L2/21-210

Updated proposal to encode Tulu-Tigalari script in Unicode

Vaishnavi Murthy Yerkadithaya [vaishnavimurthy@gmail.com]
Vinodh Rajan [vinodh@virtualvinodh.com]

For the 13th Aug 2021 meeting.
(14th Jul Meeting feedback is updated in this document)

Background Documents :

(This document replaces L2/17-378)

L2/11-120R Preliminary proposal for encoding the Tulu script in the SMP of the UCS
— Michael Everson

L2/16-241 Preliminary proposal to encode Tigalari script
— Vaishnavi Murthy K Y

L2/16-342 Recommendations to UTC #149 November 2016 on Script Proposals
— Deborah Anderson, Ken Whistler, Roozbeh Pournader, Andrew Glass & Laurentiu Iancu

L2/17-182 Comments on encoding the Tigalari script
— Srinidhi and Sridatta

L2/18-175 Replies to Script Ad Hoc Recommendations (L2/16-342) and Comments (L2/17-182) on Tigalari proposal (L2/16-241)
— Vaishnavi Murthy K Y

L2/17-378 Preliminary proposal to encode Tigalari script
— Vaishnavi Murthy K Y, Vinodh Rajan

L2/17-422 Letter to Vaishnavi Murthy in support of Tigalari encoding proposal
— A. V. Nagasampige

L2/18-039 Recommendations to UTC #154 January 2018 on Script Proposals
— Deborah Anderson, Ken Whistler, Roozbeh Pournader, Lisa Moore, Liang Hai, and Richard Cook

L2/20-279 Comments on differences between Tulu and Tigalari proposals
— Jan Kučera

L2/21-016 Recommendations to UTC #166 January 2021 on Script Proposals

L2/21-086 (replaces L2/17-378) Updated proposal to encode Tulu-Tigalari script in Unicode
— Vaishnavi Murthy Kodipady Yerkadithaya, Vinodh Rajan

L2/21-092 Proposal to postpone encoding of the new Tulu script from the Karnataka Tulu Sahitya Academy
— Vinodh Rajan, Liang Hai, Srinidhi A, Sridatta A, Vaishnavi Murthy Yerkadithaya

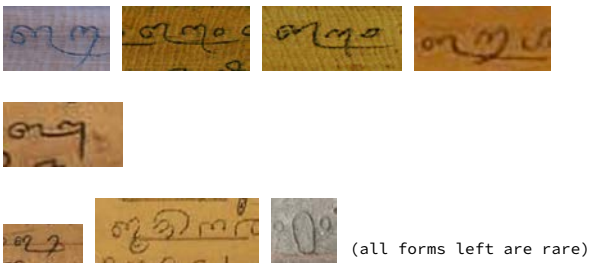
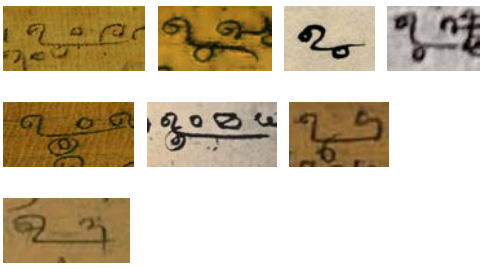
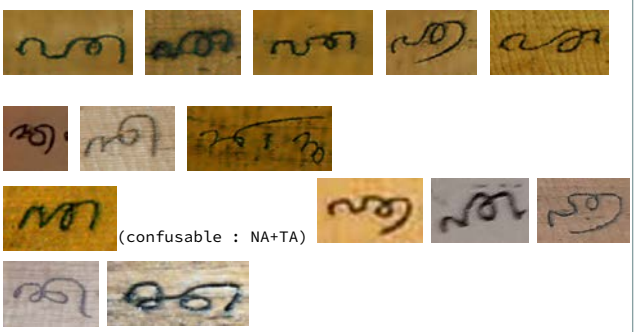
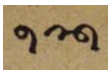
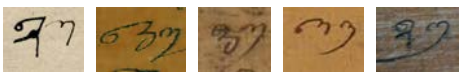
L2/21-073 Recommendations to UTC #167 April 2021 on Script Proposals

Recent updates :

— **Glyph Variants** (Section 6.1) **& Two Part Vowels** (Section 5.1)

A few sample glyphs for examining the vowel variants :

Rare forms = Pink // Ref. Sup. Paper : ' A list of common Tulu-Tigalari conjuncts' for details.

VOWEL II	𑎮𑎺	𑎮 𑎮𑎾𑎺	 (all forms left are rare)
VOWEL UU	𑎮𑎾	𑎮𑎾𑎮	
VOWEL EE	𑎯𑎰	𑎯𑎰	 (confusable : NA+TA)
VOWEL AI	𑎯𑎰𑎺	𑎯𑎰𑎺	
VOWEL OO	𑎯	𑎳 𑎯	
VOWEL AU	𑎯𑎺	𑎳𑎺 𑎯𑎺	

TULU-TIGALARI LETTER II (ī) 𑤍𑤎 𑤍𑤏 𑤍𑤐

TULU-TIGALARI LETTER UU (ū) 𑤍𑤖 𑤍𑤗 𑤎𑤎

TULU-TIGALARI LETTER EE (ee) 𑤍𑤘 𑤍𑤙

TULU-TIGALARI LETTER AI (ai) 𑤍𑤘𑤘 𑤍𑤙𑤙

TULU-TIGALARI LETTER OO (ō) 𑤍𑤚 | 𑤍𑤛 | 𑤍𑤜

TULU-TIGALARI LETTER AU (au) 𑤍𑤚𑤎 | 𑤍𑤛𑤎 | 𑤍𑤜𑤎

	USE ☑		DO NOT USE ☒	
Vowel AI	1138E	𑤍𑤘𑤘 / 𑤍𑤙𑤙	< 1138B + 113C2 >	(𑤘𑤘 / 𑤙𑤙) + 𑤍◌
Vowel AU	11391	𑤍𑤚𑤎 / 𑤍𑤛𑤎 / 𑤍𑤜𑤎	< 11390 + 113C9 >	(𑤍𑤚 / 𑤍𑤛 / 𑤍𑤜) + ◌𑤎
v.s. AI	113C5	𑤍𑤍◌	< 113C2 + 113C2 >	𑤍◌ + 𑤍◌

Note : Decompositions are provided for Vowel Signs OO & AU and therefore not included in this table.

We are strongly in favour of the unified atomic encoding of vowels.

At this stage, for a non-standardized script like Tulu-Tigalari, atomic encoding of glyph variants will provide the foundation on which possible future requirements can be built-upon easily. The alternate being a large number of variants being differentiated at the encoding level without any known significance or logic behind the glyph's varying representations besides a few minor variations in the scribal hand documented thus far.

For the vowel variants, a glyph-based encoding (or decomposition otherwise) would create multiple representations of the same vowel at the encoding level. Any basic text processing (or text comparison) would be made complicated with the users (or the application) having to define the equivalences of multiple encoded representations of the basic vowels. In an Indic context, this is totally unwarranted as the users unanimously recognize and cognize a single independent vowel letter (with variant visual realizations). These are presentation forms and should be treated as such.

We can't use a Javanese-like model (or provide decompositions) as this would probably result in forms, which should be rightly considered as glyphic variants (due to ductus variation) like UU (with circle below) 𑤍𑤖 & UU (with elongated circle below) 𑤍𑤗 . We do not support differentiating them at the encoding level, hypothetically, with 113BB ◌𑤻 and 113BC ◌𑤼.

Similarly, the II forms 𑤍𑤏 , 𑤍𑤎 and UU (with AU length mark) 𑤎𑤎 cannot be clearly decomposed into parts similar to Tamil/Grantha உள . These secondary glyphic parts in Tigalari take a modified appearance and are integrated into the base glyph. Besides adding an AU length mark to elongate the base vowels I or U to represent II & UU does not make sense as it is not visualised as such.

In case, there are alternate forms occurring in the same text with different connotations (particularly in the case of Tantric Bijaksharas (Seed Syllable) and various mantras), where the visual form of a letter is significant (as in the case of Siddham alternate vowel sign U/UU and Sharada Chandrabindu and Inverted Chandrabindu), then we may revisit this issue. But as of now, there doesn't seem to be any such attestations of this kind for Tulu-Tigalari vowels.

Additionally, decompositions for characters like 𑐮𑑂 ,𑐮𑑄 ,𑐮𑑅 cannot be provided because there might be alternate cursive forms that are not essentially decomposable.

Hypothetically, it is also possible there are other forms of the long vowels that are more cursive and written with a single ductus as a unified glyph. One might notice that the modern Tamil Vowel Sign AI ை is essentially a cursive form of ெெ. While such cursive forms are not attested yet in Tulu-Tigalari, it is possible that they might appear.

— Reph + Vocalic R & Reph + Vocalic L

In several Tulu-Tigalari manuscripts we find the Repha combining with the Vowels Vocalic R, Vocalic RR & Vocalic L. Repha + Voc. R occurs in Sanskrit in words such as nirRti. This sequence needs to be supported in Tulu-Tigalari.

EXAMPLE 10 : *NaiRRtyaam. Sanskrit language manuscript.*
(*SOURCE*) *Personal Collection*

𑐋𑑞	=	◌𑑍	+	𑐋
Vocalic RR		Repha		Vocalic R
𑐋𑑟	=	◌𑑍	+	𑐋𑑟
Vocalic RR		Repha		Vocalic RR
𑐌𑑞	=	◌𑑍	+	𑐌
Vocalic LL		Repha		Vocalic L

Note : 𑐋𑑞 & 𑐌𑑞 are identified as alternate spellings and not variant glyph forms of Voc.LL& Voc.RR.

Contents :

KEY : **V.S.** Vowel Sign
V/V.S. Vowel / Vowel Sign
L.Vir Ligating Virama
(to the left of a character) ← ◌ → (to the right of a character)

1 Introduction

This proposal attempts to present a coherent orthography for the archaic Tulu-Tigalari script as seen used predominantly in hand-written manuscripts. Additionally, it records the recently added characters that are being used to support the Tulu language. All the recommendations made in this proposal are the authors' view alone. Srinidhi A and Sridatta A have generously shared their original research into Tulu-Tigalari script orthography with the authors. Their work and feedback is integrated into this paper.

The Tulu-Tigalari[1] script is commonly found in several manuscripts found all along the western coastal belts and the Sahyadri mountain ranges (*Malanad*) of Karnataka and the northern districts of Kerala. Since Tulu-Tigalari was never used in a printed format, it gradually fell into disuse and was forgotten as a secret script (*Gupta lipi*). The large number of manuscripts available in this script have been found to be of great value due to the variety and complexity of topics covered by them.[2] A vast majority of these manuscripts are being restored, catalogued, digitised and studied today by several institutions.[3] The research community would therefore find it useful to have a Unicode supported Tulu-Tigalari typeface.

On another front, there is a renewed interest in the Tulu-Tigalari script among the Tulu speaking community as this script was previously used in the Tulu speaking regions. Tulu language requires a few additional characters in Tulu-Tigalari to support it fully (Refer to the supplementary paper 'Tulu Language and Tulu-Tigalari script' for details). It would therefore be very useful to support Tulu-Tigalari as there is ready use for this script.

Tulu-Tigalari was used in print and therefore not formally standardized. The glyphs referred to here are based on: hand written samples found largely on palm leaf/paper manuscripts, stone/metal inscriptions and the works of several scholars who have studied this script closely (Refer Figures 1-4). It is to be noted here that the Tulu-Tigalari script in most of these samples are surprisingly similar in their orthography and letter construction considering there was no formal standard that was followed. The samples studied are largely from libraries and private collections found across the sates of Karnataka, Tamil Nadu and Kerala. A handful of users who still practice this script were also contacted.

1 Tigaḷāri

2 There are over 5,000 manuscripts in the Udupi Ashta Muthas alone. Over 500 manuscripts at Dharmasthala and 4000 manuscripts recorded in the Descriptive Catalogue of Tigalari Palm Leaf Manuscripts complied Keladi Gunda Jois and S.R. Rao. There would be several thousands more if you take into account manuscripts found in smaller temples and homes of people of this region along with many manuscripts found in libraries and archives across India.

3 Several manuscripts are being restored, digitized and read in places like Udupi Mutts (Udupi, Mangalore, Sirsi etc.,), Dharmasthala Trust (Mangalore), Tara Prakashana (Bangalore), French Institute of Pondicherry (Puducherry), Poornaprajna Samshodhana Mandiram (Bangalore), Keladi Museum (Sagara), Govind Pai Research Institute (Udupi) to name a few. A few digitised manuscripts from FIP are available online : http://www.ifpindia.org/manuscripts/

1.1 Script Name

The script being proposed here is was referred to by several names. The four commonly used ones are listed below (Refer to the supplementary paper 'Tulu Language and Tulu-Tigalari script' for a detailed analysis of this topic) :

NAME OF THE SCRIPT	PREVALENT IN	REFERENCES TO THEIR ROOTS
Western Grantha / Tulu-Malayalam[4]	A few academic publications	19th Century Western scholars.
Tulu Lipi / Taulava Lipi	Coastal Karnataka	Tulu speakers, Tulu Sahitya Academy Used by scholars like : Dr. P Venkataraj Punichittaya & A C Burnell.
Tigalari / Tigalarya	Tulunadu, *Malenadu*[5] (hilly regions of Karnataka), Uttara Kannada	Kannada speakers. Havyaka Community of both *Tulunadu* and *Malenadu*, National Manuscript Mission Catalogues : popularised by Keladi Gunda Jois. Recoded by Dr P Venkataraj Punichittaya as an alias in his books.
Grantha Lipi / Tulu Grantha Lipi	Udupi Ashta Matha	Used for Hindu religious purposes and learning.

