follow the path of Dharma; they are unbending and uncompromising in their adherence to principles; they are bent on removing the ignorance of ordinary human beings. The benign look of these great men will remove our sins.

Table 2: Vedic Numerical Coding of the Verse 6-4 of the text

Line 1	9	5	7	6	0	4	1	0
Line 2	5	6	3	0	3	2	1	7
Line 3	8	0	5	6	2	4	6	0
Line 4	8	1	1	1	0	4	6	0

In this verse the word pāpa (**पाप**) is decoded as the number 11 using Vedic numerical code. When the poet says pāpa nivartanī (पापनिवर्तनी), he suggests the algebraic concept of 'divisibility by 11'. The following table is self-explanatory:

Table 3: The words of the verse 6-4 of the text decoded with meaning

Line Number	Word	Decoded Number	Meaning of the word
2	Acalānām (**अचलानां)**	--	Of the constants (6th case)
4	drishtiḥ (**दृष्टि**:)	18	Eighteen (digits)
4	pāpa (**पाप)**	11	The number 11
4	Nivartanī (**निवर्तनी)**	--	is divided exactly

Hence we get the following suggestion:
Acalānām drishtiḥ pāpanivartanī (अचलानां दृष्टि: पापनिवर्तनी) which means 'the 18-digit number is exactly divisible by 11'.

Working
Take the middle 18 digits from the verse omitting the first 4 digits corresponding to the word Dharma setu (धर्मसेतु); the first four digits are omitted since the poet asks the reader to consider 'the banks of Dharma (धर्म)'only. Then we are left with 32 – 4 = 28 digits only. Considering the middle 18 digits among these 28 digits we get the following number:

| 6 3 0 3 2 1 7 8 0 5 6 2 4 6 0 8 1 1 |

A = Sum of the digits at odd places of the above number = 26
B = Sum of the digits at even places of the above number = 37
Using the criterion for divisibility by 11, we see that
$|A - B| = |26-37| = 11$ so the number is divisible by 11.
The same concept of divisibility is found in his another Stotra work Sristuti as revealed below:

Extension of the above application of divisibility by 11 to Śristuti
In the 15th verse of his 'Master-piece' Paduka Sahasram (पादुकासहस्रम्) on Lord Ranganatha's Sandal, Swāmi Śri Deśika uses the same two words Dharma and setu (धर्म & सेतु) in the middle; stunningly the decoded number from *Dharma* to *Setu*(both inclusive) is exactly divisible by 11.

Verse of Paduka Sahasram (पादुकासहस्रम्)
Verse

हिमवन्नळसेतुमध्यभाजां
भरताभ्यर्चितपादुकावतंसः।
अतपोधनधर्मतः कवीना-
मखिलेष्वस्मि मनोरथेष्वबाह्यः॥ (पा.स. 1.15)

Transliteration of the verse

Himavannaḷasetumadhyabhājāṃ
Bharatābhyarcitapādukāvataṃsaḥ.
Atapodhanadharmataḥ kavīnā-
Makhileṣvasmi manoratheṣvabāhyaḥ. (Pa.Sa.1.15)

One literary meaning of the verse
Those Pādukā-s worshipped earlier by Bharata is on my lowly head now. As a direct result, I have become without effort, the Master of all talented poets living between the Himalaya Mountain and the bridge constructed by Nala over the southern Ocean for Sri Rama (to reach Srilanka). All the skills of these renowned poets have entered into me. I am now truly blessed to undertake this auspicious act of eulogizing the greatness of the Divya Pādukā-s.

Table 4: Vedic Numerical Coding of the verse

Line 1	8	5	4	0	9	7	6	5	1	4	8	
Line 2	4	2	6	1	6	6	1	8	1	4	6	7
Line 3	0	6	1	9	2	9	5	6	1	4	0	
Line 4	5	2	3	4	5	5	0	2	7	4	3	1

All the decoded digits from '9 5' corresponding to the word *Dharma* (धर्मतः) of the third line, upto '7 6' correspoinding to he word *Setu* (सेतु) of the first line, written continuously give a 25-digit number as below:

9 5 6 1 4 0 5 2 3 4 5 5 0 2 7 4 3 1 8 5 4 0 9 7 6

A = Sum of the digits at odd places of the above 25-digit number = 69
B = Sum of the digits at even places of the above 25-digit number = 36
Using the criterion for divisibility by 11, we see that
$| A - B | = | 69 - 36| = 33$; so the number is divisible by 11.

Conclusion
This Stanza speaks volumes for the fact that all Sanskrit scholars of Ancient India were invariably well informed of all branches knowledge that they immingled various subjects in one form of expression. This paper is only a pebble on the seashore of the vast Ocean of Sanskrit works written by Swāmi Śri Vedānta Deśika, a Lion among Poets and Logicians (Kavi-tārkika-kesari) and a Sarva-Tantra-Swatantra (सर्व-तन्त्र-स्वतन्त्र).

References
1. Dr. Balachandra Rao S. Indian Astronomy, An introduction, Universities Press, Hyderabad, 2000.
2. Dr. Balachandra Rao S. Indian Mathematics and Astronomy, Bhavan's Gandhi Centre of Science & Human Values, Bangalore, 2005.
3. Dr. Nagarajan KS. Subhāshita Nīvī with English Translation, Vedanta Deśika Research Society, Madras, 1952.
4. Vedanta VN. Desikan Śri Pāduka Sahasram with Translation, Srimad Poundarikapuram, Andavan Ashramam, Srirangam, 1991.
5. Satyavrata Singh, Vedanta Desika (A Study) — Chowkhamba Sanskrit Series Office, Varanasi-1, 1958.