The name by which this script is referred to is closely tied to its regional, linguistic or historical roots. It would not be wrong to assign all the names mentioned above to this script. Considering the technical difficulties in doing so, discussed below are a few reasons for choosing the term ‘Tulu-Tigalari’ in the current context.

It is to be noted here that *Arya Ezhuttu* or what is commonly referred to as 'Grantha Malayalam' or sometimes the 'Tulu-Malayalam script', is a sister script of the Tulu-Tigalari Script that is being discussed here. It is the predecessor to the current reformed Malayalam script. Grantha Malayalam has a few peculiarities that diverge from Tigalari like CHILLU LLL, LETTER TTTA and *Samvrutokaram* behaviour, to name a few. The character shapes of Grantha Malayalam differ slightly from Tigalari when seen closely.

'Tulu script' or 'Taulava Grantha script' is the term used to refer to this script in the coastal regions of Karnataka and the Kasaragod district of Kerala. It is also called the 'Tulu script' in the seminal book documenting the various South Indian scripts, 'Elements of South Indian Palaeography' by Rev. A C Burnell. He also calls this the 'Western Grantha Script' in the same book. Dr. Venkataraja Puninchathaya has also published a book called Tulu lipi (*Lipi* meaning

4 Rev. A C Burnell refers to this script as Tulu-Malayalam script and calls it a form of western Grantha script. The Grantha script used in the Tamil region is in the same sentence called the Eastern Grantha script. (page 41.)

5 Also called Malanadu and Malnad

script) where he mentions Tulu-Malayalam, Tigalari and Tulu scripts as being sister scripts. There are several recent publications and instructional books for learning this script in the Tulu regions that use the term 'Tulu Script'.

The term 'Tigalari' is used to this day by the Havyaka brahmins of the *Malenadu* and *Tulunadu* regions. 'Tigalari' is also commonly used to refer to this script in several manuscript catalogues and in academic publications today. Prof. Keladi Gunda Jois popularised 'Tigalari' to refer to this script across India. He published his findings that were based on evidences found in stone inscriptions (Refer Figure 5), palm leaf manuscripts and early research work done by scholars like Prof. B L Rice. He finds the name used for this script historically in Karnataka as being 'Tigalari'. The stone inscription referred to by Prof. Gunda Jois where the term 'Tigalari' is mentioned however seems to refer to the Tamil Grantha script that was being used at the time in the Mysore region where the inscription was found. However, there are various instances where scholars like Gunda Jois, Punichataya and Vighnaraj have documented 'Tigalari' as being the term used to refer to this script by the Havyaka Brahmins of *Tulunadu* and *Malenadu*.

There are several scholars who are of the opinion that the Tulu script and Tigalari are two different scripts. This is however untrue. These scripts are found to be identical in every way by the authors. The minor variations in the various scribal hands is homogeneous to both the *Tulunadu* and *Malenadu* regions. There is no specific regional differences when it comes to shapes or script behaviour that stands out.

The question arises whether 'Tulu' or 'Tigalari' should be chosen to name this script. Adopting a hybrid naming scheme such as 'Tulu-Tigalari' for all practical purposes of this script encoding is therefore proposed by the authors. The alternate 'Taulava Grantha' can be added as an alias similar to the alternate names added to Siddham and Tai Tham scripts.

In a very general sense, Tigalari can be used to refer to all Grantha based scripts in Karnataka. Thus, the specific term 'Tulu-Tigalari' also serves to distinguish this particular style of the Tigalari script used in the western regions of Karnataka from c. 11th Century onwards.

The Tulu-Tigalari script proposal will cover only the traditional script's orthography. This includes the stone inscriptions as well as the manuscript forms. There have been been some attempts to reform the script by adding characters and simplifying the script in order to imitate the behaviour of the Kannada/Malayalam scripts. We are of the opinion that the reformed script should be dealt separately when it matures and is widely adopted. **(See L2/21-092)**

1.2 Geography

Tulu-Tigalari was used along the western coastal regions of South India (from Goa to Kasaragod) and the surrounding mountain ranges of the western ghats (Sahyadri). These regions would mainly comprise *Uttara Kannada*, Udupi, Mangalore and Shimoga districts of Karnataka and Kasaragod district in Kerala.

1.3 Languages

Tulu-Tigalari was used to write Sanskrit, Tulu and Kannada languages. It was used mostly by the Shivalli (Tulu/Kannada speaking), Havyaka (Kannada speaking) and Kota (Kannada speaking) brahmins to write Sanskrit religious texts. We also find a few examples of Tulu-Tigalari manuscripts containing original pieces of Tulu (Refer Figures 12, 14) and Kannada literature (Refer Figures 8.1, 8.2, 10).[6] The orthography of Tulu-Tigalari is influenced by other dominant languages/scripts like Nandinagari, Kannada, Tamil Grantha and Malayalam (Refer to the script comparison cart : Figure 6). We find several predominantly Tulu-Tigalari manuscripts that use multiple scripts (Refer Figures 8.2, 8.3). The commonly found scripts in such manuscripts are Kannada and Nandinagari.

2 History of Tulu-Tigalari Script

There is a lack of material/research available for accurately dating the introduction of this script to these regions and the reasons for doing so when there were several other scripts that were actively used here at the time to write Sanskrit.

In a few of the older manuscript examples found so far, we come across the notable philosopher and god man Madhwacharya's student Hrishikesha Teertha recording Madhwa's teachings using this script. These manuscripts are called *Sarvamoola Grantha* or the root books.[7] From this, based on the time-period that Madhwacharya might have been alive, we can comfortably come to the conclusion that Tuḷu script was being actively used in this region from at least 1300 CE.

It is commonly stated by those who have studied this script that due to geographic isolation of this region created by the western ghats to the east and the Arabian sea to its west, Tulu-Tigalari further evolved independently from the Chola Grantha Script.[8] Besides this, if you take into account several prominent character constructions it retains from the Chola Grantha script and the fact that it was a fully formed script when it was used in *Sarvamoola Grantha*, it seems possible that Tulu-Tigalari might have existed at-least a century before Madhwa.[9]

The regions where Tulu-Tigalari was used have been centres of learning for centuries and still continues to have high levels of literacy. It naturally follows that the manuscripts written in

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6 Tulu books : Kaveri, Ramayana, Bhagavato, Mahabharato, Devi Mahatmyam
Kannada Books : Vamanajayanti anantavratam, Gramapaddhati, Yajnavalkya vyavaharadhiyaya, Surya-chandra grahan-adhyaya, Gokarna Mahatmyam (Note : Keladi Museum: Descriptive catalogue of Tigalari manuscripts records several Tigalari script, Kannada language books. On inspection of a couple of these manuscripts, they appeared to contain Kannada script along with Tulu-Tigalari and not Kannada language (the language was Sanskrit). Awaiting scans for the manuscripts listed here currently not available in the Museum.)

7 http://www.sciencedaily.com/releases/2006/09/060919102046.htm

8 Rev. Burnell (EOSIP Pg. 41, 42) ascribes this script to about 8th or 9th Centuries AD and goes on to analyse the characteristic features this script and compares it with the Chola Grantha script.

9 Several stone inscriptions found in Udupi Taluk and Kadargod are currently being examined and are tentatively dated to mid 12th century based on the name references.

these regions; majority of which are in Tulu-Tigalari script; to be of great literary and scientific value. These manuscripts cover a wide range of subjects such as: medicine, various sciences, Vedas, Sutras, Upanishads, mathematical formulae, daily accounts, astronomy, aesthetics and philosophy to name a few.

Historically, the rulers of these regions were subordinates of the larger Kannada kingdoms. They used Kannada script for official purposes. It's probably because of this along with economic reasons that the Basel Missionaries, who were aware of its use and having studied this script closely, thought it best to use Kannada script over Tulu-Tigalari.

3 Current Situation

Tuḷu Sahitya academy, a cultural wing of the Government of Karnataka, has introduced Tuḷu language study materials. Tulu language is being taught in schools across the Mangalore and Udupi districts. The text books for Tulu are currently in Kannada script. They are however trying to re-introduce Tulu-Tigalari (called Tulu script in these regions) by providing instructional manuals to learn this script (Refer Figure 45). A few workshops[10] conducted by them in the previous years to teach Tulu-Tigalari were well attended. They have also published 'Tuḷu script' lessons on their website to popularise it.[11] Due to this increased interest in Tulu-Tigalari, there is a pressing need to have a Unicode compliant Typeface that will enable its use both in print and web.

In *the Tulu speaking regions*, Tulu-Tigalari is in continuous use for several ritual purposes like writing birth charts, creating charms and *Mandalas* (during *Yajña*) or for reciting/memorising religious scriptures (*Pārāyaṇa*) from manuscripts that have been handed down generations. Making new copies of the ancestral manuscripts is considered meritorious and several copies of the same manuscript are commonly found. The religious heads of the eight Mutts (*Ashta matha*) of Udupi (established over 800 years ago) have been traditionally forbidden to use any script apart from Tulu-Tigalari. Due to this, we see their signatures in this script to this day (Refer Figure 9). We also find large collections of Tulu-Tigalari manuscripts in these Mutts and the students are taught this script by following the lines in the manuscript as the teacher recites. Over time, one begins recognise the characters for the sounds they stand for.
Apart from this, there are several religious and government bodies who have undertaken large-scale conservation and digitisation of the Tulu-Tigalari manuscripts. A working typeface for Tulu-Tigalari is an immediate requirement for archival, research and documentation purposes.

10 Tuḷu Script workshops are also held at Poornaprajna Vidyapeetha, Bangalore, which is affiliated to Karnataka Sanskrit University. Poornaprajna Vidyapeetha and Udupi Mutts house several scholars in Sanskrit and Tuḷu languages who also know Tulu-Tigalari. Many of the old Tulu-Tigalari manuscripts are serving as materials of study for Ph.D. students.

11 http://www.tuluacademy.org/en/category/tulu-alphabets/ There are several errors in representing Tulu-Tigalari in this primer and therefore cannot be used as a reference.

A Tulu-Tigalari font was released by the Tulu Sahitya Academy under the name 'Tulu script Unicode Version' on 15 September 2014. This font built on Malayalam code-points. This font, despite being an interesting experiment, does not function properly to support Tulu-Tigalari for academic use. It does not take advance of the advances in type technology available today that enables better representation of alternate forms and complex character constructions. Also, the font reflects a lot of contemporary Malayalam script influences in its typographic interpretation.

4 Proposal History

Page 1 of this document lists several proposals and documents that have been submitted to encode the Tulu-Tigalari script into Unicode. Over the years, the proposals have been refined to identify the orthography and behaviour of this script which allows for closely representing the Tulu-Tigalari script as found in the manuscripts and stone inscriptions.

5 Structure

Tulu-Tigalari is an alpha syllabic script belonging to the Brahmic family where each letter carries an inherent schwa vowel. This vowel is commonly referred to as the vowel 'A' or [ə] in the IPA. **Its orthography is similar to Grantha**[12] **and Malayalam scripts** (Refer Figure 6)[13]. Today, majority of the Tulu-Tigalari script users are well versed in Kannada/ Malayalam and Devanagari scripts. Because of this, the switch will be mostly between these scripts and Tigalari. (Refer to the supplementary paper 'Tulu language and the Tulu-Tigalari script'.)

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Total number of proposed characters : 80
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5.1 Vowels (*Swarakshara*)

Tulu-Tigalari has 16 independent vowels or *Swarakshara* which includes 2 diphthongs (TULU-TIGALARI LETTER AI & TULU-TIGALARI LETTER AU) along with *Anusvara* and *Visarga*. Keeping with the structure of Indic proposals, *Anusvara* and *Visarga* are discussed under Section 5.7.
The Tulu-Tigalari vowels are to be encoded atomically in Unicode even if they can be analysed visually as consisting of multiple parts. This behaviour is similar to the vowel letter behaviour in Malayalam[14]. For example, Tulu-Tigalari Letter AI (𑤎𑤶𑤀) does not decompose as Tulu-Tigalari Letter EE (𑤶𑤀) + Tulu-Tigalari Vowel Sign EE (𑤎◌). Instead, Tulu-Tigalari Letter AI (𑤎𑤶𑤀) will have a separate unique Unicode value.

Tulu-Tiglari also has multiple glyph variants for vowels as listed in the Section 6.1. We recommend encoding the vowel variants as a single atomic vowel for now. The variants that can be handled at the font level. This behaviour can be easily built-upon/modified at a later date if a need so arises.

12 Throughout this document, 'Grantha', when used alone, refers to the modern Grantha script (U+11300–U+1137F).

13 Despite Tulu-Tigalari being visually similar to Malayalam, its behaviour and combining mark properties are closer to Grantha. It is therefore advisable to not correlate the character properties between Malayalam and Tulu-Tigalari to a large extent. Especially when it comes to *Chillu* behaviour.

14 Refer to Table 12-30 for Malayalam in The Unicode Standard 9.0 (TUS).

	USE ☑		DO NOT USE ☒	
Vowel AI	1138E	𑤎𑤲 / 𑤎𑤦	< 1138B + 113C2 >	(𑤲 / 𑤦) + 𑤎◌
Vowel AU	11391	𑤏𑤵 / 𑤏𑤶 / 𑤏𑤷	< 11390 + 113C9 >	(𑤏 / 𑤏 / 𑤏) + ◌𑤵
v.s. AI	113C5	𑤎𑤎◌	< 113C2 + 113C2 >	𑤎◌ + 𑤎◌

Note : Decompositions are provided for Vowel Signs OO & AU and therefore not included in this table.

It needs to be noted here that many scholars of the Tulu speaking region recognise special vowels : ೞ (𑤆𑤴) & ೞ: (𑤆𑤳) as *Swarakshara* (discussed under Section 5.4) (Refer to the supplementary paper 'Tulu language and Tulu-Tigalari Script'.).

TULU-TIGALARI LETTER A (a) 𑤆

TULU-TIGALARI LETTER AA (ā) 𑤇

TULU-TIGALARI LETTER I (i) 𑤈

TULU-TIGALARI LETTER II (ī) 𑤉

TULU-TIGALARI LETTER U (u) 𑤊

TULU-TIGALARI LETTER UU (ū) 𑤋

TULU-TIGALARI LETTER VOCALIC R (ṛ) 𑤌

TULU-TIGALARI LETTER EE (ē) 𑤲

TULU-TIGALARI LETTER AI (ai) 𑤎𑤲

TULU-TIGALARI LETTER OO (ō) 𑤏

TULU-TIGALARI LETTER AU (au) 𑤏𑤵

TULU-TIGALARI LETTER VOCALIC RR (ṝ) and TULU-TIGALARI LETTER VOCALIC L (ऌ) are rare and are mostly found in the Sanskrit language *Shakta* texts as *Bijakshara*. The long syllabic lateral: TULU-TIGALARI LETTER VOCALIC LL (ॡ) is found only nominally in the alphabet[15]. Their sounds are common to Tulu but is not recorded in the written language.

TULU-TIGALARI LETTER VOCALIC RR (ṝ) 𑤍

TULU-TIGALARI LETTER VOCALIC L (ऌ) ऌ

TULU-TIGALARI LETTER VOCALIC LL (ॡ) ॡ

15 The debate on whether or not to add vocalic LL character to the Sanskrit alphabet has been going on since the time of Panini. It is he who supposedly introduced this character. Prominent Sanskrit grammarians like Apishali have questioned the existence of this. Despite this millennia old debate, vocalic LL needs to be encoded as this character exists in the Tulu-Tigalari manuscripts. (Ref : Emeneau, M. B. "The Nasal Phonemes of Sanskrit." Language, vol. 22, no. 2, 1946, pp. 86. JSTOR, www.jstor.org/stable/410341.)

TULU-TIGALARI LETTER O & TULU-TIGALARI LETTER E and their equivalent vowel signs are not present in the traditional Tulu-Tigalari orthography and therefore not included in this proposal. However, these two characters are essential for writing Tulu and Kannada languages. We see some initial attempts to introduce these characters for Tulu-Tigalari in Tulu language manuscripts (discussed in detail in the attached supplementary paper : Tulu Language and Tulu-Tigalari Script). It will be useful to have these characters and their equivalent vowel signs encoded for the Tulu audience who are already using this script as a part of the language and script revival exercise in schools and public gatherings. (Refer Figures 42, 43, 44.1. Refer to the supplementary paper 'Tulu Language and Tulu-Tigalari script' for a detailed analysis of this topic).

5.2 Dependent Vowel Signs

All independent *Swarakshara* have their corresponding dependent vowel signs except for TULU-TIGALARI LETTER A (inherent). These signs are positioned to the left, right, above or below consonants/conjuncts, replacing the final inherent vowel 'A'. TULU-TIGALARI VOWEL SIGN AA is seen combining with independent vowels in a few manuscripts to indicate the elongation of the shorter vowels[16]. This behaviour of 'AA' as a vowel lengthening sign should be supported by rendering engines. The vowel signs' decomposition is similar to their Malayalam counterparts.

(a.) Right Spacing Vowel Signs

Vowel signs AA, I & II are placed to the right of a character/conjunct.

TULU-TIGALARI VOWEL SIGN AA (ā) ◌ാ

ക്കാ	=	ക	+	◌ാ
KA.A		KA		A-v.s.

Behavior ക - ഹ :

ക്കാ ഖാ ഗാ ഘാ ങാ ചാ ഛാ ജാ ഝാ ഞാ ടാ ഠാ ഡാ ഢാ ണാ താ ഥാ ദാ ധാ നാ പാ ഫാ ബാ ഭാ മാ യാ രാ ലാ ഴാ വാ ശാ ഷാ സാ ഹാ

16 This behaviour is seen in old Kannada manuscripts as-well. For examlple : U (ഉ)+ AA vowel mark (◌ൂ) = UU (ഊ)

TULU-TIGALARI VOWEL SIGN I (ī) ◌ി

കി	=	ക	+	◌ി
KI		KA		I-v.s.

Behavior ക - ഹ :

കി ഖി ഗി ഘി ങി ചി ഛി ജി ഝി ഞി ടി ഠി ഡി
ഢി ണി തി ഥി ദി ധി നി പി ഫി ബി ഭി മി യി
രി റി ലി ഴി വി ശി ഷി സി ഹി

TULU-TIGALARI VOWEL SIGN II (ī) ◌ീ

കീ	=	ക	+	◌ീ
KII		KA		II-v.s.

Behavior ക - ഹ :

കീ ഖീ ഗീ ഘീ ങീ ചീ ഛീ ജീ ഝീ ഞീ ടീ ഠീ ഡീ
ഢീ ണീ തീ ഥീ ദീ ധീ നീ പീ ഫീ ബീ ഭീ മീ യീ
രീ റീ ലീ ഴീ വീ ശീ ഷീ സീ ഹീ

(b.) Vowel Signs Re-Ordered to the Left of the Base Character

Tulu-Tigalari vowel signs EE & AI re-order; appearing before a character/conjunct.

TULU-TIGALARI VOWEL SIGN EE (ē) ൎ◌

ൎക	=	ക	+	ൎ◌
KEE		KA		EE-v.s.

Behavior ക - ഹ :

ൎക ൎഖ ൎഗ ൎഘ ൎങ ൎച ൎഛ ൎജ ൎഝ ൎഞ ൎട
ൎഠ ൎഡ ൎഢ ൎണ ൎത ൎഥ ൎദ ൎധ ൎന ൎപ ൎഫ ൎബ
ൎഭ ൎമ ൎയ ൎര ൎറ ൎല ൎള ൎഴ ൎവ ൎശ ൎഷ ൎസ
ൎഹ

TULU-TIGALARI VOWEL SIGN AI (ai) 𑤮𑤰𑤾

𑤮𑤰𑤃	=	𑤃	+	𑤮𑤰𑤾
KAI		KA		AI-v.s.

TULU-TIGALARI AI VOWEL SIGN (𑤮𑤰𑤾) U+ 113C5 should be used.

𑤮𑤰𑤾	IS NOT	𑤮𑤾	+	𑤮𑤾
AI-v.s.	≠	EE-v.s.		EE-v.s.

Behavior 𑤃 - 𑤍 :

𑤮𑤰𑤃 𑤮𑤰𑤅 𑤮𑤰𑤇 𑤮𑤰𑤋 𑤮𑤰𑤌 𑤮𑤰𑤉 𑤮𑤰𑤍 𑤮𑤰𑤎 𑤮𑤰𑤐

𑤮𑤰𑤈 𑤮𑤰𑤊 𑤮𑤰𑤏 𑤮𑤰𑤑 𑤮𑤰𑤒 𑤮𑤰𑤓 𑤮𑤰𑤔 𑤮𑤰𑤕 𑤮𑤰𑤖 𑤮𑤰𑤗

𑤮𑤰𑤘 𑤮𑤰𑤙 𑤮𑤰𑤚 𑤮𑤰𑤛 𑤮𑤰𑤜 𑤮𑤰𑤝 𑤮𑤰𑤞 𑤮𑤰𑤟 𑤮𑤰𑤠 𑤮𑤰𑤡

𑤮𑤰𑤢 𑤮𑤰𑤣 𑤮𑤰𑤤 𑤮𑤰𑤥 𑤮𑤰𑤦 𑤮𑤰𑤧 𑤮𑤰𑤨 𑤮𑤰𑤩 𑤮𑤰𑤪

(c.) Two Part Vowel Signs

Vowel signs OO & AU are two part vowel signs that appear both before and after a character/ conjunct and would also require re-ordering. The behaviour of Tulu-Tigalari two part vowels are similar to Malayalam two part vowels with an exception of TULU-TIGALARI VOWEL SIGN AU.

TULU-TIGALARI AU LENGTH MARK (𑤾𑤵) is encoded separately similar to TAMIL AU LENGTH MARK U+0BD7. It is to be noted here that unlike MALAYALAM AU LENGTH MARK U+0D57, in attested usage of the Tulu-Tigalari script, this mark is not used on its own as a complete vowel sign. The 𑤵 mark is used primarily to render the two part TULU-TIGALARI VOWEL SIGN AU represented as VOWEL SIGN EE + AU LENGTH MARK.

A two-part vowel can be represented by a single code point, mapped to a glyph representing the composite, and then split into its components at the glyph level to implement the reordering. The equivalence decomposition information for the rendering engines is as follows :

TULU-TIGALARI VOWEL SIGN OO (ō) 𑤮𑤾𑤱

𑤮𑤃𑤱	=	𑤃	+	𑤮𑤾𑤱
KOO		KA		OO-v.s.

𑤮𑤾𑤱	≡	𑤮𑤾	+	𑤾𑤱
OO-v.s.		EE-v.s.		A-v.s.

Behavior 𑤓 - 𑤲 :

𑤁𑤓 𑤁𑤖 𑤁𑤗 𑤁𑤙 𑤁𑤚 𑤁𑤛 𑤁𑤜 𑤁𑤝 𑤁𑤞
𑤁𑤟 𑤁𑤠 𑤁𑤡 𑤁𑤢 𑤁𑤣 𑤁𑤤 𑤁𑤥 𑤁𑤦 𑤁𑤧
𑤁𑤨 𑤁𑤩 𑤁𑤪 𑤁𑤫 𑤁𑤬 𑤁𑤭 𑤁𑤮 𑤁𑤯 𑤁𑤰
𑤁𑤱 𑤁𑤲 𑤁𑤳 𑤁𑤴 𑤁𑤵 𑤁𑤶 𑤁𑤷

TULU-TIGALARI VOWEL SIGN AU (au) 𑤁◌𑤸

𑤁𑤓𑤸	=	𑤓	+	𑤁◌𑤸
KAU		KA		AU-v.s.

𑤁◌𑤸	𑤁◌	+	◌𑤸
AU-v.s. ≡	EE-v.s.		AU-length mark

Behavior 𑤓 - 𑤲 :

𑤁𑤓𑤸 𑤁𑤖𑤸 𑤁𑤗𑤸 𑤁𑤙𑤸 𑤁𑤚𑤸 𑤁𑤛𑤸 𑤁𑤜𑤸 𑤁𑤝𑤸 𑤁𑤞𑤸
𑤁𑤟𑤸 𑤁𑤠𑤸 𑤁𑤡𑤸 𑤁𑤢𑤸 𑤁𑤣𑤸 𑤁𑤤𑤸 𑤁𑤥𑤸 𑤁𑤦𑤸 𑤁𑤧𑤸
𑤁𑤨𑤸 𑤁𑤩𑤸 𑤁𑤪𑤸 𑤁𑤫𑤸 𑤁𑤬𑤸 𑤁𑤭𑤸 𑤁𑤮𑤸 𑤁𑤯𑤸 𑤁𑤰𑤸
𑤁𑤱𑤸 𑤁𑤲𑤸 𑤁𑤳𑤸 𑤁𑤴𑤸 𑤁𑤵𑤸 𑤁𑤶𑤸 𑤁𑤷𑤸

(d.) Vowel Signs Placed Below & Ligating to the Right

Tulu-Tigalari vowel signs U, UU, vocalic R & vocalic RR are rendered as ligatures. TULU-TIGALARI VOWEL SIGN U & TULU-TIGALARI VOWEL SIGN UU change their shape depending on the consonant they combine with (Refer Figures 11, 37, 38. Refer to the supplementary paper ' A list of common Tigalari conjuncts'.)[17].

TULU-TIGALARI VOWEL SIGN U (u) ◌𑤹 ◌𑤺 ◌𑤻 ◌𑤼

(Default representation form : ◌𑤹)

𑤁𑤔𑤹	=	𑤁𑤔	+	◌𑤹
PU		PA		U-v.s.

𑤁𑤘𑤻	=	𑤁𑤘	+	◌𑤻
CHU		CHA		U-v.s.

17 For more information on this behaviour, refer : Comments on encoding the Tigalari script - Srinidhi A & Sridatta A - L2/17-182, 2.1 Contextual vowel signs of U and UU, Page 7. (http://www.unicode.org/L2/L2017/17182-tigalari-cmt.pdf)

ൕ	=	ക	+	◌ൕ
KU		KA		U-v.s.
ൖ	=	ക	+	◌ൖ
KU		KA		U-v.s.(alternate form)

Behavior ക - ഹ (Common forms in GREEN + Alternate forms) :

ൖ ൕ // ഖ // ഗൖ ഗ // ഝ // ഞ // ഩ // ഭ ഌ ഌ ഌ // ഷ // ഽ ൾ // ഀ // ഡ // ഋ // ഩ // ഺ // ണ ൺ ണ ത൏ ൕ // ഩ // ദ // ധ // ന ൻ // പ // ഫ // ബ // ഭൖ ഌ മ // ഷ // ര ൽ ൎ // ൢ // ഌ // ൗ // ൌ // ഩ // ശ ഺൖ ഌ ഷ ഷ// സ // ഹൖ ഌ

TULU-TIGALARI VOWEL SIGN UU (ū) ◌ൗ ◌ൗ (Default form : ◌ൗ)

ഌ	=	ഩ	+	◌ൗ
CHUU		CHA		UU-v.s.
ഖൗ	=	ഖ	+	◌ൗ
KHUU		KHA		UU-vs

Behavior ക - ഹ (Common forms in GREEN + Alternate forms) :

ൕ // ഖൗ // ഗ // ഝൗ // ഞൗ // ഩൗ // ഭൗ // ഌൗ // ഷൗ // ഽൗ ൾ ൾ // ഀ // ഡൗ // ഋൗ // ഩൗ // ഺൗ // ണൗ ൺൗ // ൕ // ദൗ // ധൗ // നൗ ൻൗ // പൗ // ഫൗ // ബൗ // ഭൗ // ൽ // ൎൗ // മൗ // ഷൗ // ര ൽ ൢൗ // ൗ // ൌ // ഩൗ // ശൗ // ഷൗ ഷൗ // സൗ // ഹൗ

TULU-TIGALARI VOWEL SIGN VOCALIC R (ṛ) ◌ൃ

ൠ	=	ക	+	◌ൃ
KRU		KA		Vocalic RR-v.s.

Behavior ക - ഹ :

ൠ ഖൃ ഗൃ ഘൃ ങൃ ചൃ ഛൃ ജൃ ഝൃ ഞൃ ടൃ ഠൃ ഡൃ ഢൃ ണൃ
തൃ ഥൃ ദൃ ധൃ നൃ പൃ ഫൃ ബൃ ഭൃ മൃ യൃ രൃ ലൃ ളൃ ഴൃ വൃ
ശൃ ഷൃ സൃ ഹൃ

TULU-TIGALARI VOWEL SIGN VOCALIC RR (ṝ) ◌ൄ

ൡ	=	ക	+	◌ൄ
KRUU		KA		Vocalic RR-v.s.

Behavior ക - ഹ :

ൡ ഖൄ ഗൄ ഘൄ ങൄ ചൄ ഛൄ ജൄ ഝൄ ഞൄ ടൄ ഠൄ ഡൄ ഢൄ ണൄ
തൄ ഥൄ ദൄ ധൄ നൄ പൄ ഫൄ ബൄ ഭൄ മൄ യൄ രൄ ലൄ ളൄ ഴൄ വൄ
ശൄ ഷൄ സൄ ഹൄ

(e.) Placed Below [or] Placed Below & Ligating to the Right

We find this behaviour in Vowel Signs for Vocalic L & Vocalic LL. Both these vowels and extremely rate to come-by in manuscripts.

The Vowel sign for Vocalic L has two varying forms[18]. The first form is most commonly seen in manuscripts. The second form is recorded by Dr. Venkataraja Puninchathaya in a booklet called Tulu Lipi, 2001.

1.) Placed directly below (◌ൢ) (*This is the most commonly used form of Tulu-Tigalari manuscripts*)

2.) Below + right ligating (◌ൣ)[19]

18 A third option exists where the vocalic L and vocalic LL marks are placed placed above the base and to the right (ക്ഞ & ക്ഝ). This behaviour is seen in only one manuscript so-far and therefore not included here.

19 This form of Vowel Sign Vocalic LL is seen recorded by : Burnell, A. C. “Elements Of South-Indian Palæography.” Elements of South-Indian Palaeography from the Fourth to the Seventeenth Century A.D., 1878, Plate XVI.

Further illustrating their behaviour :

TULU-TIGALARI VOWEL SIGN VOCALIC L (ḷ) ◌ൢ

ക്ലൢ	=	ക	+	◌ൢ
KLU		KA		Vocalic L-v.s.

Behavior ക - ഹ :

ക്ലൢ ഖ്ലൢ ഗ്ലൢ ഘ്ലൢ ങ്ലൢ ച്ലൢ ഛ്ലൢ ജ്ലൢ ഝ്ലൢ ഞ്ലൢ ട്ലൢ ഠ്ലൢ ഡ്ലൢ ഢ്ലൢ ണ്ലൢ
ത്ലൢ ഥ്ലൢ ദ്ലൢ ധ്ലൢ ന്ലൢ പ്ലൢ ഫ്ലൢ ബ്ലൢ ഭ്ലൢ മ്ലൢ യ്ലൢ ര്ലൢ ല്ലൢ വ്ലൢ ശ്ലൢ
ഷ്ലൢ സ്ലൢ ഹ്ലൢ

TULU-TIGALARI VOWEL SIGN VOCALIC L (ḷ) ◌ൣ

ക്ലൣ	=	ക	+	◌ൣ
KLU		KA		Vocalic L-v.s. (alternate form)

Behavior ക - ഹ :

ക്ലൣ ഖ്ലൣ ഗ്ലൣ ഘ്ലൣ ങ്ലൣ ച്ലൣ ഛ്ലൣ ജ്ലൣ ഝ്ലൣ ഞ്ലൣ ട്ലൣ ഠ്ലൣ ഡ്ലൣ ഢ്ലൣ ണ്ലൣ
ത്ലൣ ഥ്ലൣ ദ്ലൣ ധ്ലൣ ന്ലൣ പ്ലൣ ഫ്ലൣ ബ്ലൣ ഭ്ലൣ മ്ലൣ യ്ലൣ ര്ലൣ ല്ലൣ വ്ലൣ ശ്ലൣ
ഷ്ലൣ സ്ലൣ ഹ്ലൣ

Vocalic LL vowel mark is added directly below the consonant it is combining with.

TULU-TIGALARI VOWEL SIGN VOCALIC LL (ḹ) ◌ൡ

ക്ലൡ	=	ക	+	◌ൡ
KLUU		KA		Vocalic LL-v.s.

Behavior ക - ഹ :

ക്ലൡ ഖ്ലൡ ഗ്ലൡ ഘ്ലൡ ങ്ലൡ ച്ലൡ ഛ്ലൡ ജ്ലൡ ഝ്ലൡ ഞ്ലൡ ട്ലൡ ഠ്ലൡ ഡ്ലൡ ഢ്ലൡ ണ്ലൡ
ത്ലൡ ഥ്ലൡ ദ്ലൡ ധ്ലൡ ന്ലൡ പ്ലൡ ഫ്ലൡ ബ്ലൡ ഭ്ലൡ മ്ലൡ യ്ലൡ ര്ലൡ ല്ലൡ വ്ലൡ ശ്ലൡ
ഷ്ലൡ സ്ലൡ ഹ്ലൡ

5.3 Consonants & Semi-vowels (*Vyanjanakshara*)

Consonants and semi-vowels together constitute *Vyanjanakshara*. Consonants in Tulu-Tigalari script orthography are traditionally laid-out in a phonetic order similar to other Indic scripts.

Consonants (25)	**Un-aspirated**	**Aspirated**	**Nasals**
Gutteral	KA, GA	KHA, GHA	NGA
Palatal	CA, JA	CHA, JHA	NYA
Retroflex	TTA, DDA	TTHA, DDHA	NNA
Dental	TA, DA	THA, DHA	NA
Labial	PA, BA	PHA, BHA	MA
Semi-vowels (11)	YA, RA, RRA, LA, VA, SHA, SSA, SA, HA, LLA, LLLA		

All *Vyanjanakshara* have an equivalent post-base form called *Adi vottu*[20]. The behaviour of *Adi vottu* is further discussed under Section 5.6

	CONSONANTS	POST-BASE / BELOW-BASE FORMS
TULU-TIGALARI LETTER KA (ka)	𑤓	◌𑤓
TULU-TIGALARI LETTER KHA (kha)	𑤔	◌𑤔
TULU-TIGALARI LETTER GA (ga)	𑤕	◌𑤕
TULU-TIGALARI LETTER GHA (gha)	𑤖	◌𑤖
TULU-TIGALARI LETTER NGA (ṅa)	𑤗	◌𑤗
TULU-TIGALARI LETTER CA (ca)	𑤘	◌𑤘
TULU-TIGALARI LETTER CHA (cha)	𑤙	◌𑤙
TULU-TIGALARI LETTER JA (ja)	𑤚	◌𑤚
TULU-TIGALARI LETTER JHA (jha)	𑤛	◌𑤛
TULU-TIGALARI LETTER NYA (ña)	𑤜	◌𑤜
TULU-TIGALARI LETTER TTA (ṭa)	𑤝	◌𑤝
TULU-TIGALARI LETTER TTHA (ṭha)	𑤞	◌𑤞
TULU-TIGALARI LETTER DDA (ḍa)	𑤟	◌𑤟
TULU-TIGALARI LETTER DDHA (ḍha)	𑤠	◌𑤠
TULU-TIGALARI LETTER NNA (ṇa)	𑤡	◌𑤡
TULU-TIGALARI LETTER TA (ta)	𑤢	◌𑤢

20 The term '*adi vottu*' is borrowed from Kannada.

TULU-TIGALARI LETTER THA (tha)	𑤞	◌𑤞
TULU-TIGALARI LETTER DA (da)	𑤟	◌𑤟
TULU-TIGALARI LETTER DHA (dha)	𑤠	◌𑤠
TULU-TIGALARI LETTER NA (na)	𑤡	◌𑤡
TULU-TIGALARI LETTER PA (pa)	𑤢	◌𑤢
TULU-TIGALARI LETTER PHA (pha)	𑤣	◌𑤣
TULU-TIGALARI LETTER BA (ba)	𑤤	◌𑤤
TULU-TIGALARI LETTER BHA (bha)	𑤥	◌𑤥
TULU-TIGALARI LETTER MA (ma)	𑤦	◌𑤦

	SEMI-VOWELS	POST-BASE / BELOW-BASE FORMS
TULU-TIGALARI LETTER YA (ya)	𑤧	◌𑤧
TULU-TIGALARI LETTER RA (ra)	𑤨	◌𑤨
TULU-TIGALARI LETTER LA (la)	𑤩	◌𑤩
TULU-TIGALARI LETTER VA (va)	𑤪	◌𑤪
TULU-TIGALARI LETTER SSA (śa)	𑤫	◌𑤫
TULU-TIGALARI LETTER SHA (ṣa)	𑤬	◌𑤬
TULU-TIGALARI LETTER SA (sa)	𑤭	◌𑤭
TULU-TIGALARI LETTER HA (ha)	𑤮	◌𑤮
TULU-TIGALARI LETTER LA (ḷa)	𑤯	◌𑤯

Tulu-Tigalari has two characters that represent the Dravidian sounds : LLLA (l̲a)) and RRA (r̲a, its called *Shakata Repha*). These two characters are rare and are mostly found in Kannada language manuscripts (Refer Figures 10). It is due to the discovery of these two borrowed Dravidian phonemes in Tulu-Tigalari manuscripts studied so far that a space for the TULU-TIGALARI LETTER NNNA is reserved.

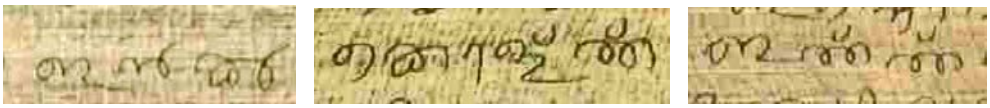
TULU-TIGALARI LETTER LLLA (l̲a)	𑤰	◌𑤰
TULU-TIGALARI LETTER RRA (r̲a)	𑤱	◌𑤱

5.4 Virama

(Refer to the supplementary paper, 'Tulu language and Tulu-Tigalari Script' for Figures and examples for the Virama behaviour listed in this section.)

In ISCII based encoding models, the Virama character has been serving two purposes : to suppress the inherent Vowel A and as a control character to create conjuncts when placed next to a consonant/semi-vowel. In the Tulu-Tigalari script, Virama handling is complex. Virama's function as a control character is being re-looked at in this section to aid accurate shaping and indexing.

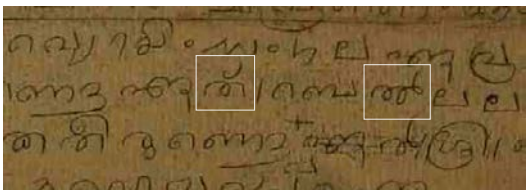
The special vowels ೨ & ೨ೃ appear frequently. The Tulu language, Tulu-Tigalari script manuscripts use the Virama character combined with the base V./V.S. A, AA & EE to represent these additional vowels discussed in the supplementary paper, 'Tulu Language and Tulu-Tigalari Script'. The Tulu language, Tulu-Tigalari script manuscripts often contain several successive characters with the Virama sign employed to represent these sounds. For example:



EXAMPLE 1 : *(LEFT) N ൻ, K ൽ, Tulu Word : INK೨ , ಇನ್ಕ್*
(CENTRE) LL ೌ , TT ത്ത് , Tulu Word : KOLL೨TT೨ , ಕೊಳ್ತ್ತ್
(RIGHT) TT ത്ത് , TT ത്ത് , Tulu Word : ITT೨TT೨ , ಇತ್ತ್ತ್
(SOURCE) Tulu Ananta Vruta Kathe, Govinda Pai Research Centre, Udupi

A Virama also functioning as a control character when implemented for the Tulu language, would require extensive use of ZWNJ. Issues with shaping and indexing that arise from this can be avoided by having an independent Virama and adding a separated Conjoiner to create ligatures.

In addition to the two phonetic values, the Virama also forms a ligature with certain consonants and conjuncts. It is to be noted here that, there is no particular rule for the disjunct and conjunct Virama forms. Both the Virama forms appear with the same base consonant within a manuscript leaf. This behaviour is therefore not predictable.



EXAMPLE 2 : *The two Virama forms appearing within the same leaf. On the left the disjunct Virama is added to the base NA.*
On the right there is NA+NA+Virama ligature.
(SOURCE) Tulu Ananta Vruta Kathe, Govinda Pai Research Centre, Udupi

There is however a strong preference to form Virama ligatures with the characters listed below :

Consonants :

K G TT T N

Conjunct sequences :

K.K  K.N  K.T  K.TT 

TT.TT

T.T  T.K  T.N 

N.N  N.T  N.TT

The proposed solution would involve supporting the characters listed below for Virama handling in Tulu-Tigalari:

(a.) Virama - ◌್

The Virama character will be independently encoded. It will used to represent the Vowel suppressant and the Tulu vowels ೨ & ೯:.

(b.) Conjoiner - ◌‍

A Conjoiner character will be used to create conjuncts.

(c.) Looped Virama - ◌ೱ

A Looped Virama character will be used to create Virama ligatures with KA, TTA, TA & NA and other characters that may be attested in the future.

Illustrating their use :

(a.) Virama (◌್)

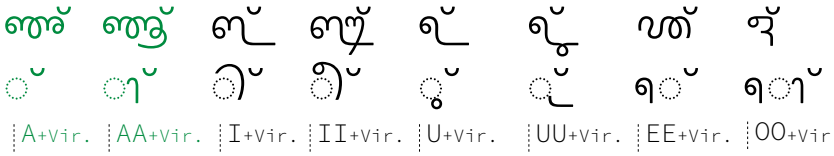
A Virama is used to suppress the inherent vowel A present in consonants/semi-vowels & to denote the Tulu language vowels ೨ & ೯:

	=		+	◌್	+	
K(೨).KA		KA		Virama		KA

Sequence to break the KA & LA conjunct form () and call the KA+Virama followed by LA+Virama :

	=		+	◌್	+		+	◌್
K(೨).L(೨)		KA		Virama		LA		Virama

The Virama combinations with V./V.S. A, AA, I, II, U, UU, EE and OO [21] needs to be supported to represent the special Tulu vowels. The Universal Shaping Engine (USE) currently treats Pure Killers as Vowels. Sequences involving Tulu Sign Virama should, therefore, be treated as valid. There shouldn't be any complications in rendering Tulu syllable sequences that use Tulu Sign Virama as a diacritic marker after Tulu Vowel Signs. The common combinations are marked in Green :



***Virama* Character Order :**
Virama character always appears at the end of and to the top right of a cluster.

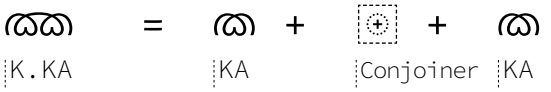
Consonant (ω) → Vowel Sign (ാ) → Virama (്) = ωാ്

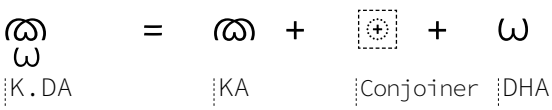
The above sequence would not properly render in the Universal Shaping Engine, as USE expects the Above-Base vowel signs to precede the Post-Base vowel signs. Here, Virama effectively acts a diacritic mark that modifies the preceding vowel sign. It is probably counter-intuitive therefore to expect users to input Virama before the vowel sign. **We suggest a USE override for Tulu Virama by assigning it the value of 'Bindu'.** This will allow it to appear at cluster-final positions as illustrated above.

(b.) Conjoiner (◌)

(*The '+' below the dotted circle (◌+) representation as seen in other scripts is used for 'Tiddu' in Tulu-Tigalari.* ◌ *is used instead for Conjoiner glyph.*)

The Conjoiner character is used to call ligature forms.





Sequence to call the KA+LA ligature form ending with a Virama :

21 The combinations with V./V.S. I, II & OO can be allowed for as there seems to be additional vowels not yet documented.

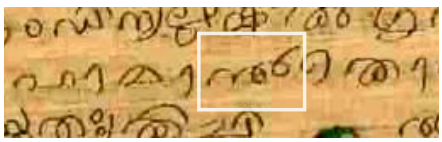
When there are multiple ways to represent a particular sequence of ligating characters[22], it is recommended to handle this at the font level. If, at a later date, a need arises wherein the users choose to have greater control over this representation, this basic behaviour can be easily modified as per their requirements.

Broken/Incorrect Rendering :

(c.) Looped Virama (◌ൽ)

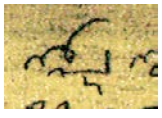
The Looped Virama to call the Virama ligatures that form with KA ക്ക, GA ഗ്ഗ, TTA ട്ട/ ള്ള, TA ത്ത & NA ന്ന. The Looped Virama is tightly bound to the preceding character and does not apply at a syllable level.

Conjunct sequences that end with a Virama ligature are rare. Conjunct sequences that end with a Virama ligature : KK ക്ക, KN ക്ന, KT ക്ത, KTT ക്ട, TTTT ട്ട, TT ത്ത , TK ത്ക, TN ന്ത, NN ന്ന, NT ന്ത, NTT ന്ട. As this is not a predictable sequence at this stage of encoding, there is no need to restrict the behaviour of Looped Virama.



EXAMPLE 3 : *NT* ന്ത
(SOURCE) *Tulu Ananta Vruta Kathe, Govinda Pai Research Centre, Udupi*

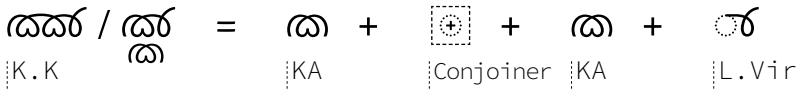
It is rare to find clusters with Vattu forms with a Looped Virama. Example 4 illustrates a stray instance where this form occurs. The LOOPED VIRAMA acts on the entire preceding cluster.



EXAMPLE 4 : *A rare example of a Looped Virama Conjunct + Vattu form. NA+PA+Virama*
(SOURCE) *Rigveda, Dodmane, Udupi*

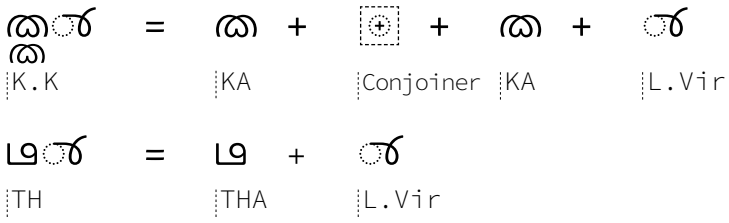
22 The commonly found ligatures in Tulu-Tigalari manuscripts are listed in the supplementary paper titled, 'A list of common Tulu-Tigalari Conjuncts'.

In the below sequence, both the character representations (ದ್ರ & ದ್ರ) are equivalent and represent the same phonetic value: KK.[23]



Sequence to form KA (+ Virama Ligature) & KA (+ Virama):

The following are acceptable rendering for the sequences when the requested form is not attested or supported by the font. The incorrect rendering is to be clearly displayed :



5.5 Repha

Repha is also called *Arka Vottu in* Tulu-Tigalari/Kannada. In connection to Tulu-Tiglari, the term *Repha* instead of *Reph* is recommended.

A Repha is typically rendered as a special symbol when RA+Virama precedes a consonant/ semi-vowel. This behaviour is common to many Indic scripts.

Adding Repha as an independent character (◌) is proposed for Tulu-Tigalari.

In Tulu-Tigalari, Cluster initial RA has three forms :

(a.) Explicit initial RA in a cluster

(b.) As a Combining Mark

(c.) As a special Conjunct

23 Hypothetically, we could have used KA+LOOPED VIRAMA+CONJOINER+KA to specifically generate ದ್ರ. However, the sequence LOOPED VIRAMA+CONJOINER might be problematic for rendering engines. Since the VIRAMA is usually placed in reference to the entire cluster, the LOOPED VIRAMA can also be similarly considered to be applied to the entire cluster. For instance KA+CONJOINER+KA+VIRAMA can give you ದ್ದ್ or, ದ್ದ್. Similarly, KA+CONJOINER+KA+LOOPED VIRAMA can produce ದ್ರ or ದ್ರ

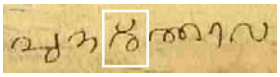
(a.) Explicit Initial RA in a Cluster

The initial RA+Virama in a conjunct sequence is used independently as seen in several manuscripts. It is also used to represent Tulu special vowel ೨ (R೨ : ರ್) where a Virama is used explicitly. This behaviour is common in the Tulu language manuscripts.

The automatic conversion of RA+Virama sequence needs to be disallowed in Tulu-Tigalari for better control over RA conjuncts, RA+Virama, Repha & Repha ligature forms.

The RA+Virama sequence commonly used to represent the Tulu language C-M-C-U Letter A/U :

ರ್ಯ = ರ + ◌್ + ಯ
R.YA RA Virama YA



EXAMPLE 5 : *PuDAR೨TTAaVA. Tulu language manuscript.*
(SOURCE) *Anantavruta Kathe, Govinda Pai Research Centre, Udupi*

The RA is used as a base glyph in conjunct and the Repha behaviour is ignored :

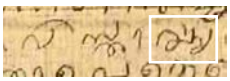
ರ್ಜ = ರ + ◌್‍ + ಜ
R.YA RA Conjoiner YA

EXAMPLE 6 : *KAaRYoKAaRANNAm. Tulu language manuscript.*
(SOURCE) *Anantavruta Kathe, Govinda Pai Research Centre, Udupi*

(b.) As a Combining Mark : Repha – ◌೰

Tulu-Tigalari uses a Repha form that is placed above the base consonant/conjunct to represent : RA+Virama (◌್). Encoding the Repha as a separate character is required to avoid extensive use of ZWJ. The conventional Repha form appears as illustrated below. The short vertical line placed above the base glyph :

ಌ್ = ◌೰ + ಌ
R.YA Repha YA



EXAMPLE 7 : *ViSTAaRYYA. Tulu language manuscript.*
(SOURCE) *Anantavruta Kathe, Govinda Pai Research Centre, Udupi*

[Repha + Virama] forms a mark conjunct in Tulu-Tigalari. This can be handled at the font level. The input sequence is as follows :

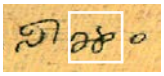
(c.) As a Special Conjunct

Repha produces conjuncts with the following three consonants :

MA - ᩆ / ᩇ

YA - ᩉ

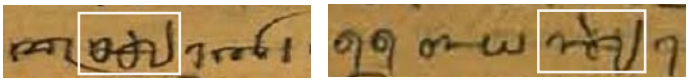
VA - ᩋ/ᩌ



EXAMPLE 8 : *Vii<u>RYA</u>m. Sanskrit language manuscript.*
(*SOURCE*) *Ramayana, Dodmane, Uduipi.*

These are to be considered equivalent glyph variants and handled at the font-level. That is, the font chooses the appropriate form of the Repha to be produced. The conjunct form of Repha for the above three base consonants : MA, YA & VA is recommended as a default for all Tulu-Tigalari fonts. Using font level features (see section 5.4) to achieve this instead of joiners is strongly recommended.

Repha ligature can combine with other combining forms. Therefore it is not necessary to restrict such behaviour :



EXAMPLE 9 : *Left : RYYAa. Right : RVYAaa. Sanskrit language manuscript.*
(*SOURCE*) *Srinidhi A*

Notes on Repha Combining with Vowels :

In several Tulu-Tigalari manuscripts we find the Repha combining with the Vowels Vocalic R, Vocalic RR & Vocalic L. Repha + Voc. R occurs in Sanskrit in words such as nirRti. This sequence needs to be supported in Tulu-Tigalari.

EXAMPLE 10 : *NaiRRtyaam. Sanskrit language manuscript.*
(SOURCE) Personal Collection

ᳵ	=	◌ᳵ	+	ᳯ		
Vocalic RR		Repha		Vocalic R		
ᳶ	=	◌ᳵ	+	ᳰ		
Vocalic RR		Repha		Vocalic RR		
᳷	=	◌ᳵ	+	ᳱ		
Vocalic LL		Repha		Vocalic L		

Visual Placement of Repha :

The Repha is placed directly above a character/conjunct (centred). This placement is most commonly seen used in manuscripts and is the recommended form with all characters.

Repha (◌ᳵ) → Character (ക) → Vowel Mark (ീ) = ക്രീ

5.6 Ligature Formation :

A maximum of four consonant/semi-vowel characters can be found in Tagalari manuscripts that form a ligature. Similar to Grantha and old style Malayalam scripts, we find a large number of ligature forms across Tulu-Tigalari manuscripts (Submitted along with this document, as a separate paper, is a Conjuncts list commonly found in Tulu-Tigalari). One can assume that character clusters which were easy to write in a single continuous stroke without lifting the stylus/chisel ended-up as ligatures. There are a few Tulu-Tigalari ligatures that have varying behaviours across manuscripts as illustrated in an example below[24]. It is hard to come to a consensus and identify a definitive conjunct/ligature set or shape for this script as of now. As discussed in Section 5.4, we strongly recommend that the alternate forms of ligatures (stacked vs horizontal) should be handled at the font level :

ൽ൹ൽ	=	ൽ	+	◌്	+	ൽ	(option 1)
J.JA		JA		Conjoiner		JA	
ൽ ൽ	=	ൽ	+	◌്	+	ൽ	(option 2)
J.JA		JA		Conjoiner		JA	

24 Further study into this subject is required.

There are four basic types of ligatures in Tulu-Tigalari :

(a.) [Consonant/Semi-Vowel] + [Consonant(s)/Semi-Vowel(s)] = Conjunct

(b.) [Consonant / Conjunct/Semi-Vowel] + Vowel Sign

(c.) [Consonant/Conjunct/Semi-Vowel] + Special Character

(d.) Ligating Special Characters

(a.) [Consonant/Semi-Vowel] + [Consonant(s)/Semi-Vowel(s)] = Conjunct

Consonants and semi-vowels in most cases have a corresponding post-base form that look similar to the independent consonant/semi-vowel that sits vertically centred below the base character (◌്യ). These characters form vertical conjunct stacks with combining *vottu* forms. These post-base character(s) are represented at the same size as their corresponding base glyphs. These below-base forms are not reduced in size to save inter-linear space or to improve the over-all texture. This practice however might change over time as reflected in reformed Malayalam or Grantha typefaces. The conjunct forms can be defined at the font level. Stacking forms can be used where the ligature forms are not available.

Vertical stacking of conjunct forms is the default behaviour unless the font provides for an alternate rendering of a ligating form.

ജ്ഞ	=	ജ	+	◌്	+	ഞ	
JH.NA		JHA		Conjoiner		NA	

Consonants/semi-vowels can combine horizontally, vertically or have a combination of both in Tagalari. Sometimes the same conjunct can have both these ways of ligating as seen above in the case of J.JA. It is commonly found that the characters which have their final stem turning downwards and ending at the baseline form horizontal ligatures with characters that begin with upward strokes (K.TA). Characters which have their final stem turning downwards often combine horizontally with other character that begin with the downward stroke by loosing a stem in-between (NN.GA).

ക്ത	=	ക	+	◌്	+	ത	
K.TA		KA		Conjoiner		TA	
ങ്ങ	=	ങ	+	◌്	+	ഗ	
NN.GA		NNA		Conjoiner		GA	

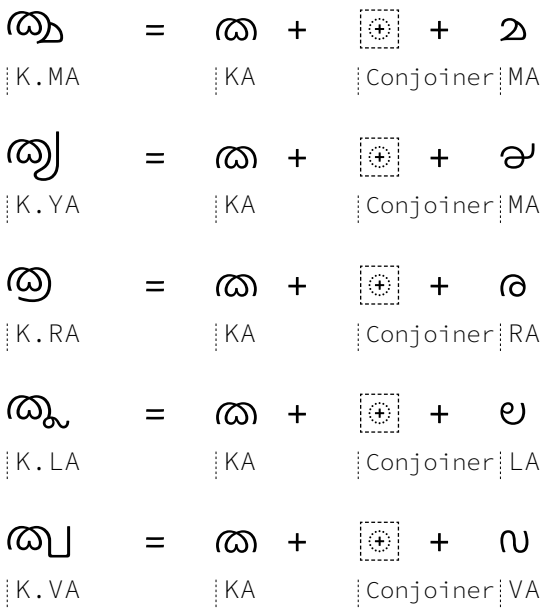
There are always exceptions to these general patterns :

ള്ള	=	ള	+	◌്	+	ള	
LL.LLA		LLA		Conjoiner		LLA	

The characters that have their final stem turning upwards form vertical ligatures with other characters of the same kind :

A ligature can have both horizontal and vertical combinations based on the same logic. The characters that combine vertically are usually formed at the end of such a ligature.

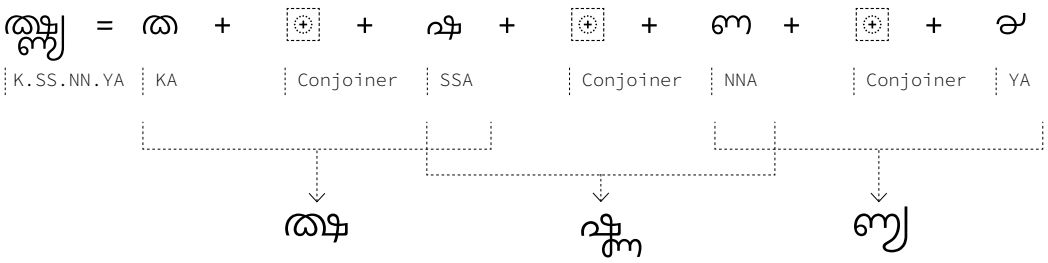
TULU-TIGALARI LETTER MA, TULU-TIGALARI LETTER YA, TULU-TIGALARI LETTER RA, TULU-TIGALARI LETTER LA & TULU-TIGALARI LETTER VA have a combining post-base form that is unrelated to their parent shapes. These characters usually form ligatures with the characters they're combing with.



The semi-vowel signs that attach below the baseline in a conjunct cluster are attached to the final character (similar to vowel signs that attach below the baseline).

25 Here the triangular form attached to the bottom right of letter CA is a duplication symbol (germination) that also appears with letters BA, VA and YA. This behaviour is not very common in Tulu-Tigalari and seems to be an influence of Malayalam script.

Ligature forms of conjuncts can appear as post-base forms in a vertical stack. This occurs often when a below-base consonant/semi-vowel combines horizontally with the post-base forms of RA, LA, VA, MA or YA :



The above mentioned ways of forming consonant ligatures is not a rule but merely an observation and there are several exceptions to this behaviour.

(b.) [Consonant/Conjunct/Semi-Vowel] + Vowel Sign

The vowel signs U, UU[26], Vocalic R & Vocalic RR combine with other base or post-base consonants/semi-vowels/conjuncts forming ligatures. The vowel signs that appear below the baseline in a conjunct cluster are attached to the final character.

(c.) [Consonant/Conjunct/Semi-Vowel] + Special Character :

In Tulu-Tigalari, this kind of ligatures are seen formed by *Virama* and *Repha* with a select few characters :

The *Virama* ligatures are formed with :
KA (ൽ), GA (ൾ), NA (ൻ), TA (ൽ) & TTA (ൿ/ ൎ)
(*Refer Section 5.4.c*)

Repha ligatures are formed with letters :
MA ൟ /ൔ, YA ൕ & VA ൖ/ൗ
(*Refer Section 5.5.c*)

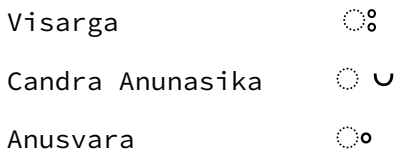
26 Various U & UU ligature forms are discussed on pp. 12, 13

(d.) Ligating Special Characters

There is only one found example of a special character ligature so far : *Repha* + *Virama* (◌𑴓◌𑴺). This occurs when the character/conjunct following the *Repha* ends with a *Virama* (Refer Figure 19, below.). This ligature form can be handled at a font level. The input sequence for this will be as follows :

This *Repha+Virama* ligature follows the character order of *Virama* and not *Repha*.

5.7 *Visarga, Candra Anunasika, Anusvara*

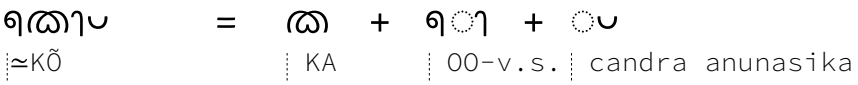


Anunasika means to pronounce simultaneously through the nose and mouth. It is not a pure nasalisation (*Anusvara*). In Sanskrit, a whole range of sounds are termed *Anunasika*.

In Tulu-Tigalari manuscripts, the *Anunasika* sounds closely follow the Paninyan rules of nasalisation using class consonants. A spacing semicircle also represents the *Anunasika* in Tulu-Tigalari, similar to Grantha sign *Candrabindu* U+11301[27]. The resulting vowel sounds this character affects is produced through both the nose and the mouth, nasalising it in the process (making this an *Anunasika*).

The *Candra Anunasika* mark (◌𑴹) indicates one of the *Anunasika* sounds similar to a *Candra Bindu* in Devanagari. It is not called *Candrabindu* because this character does not have a dot (*Bindu*) in Tulu-Tigalari.

Attestations for this semi-circular (*Candra*) *Anunasika* form can be found in the document : L2/17-182, Comments on encoding the Tigalari script - Srinidhi A and Sridatta A (5.2 ANUNASIKA, p. 13)[28]. This character can combine with all letters and vowel marks.



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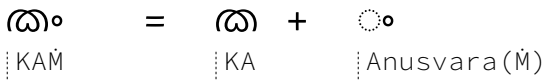
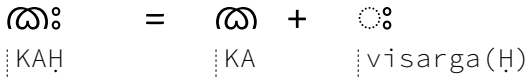
27 There is a *Candrabindu* form of *Anunasika* in Tulu-Tigalari (Refer Figure 28). Its use in Tulu-Tigalari is very rare and experimental (found in Tulu Ramayana). The *Candrabindu* form can be added at a later date (if at all) as an alternate form of *Anunasika* if more manuscripts containing *Candrabindu* are found where it represents the *Anunasika* sound.

28 In the document L2/17-182, this character is called *Anunasika*.

A pure nasal sound in Tulu-Tigalari is represented by an *Anusvara* (◌ം). *Anusvara* means that which follows a vowel (where the vowel sound is not disturbed). *Anusvara* is a right side mark and forms a part of the syllable.



Visarga (◌ഃ) indicates a voiceless glottal fricative. It is added to the right of the characters it affects.



5.8 *Avagraha*

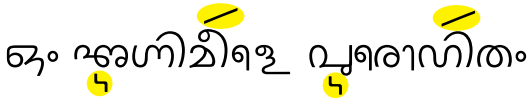
Tulu-Tigalari *Avagraha* (ऽ) follows the Devanagari (U+093D) Malayalam (U+0D3D) model and can be encoded on similar lines.

5.9 Vedic Tone Marks

Tulu-Tigalari manuscripts have many Vedic marks [29]. The whole repertoire of these symbols needs to be added to the Tulu-Tigalari block at a later date after studying them closely.

Svarita (◌̀) and *Anudatta* (◌̱) are the two most commonly found Vedic Tone (*Swara*) marks in Tulu-Tigalari script. They are non-spacing signs (Refer Figure 26). *Svarita* and *Anudatta* are added centred directly above and below a cluster respectively.[30]

To illustrate its use :



Oṁ agnimīḷe purohitaṁ

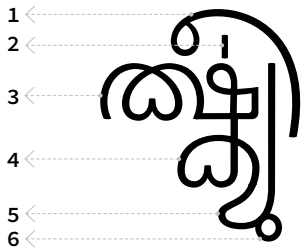
29 Discussed in another unicode proposal by Srinidhi : http://www.unicode.org/L2/L2015/15101-vedic.pdf Further comments on this : http://www.unicode.org/L2/L2015/15113-vedic-nondeva-cmt.pdf

30 *Udatta* is generally left unmarked.

5.10 Vertical metrics

Tulu-Tigalari is seen to have a maximum of six characters in a cluster (Eg.: ). Characters that form these clusters come together in several ways making Tulu-Tigalari a challenging script to build on a font platform that's made primarily for Latin based scripts (Refer Figures 15, 16, 17) (Refer to the supplementary paper, 'A list of common Tigalari conjuncts' for a list of Tigalari conjunct forms as found in the palm leaf manuscripts.)

To avoid the possibility of an infinite vertical stack, a *Virama* character can be used by the font to break a cluster after three vertically stacking consonants/semi-vowels. Tulu-Tigalari font metrics needs to accommodate up-to six vertical stacks. Below is an example of this using a hypothetical cluster :



1. VOWEL SIGN II
2. REPHA
3. KA+CONJOINER+SSA
4. +CONJOINER+KA
5. +CONJOINER+YA
6. VOWEL SIGN U

REPHA+KA+CONJOINER+SSA+CONJOINER+KA+CONJOINER+YA+ VOWEL SIGN II+VOWEL SIGN U

6 Basis for Glyph Shapes

Historically, Tulu-Tigalari letter shapes have undergone several changes across various regions, time periods and materials (as is expected with any script). It is therefore possible to represent only the most commonly used forms while also considering the relevance of several later influences of the surrounding script systems like Kannada, Tamil, Grantha, Nandinagari and Malayalam on Tulu-Tigalari.

The Tulu-Tigalari script is slowly transitioning from a scribal culture to mass literacy—especially in the context of it being adopted to write the Tulu language. This implies the need for Tulu-Tigalari to be standardised; keeping in mind its practical uses for archival, literary and educational purposes. Since this is an early attempt at standardisation; there is a possibility of Tulu-Tigalari evolving quite differently from what is proposed here.

6.1 Alternate Glyph Shapes

Tulu-Tigalari script has been studied by scholars like Venkataraja Puninchathaya, *Shrii* Bannanje Govindacharya, Keladi Gunda Jois, Dr S R Vighnaraj, *Shrii* Ramanath Acharya and *Shri* Krishnaraja Bhat to name a few. After having consulted them regarding this issue, several characters clearly seem to have no resolution for the glyph shapes due to the frequency of

their occurrence and the presence of several commonly used alternate glyph shapes as seen below. A few of these alternate shapes appear in sets (as seen grouped together under letters A, AA & O, OO). All the instances of alternate shapes can be addressed at the font level and need not be encoded as separate characters. The exception to this being *Pushpika*. *Pushpika* forms have many variations across manuscripts. This is discussed further under Section 8.1.

Pushpika 

We recommend the atomic encoding of vowels. Tulu-Tigalari is non-standardized and there could be multiple variations of the vowels. We need further research to catalogue all non-standard forms. As of now it would make sense to unify them under a single code point.

We can't provide decompositions for characters like ,, because there might be alternate cursive forms that are not essentially decomposable as discussed under section 5.1.

If in the future, these alternate forms need to be represented or in case, they occur side-by-side in the same text, then, perhaps, they could be dis-unified.

Tulu-Tigalari vowels with alternate forms. The first glyph (from the left) in the list below is the default form. :

TULU-TIGALARI LETTER A (a) | |

TULU-TIGALARI LETTER AA (ā) | |

TULU-TIGALARI LETTER II (ī)

TULU-TIGALARI LETTER UU (ū)

TULU-TIGALARI LETTER VOCALIC RR (ṛ) (alt. spelling)

TULU-TIGALARI LETTER VOCALIC LL (ḷ) (alt. spelling)

TULU-TIGALARI LETTER EE (ee)

TULU-TIGALARI LETTER AI (ai)

TULU-TIGALARI LETTER OO (ō) | |

TULU-TIGALARI LETTER AU (au) | |

TULU-TIGALARI VOWEL SIGN U & TULU-TIGALARI VOWEL SIGN UU have varying shapes depending on the glyphs they combine with (Refer Section 5.2.d) (all these shapes belong to the same stylistic set and are not alternate shapes as is the case with the other characters listed in this section) :

TULU-TIGALARI VOWEL SIGN U (u) ◌ു ◌ു ◌ു ◌ു

TULU-TIGALARI VOWEL SIGN UU (ū) ◌ൂ ◌ൂ

TULU-TIGALARI VOWEL SIGN VOCALIC RR (ṛ) ◌ൃ ◌ൃ ◌ൃ

Consonants and their corresponding below-base forms (*Vattu*) look similar in most cases. The alternate forms of Consonants and their corresponding *Vattu* are listed below :

	CONSONANTS	POST-BASE / BELOW-BASE FORMS
TULU-TIGALARI LETTER KHA (kha)	ഖ ഖ	◌ഖ ◌ഖ
TULU-TIGALARI LETTER GHA (gha)	ഘ ഘ ഘ	◌ഘ ◌ഘ ◌ഘ
TULU-TIGALARI LETTER CHA (cha)	ഛ ഛ	◌ഛ ◌ഛ
TULU-TIGALARI LETTER JHA (jha)	ഝ ഝ ഝ	◌ഝ ◌ഝ ◌ഝ
TULU-TIGALARI LETTER NYA (ña)	ഞ ഞ ഞ	◌ഞ ◌ഞ ◌ഞ
TULU-TIGALARI LETTER DDA (ḍa)	ഡ ഡ	◌ഡ ◌ഡ
TULU-TIGALARI LETTER DDHA (ḍha)	ഢ ഢ	◌ഢ ◌ഢ
TULU-TIGALARI LETTER DA (da)	ദ ദ ദ	◌ദ ◌ദ ◌ദ
TULU-TIGALARI LETTER BHA (bha)	ഭ ഭ	◌ഭ ◌ഭ
TULU-TIGALARI LETTER MA (ma)	മ ഩ ഺ	◌മ ◌മ ◌ഩ ◌ഩ ◌ഺ
TULU-TIGALARI LETTER VA (ma)	വ വ	◌വ ◌വ ◌വ
TULU-TIGALARI LETTER LLA (ḷa)	ള ള	◌ള ◌ള
TULU-TIGALARI LETTER RRA (ṟa)	ഴ ഴ	◌ഴ ◌ഴ
TULU-TIGALARI LETTER LLLA (ṟa)	ഺ ഒ	◌ഺ ◌ഒ

Virama sign has two forms ( &) in Tulu-Tigalari as discussed under Section 5.4 in detail.

Repha forms a ligature with letters MA ( /), YA () & VA (/); discussed under Section 5.5.c.

7 Digits

The most popular convention is to use the Kannada numeral system along with Tulu-Tigalari script (Refer Figure 20). It is recommend to use these characters from the Kannada Unicode block: U+0CE6, U+0CE7, U+0CE8, U+0CE9, U+0CEA, U+0CEB, U+0CEC, U+0CED, U+0CEE & U+0CEF (Section 12 requests an extension of this Kannada block).

There are several script charts that illustrate a set of characters which are popularly called the 'Tulu Numbers'(Refer Figure 6, 21, 22). There characters are rare to come-by in Tulu-Tigalari manuscripts. They need further study before encoding them into the Tulu-Tigalari block.

8 Other / Symbols / Punctuations

Pushpika 

Tiddu Mark 

Dandas 

8.1 *Pushpika*

There are various symbols that are commonly used in Tulu-Tigalari manuscripts which are collectively referred to as *Pushpika* or *Alankaara*[31]. These decorative punctuations remain to be studied in detail. *Pushpika* is an open-ended symbol employed according to the scribes preference (Refer Figure 23, 24).
The term *Pushpika* is employed in this proposal as its an unambiguous, commonly used term to refer to these characters. *Alankaara* on the other had can also refer to a grammatical construction. The three commonly found *Pushpika* in Tulu-Tigalari manuscripts are :

31 Tulu-Tigalari manuscripts have several symbols that appear decorative. These symbols have not been studied closely and might be worth examining. Similar symbols appear in several manuscripts and stone inscriptions across most Brahmic script systems.

 Om Pushpika

 Shrii Pushpika

 Pushpa

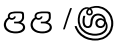
We often find all three of these symbols appearing in a single manuscript and therefore encoding them will be very useful for digitising and documenting manuscripts.
The *Om* and *Shrii Pushpika* are very similar in their use. They are often elaborately drawn and stand-out on a page. There is no formal rule that dictates their use. These symbols serve several functions :

 When a row of *Om* or *Shrii Pushpika* symbols appear between two verses, it could indicate :

- A pause of a certain length before reciting the next verse.
- To cover the imperfections on a palm leaf.
- A space-filler to make a page look evenly grey when there is a large amount of empty space.
- To repeatedly recite *Om/Shrii*.
- End of a sentence/paragraph/verse/chapter/subject/book.

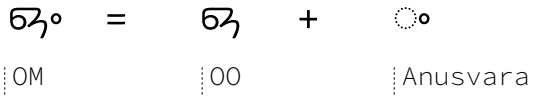
 Can indicate end of a sentence/paragraph/verse

 Can indicate end of a sentence/paragraph/verse

 Can indicate end of a sentence/paragraph/verse.

Om Pushpika ( ) :

This *Pushpika* symbol seems to be a stylised Tulu-Tigalari *Om* [32]. Similar to Shrii Pushpika, Om has 2 forms as illustrated below. Both the forms appear with the same manuscript. While form 1 is used exclusively to indicate the sound OM, form 2 can be used for both OM as well as indicators for beginnings, pauses, endings or space fillers (Refer Figure 23). There are several variations of this *Om Pushpika* that are seen across manuscripts.

1. 

2.

32 Some scholars like Shrii. Krishnaraja Bhat and Ramanatha Achar are of the opinion that this character might be an abstraction of the '*Om*' symbol.

Shrii Pushpika ( ) :

The *Shrii* ligature in Tulu-Tigalari has two forms as illustrated below under 1 &2. The *Shrii Pushpika* closely resembles the *Shrii* ligature (2 & 3). Various forms of *Pushpika* are found with dramatic flourishes (Refer Figure 24). The interpretation of the *Shrii Pushpika* will therefore depend on the scribe or the type designer in this case.

1. = + + +

SH.RII	SHA	virama	RA	II-v.s.

2. = + + +

SH.RII	SHA	virama	RA	II-vs

3.

These *Shrii liagure* and *Shrii Pushpika* are semantically different and use different code points. despite being visually similar. All the above mentioned forms occur often within the same manuscript, the *Shrii Pushpika* therefore needs to be encoded as a separate character.

Pushpa ( ) :

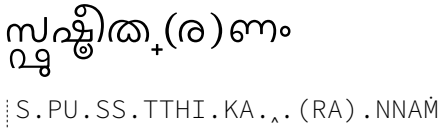
This symbol is identified as either an abstraction of an eight petalled lotus or a *Sudarshana Chakra.* It is most commonly seen as marginalia marking an important chapter. It is also used in-line to indicate chapter endings or to draw attention to a particular portion of the text.

8.2 *Tiddu* Mark : Correction / Insertion Mark

Tiddu, a correction or insertion mark ( ) in Tulu-Tigalari behaves very similar to a 'caret' and is an editor's mark that can be classified under general punctuation. *Tiddu* mark is used to indicate misspellings and insertions. This symbol is found in many manuscripts and looks like a small plus sign (Refer Figure 25). There is no particular rule to govern it's placement. It tends to orbit around a glyph/ conjunct or word that its pointing to as an error. We often find the corrections written alongside, above or below the baseline (where it usually appears in the opposite direction of the *Tiddu* mark). These corrections are often seen not inked-in as they were inscribed at a later stage (most often by the same scribe while reading from a newly inked palm leaf manuscript).

It is advisable to use this as merely a visual symbol indicating a mistake or a correction. This proposal recommends using this *Tiddu* mark as an over-hanging right spacing sign placed after the glyph/conjunct or word. This placement avoids confusion with the common PLUS SIGN (+). The conventions for its use can be determined by the user.

To illustrate its use :



8.3 *Danda* (Single & Double)

Danda (।) and Double-*Danda* (॥) are commonly seen in Tulu-Tigalari manuscripts. These can be encoded for Tulu-Tigalari as using script specific *Danda*(*s*) will help in type-setting in a multi-script environment. Legacy issues can also be avoided by including the *Danda*(*s*) right from the beginning.

8.4 Other

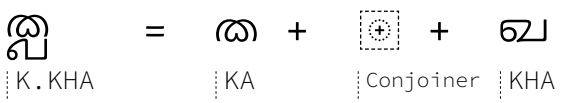
Other punctuation marks like the question mark, semicolon, ellipses, single and double quotation marks, mathematical notations etc., is used as is from the Latin script and would not require separate code points for Tulu-Tigalari.

9 Script Behaviour Summary

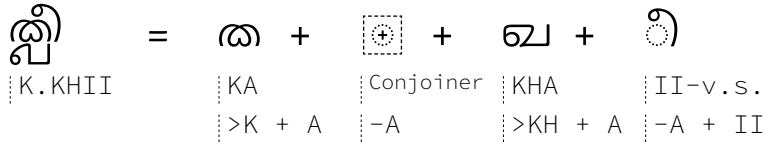
Going over what's already discussed in earlier; the inherent vowel 'A' can be suppressed by adding a *Virama*. *Virama* also represents the Tulu special vowels : ೨ & ೯ (discussed in Section 5.4).

The Looped Virama character is used to call the Virama ligatures that form with KA ക്ക, GA ഗ്ഗ, TTA ഴ്ഴ/ ൟ, TA ത്ത & NA ന്ന

The consonant clusters form a complex entity. The consonants are read from left to right and top to bottom. The inherent vowel 'A' is carried to the final consonant in a conjunct. The Conjoiner character is used to create ligatures :



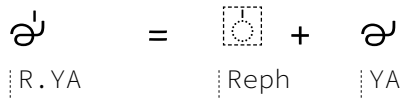
When a vowel sign is added to a character/conjunct, the inherent vowel ‘A’ is replaced by the new vowel indicated by the corresponding vowel sign and carried to the final consonant in a conjunct.



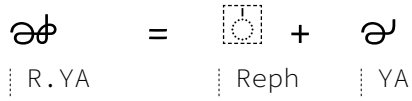
A few vowel signs reorder to appear before a consonant/conjunct, but is read after:

Two part vowel signs appear before and after a consonant/conjunct and is read after :

Repha is used to indicate : RA+Virama that precedes a vowel/consonant/semi-vowel.



The Reph forms a conjunct with consonants—MA ಶ / ಽ, YA ಱ & VA ೞ/ೱ. A Conjoiner character is used after Reph to form this ligature with the following character.



Script specific *Danda* (।) and Double-*Danda* (॥) are proposed.

Characters like Vowel O, Vowel E and their respective vowel marks are required to adequately represent the Tulu language in this script. However, since these character are recent and not yet in a standardised form, it would be advisable to retain the empty slots in the table for future encoding of these characters.

Kannada numeral system along with Tulu-Tigalari is recommend to use from the Kannada Unicode block: U+0CE6, U+0CE7, U+0CE8, U+0CE9, U+0CEA, U+0CEB, U+0CEC, U+0CED, U+0CEE & U+0CEF The 'Tulu Numbers' that appear in Figure 6, 21, 22 are rare. Space is reserved for future encoding of these characters after further study.

11380 Tigalari **113FF**

	1138	1139	113A	113B	113C	113D	113E	113F
0	11380	11390	113A0	113B0	113C0	113D0	<<UDATTA>> 113E0	<<NUM>> 113F0
1	11381	11391	113A1	113B1	<<VS.E>> 113C1	113D1	113E1	<<NUM>> 113F1
2	11382	11392	113A2	113B2	113C2	<<GERMIN-ATION>> 113D2	113E2	<<NUM>> 113F2
3	11383	11393	113A3	113B3	<<VS.>> 113C3	113D3	<<JIHVA.>> 113E3	<<NUM>> 113F3
4	11384	11394	113A4	113B4	<<VS.>> 113C4	113D4	<<UPAD.>> 113E4	<<NUM>> 113F4
5	11385	11395	113A5	113B5	113C5	113D5	<<VEDIC CHARS.>> 113E5	<<NUM>> 113F5
6	11386	11396	113A6	<<NNNA>> 113B6	<<VS.O>> 113C6	<<ALT. STOP>> 113D6	<<VEDIC CHARS.>> 113E6	<<NUM>> 113F6
7	11387	11397	113A7	113B7	113C7	113D7	<<VEDIC CHARS.>> 113E7	<<NUM>> 113F7
8	11388	11398	113A8	113B8	113C8	113D8	<<VEDIC CHARS.>> 113E8	<<NUM>> 113F8
9	11389	11399	113A9	113B9	113C9	113D9	<<VEDIC CHARS.>> 113E9	<<NUM>> 113F9
A	<<E>> 1138A	1139A	113AA	113BA	113CA	<<SYMBOLS /PUNCT.>> 113DA	<<VEDIC CHARS.>> 113EA	<<NUM>> 113FA
B	1138B	1139B	113AB	113BB	<<ALT. ANUNASIKA>> 113CB	<<SYMBOLS /PUNCT.>> 113DB	<<VEDIC CHARS.>> 113EB	<<NUM>> 113FB
C	<<VOWEL>> 1138C	1139C	113AC	113BC	113CC	<<SYMBOLS /PUNCT.>> 113DC	<<VEDIC CHARS.>> 113EC	<<NUM>> 113FC
D	<<VOWEL>> 1138D	1139D	113AD	113BD	113CD	<<SYMBOLS /PUNCT.>> 113DD	<<VEDIC CHARS.>> 113ED	<<NUM>> 113FD
E	1138E	1139E	113AE	113BE	113CE	<<SYMBOLS /PUNCT.>> 113DE	<<VEDIC CHARS.>> 113EE	<<NUM>> 113FE
F	<<O>> 1138F	1139F	113AF	113BF	113CF	<<SYMBOLS /PUNCT.>> 113DF	<<VEDIC CHARS.>> 113EF	<<NUM>> 113FF

10 Implementation

INDEPENDENT VOWELS :

11380	𑤀	TULU-TIGALARI LETTER A
11381	𑤁	TULU-TIGALARI LETTER AA
11382	𑤂	TULU-TIGALARI LETTER I
11383	𑤃	TULU-TIGALARI LETTER II
11384	𑤄	TULU-TIGALARI LETTER U
11385	𑤅	TULU-TIGALARI LETTER UU
11386	𑤆	TULU-TIGALARI LETTER VOCALIC R
11387	𑤇	TULU-TIGALARI LETTER VOCALIC RR
11388	𑤈	TULU-TIGALARI LETTER VOCALIC L
11389	𑤉	TULU-TIGALARI LETTER VOCALIC LL
1138A	---	<<RESERVED FOR E>>
1138B	𑤋	TULU-TIGALARI LETTER EE
1138E	𑤎	TULU-TIGALARI LETTER AI
1138F	---	<<RESERVED FOR O>>
11390	𑤐	TULU-TIGALARI LETTER OO
11391	𑤑	TULU-TIGALARI LETTER AU

CONSONANTS :

11392	𑤒	TULU-TIGALARI LETTER KA
11393	𑤓	TULU-TIGALARI LETTER KHA
11394	𑤔	TULU-TIGALARI LETTER GA
11395	𑤕	TULU-TIGALARI LETTER GHA
11396	𑤖	TULU-TIGALARI LETTER NGA
11397	𑤗	TULU-TIGALARI LETTER CA

11398 𑎘 TULU-TIGALARI LETTER CHA

11399 𑎙 TULU-TIGALARI LETTER JA

1139A 𑎚 TULU-TIGALARI LETTER JHA

1139B 𑎛 TULU-TIGALARI LETTER NYA

1139C 𑎜 TULU-TIGALARI LETTER TTA

1139D 𑎝 TULU-TIGALARI LETTER TTHA

1139E 𑎞 TULU-TIGALARI LETTER DDA

1139F 𑎟 TULU-TIGALARI LETTER DDHA

113A0 𑎠 TULU-TIGALARI LETTER NNA

113A1 𑎡 TULU-TIGALARI LETTER TA

113A2 𑎢 TULU-TIGALARI LETTER THA

113A3 𑎣 TULU-TIGALARI LETTER DA

113A4 𑎤 TULU-TIGALARI LETTER DHA

113A5 𑎥 TULU-TIGALARI LETTER NA

113A6 𑎦 TULU-TIGALARI LETTER PA

113A7 𑎧 TULU-TIGALARI LETTER PHA

113A8 𑎨 TULU-TIGALARI LETTER BA

113A9 𑎩 TULU-TIGALARI LETTER BHA

113AA 𑎪 TULU-TIGALARI LETTER MA

113AB 𑎫 TULU-TIGALARI LETTER YA

113AC 𑎬 TULU-TIGALARI LETTER RA

113AD 𑎭 TULU-TIGALARI LETTER LA

113AE 𑎮 TULU-TIGALARI LETTER VA

113AF 𑎯 TULU-TIGALARI LETTER SHA

113B0 𑎰 TULU-TIGALARI LETTER SSA

113B1 𑎱 TULU-TIGALARI LETTER SA

113B2 𑎲 TULU-TIGALARI LETTER HA

113B3 𑎳 TULU-TIGALARI LETTER LLA

113B4 𑎴 TULU-TIGALARI LETTER RRA

113B5 𑎵 TULU-TIGALARI LETTER LLLA

113B6 --- <<RESERVED FOR NNNA>>

OTHER LETTERS :

113B7 𑎷 TULU-TIGALARI SIGN AVAGRAHA

VOWEL SIGNS :

113B8 ◌𑎸 TULU-TIGALARI VOWEL SIGN AA

113B9 ◌𑎹 TULU-TIGALARI VOWEL SIGN I

113BA ◌𑎺 TULU-TIGALARI VOWEL SIGN II

113BB ◌𑎻 TULU-TIGALARI VOWEL SIGN U

113BC ◌𑎼 TULU-TIGALARI VOWEL SIGN UU

113BD ◌𑎽 TULU-TIGALARI VOWEL SIGN VOCALIC R

113BE ◌𑎾 TULU-TIGALARI VOWEL SIGN VOCALIC RR

113BF ◌𑎿 TULU-TIGALARI VOWEL SIGN VOCALIC L

113C0 ◌𑏀 TULU-TIGALARI VOWEL SIGN VOCALIC LL

113C1 --- <<RESERVED FOR VOWEL SIGN E>>

113C2 𑎳◌ TULU-TIGALARI VOWEL SIGN EE

113C5 𑎳𑎳◌ TULU-TIGALARI VOWEL SIGN AI

113C6 --- <<RESERVED FOR VOWEL SIGN O>>

113C7 𑎳◌𑎸 TULU-TIGALARI VOWEL SIGN OO

113C8 𑎳◌𑎷 TULU-TIGALARI VOWEL SIGN AU

VARIOUS SIGNS :

113C9 ◌𑎷 TULU-TIGALARI AU LENGTH MARK

113CA ◌𑏁 TULU-TIGALARI SIGN CANDRA ANUNASIKA

113CB --- <<RESERVED FOR ALTERNATE ANUNASIKA>>

113CC ◌𑏂 TULU-TIGALARI SIGN ANUSVARA

113CD ◌𑏃 TULU-TIGALARI SIGN VISARGA

113CE TULU-TIGALARI SIGN VIRAMA

113CF TULU-TIGALARI SIGN LOOPED VIRAMA

113D0 TULU-TIGALARI CONJOINER

- CREATES CONJUNCTS

113D1 TULU-TIGALARI REPHA

113D2 --- <<RESERVED FOR GEMINATION SIGN>>

113D3 TULU-TIGALARI SIGN TIDDU

PUNCTUATION :

113D4 TULU-TIGALARI DANDA

113D5 TULU-TIGALARI DOUBLE DANDA

113D6 --- <<RESERVED FOR ALTERNATE STOP>>

113D7 TULU-TIGALARI SIGN OM PUSHPIKA

113D8 TULU-TIGALARI SIGN SHRII PUSHPIKA

113D9 TULU-TIGALARI SIGN PUSHPA

VEDIC CHARACTERS :

113E0 --- <<RESERVED FOR UDATTA>>

113E1 TULU-TIGALARI VEDIC TONE SVARITA

113E2 TULU-TIGALARI VEDIC TONE ANUDATTA

113E3 --- <<RESERVED FOR JIHVAMULYA>>

113E4 --- <<RESERVED FOR UPADHMANIYA>>

10.1 Collation

A < AA < I < II < U < UU < Voc R < Voc RR < Voc L < Voc LL < EE < AI < OO < AU < KA < KHA < GA < GHA < NGA < CA < CHA < JA < JHA < NYA < TTA < TTHA < DDA < DDHA < NNA < TA < THA < NA < PA < PHA < BA < BHA < MA < YA < RA < REPHA < LA < VA < SHA < SSA < SA < HA < RRA < LLA < LLLA < AVAGRAHA < V.S. AA < V.S. I < VS. II < V.S. U < V.S. UU < V.S. Voc R < V.S. Voc RR < V.S. Voc. L < V.S. Voc LL << V.S. EE < V.S. AI < V.S. O < V.S. OO < V.S. AU < V.S. AU LENGTH MARK < VIRAMA < LOOPED VIRAMA < CONJOINER

10.2 Character Properties

```
11380;TULU-TIGALARI LETTER A;Lo;0;L;;;;;N;;;;;
11381;TULU-TIGALARI LETTER AA;Lo;0;L;;;;;N;;;;;
11382;TULU-TIGALARI LETTER I;Lo;0;L;;;;;N;;;;;
11383;TULU-TIGALARI LETTER II;Lo;0;L;;;;;N;;;;;
11384;TULU-TIGALARI LETTER U;Lo;0;L;;;;;N;;;;;
11385;TULU-TIGALARI LETTER UU;Lo;0;L;;;;;N;;;;;
11386;TULU-TIGALARI LETTER VOCALIC R;Lo;0;L;;;;;N;;;;;
11387;TULU-TIGALARI LETTER VOCALIC RR;Lo;0;L;;;;;N;;;;;
11388;TULU-TIGALARI LETTER VOCALIC L;Lo;0;L;;;;;N;;;;;
11389;TULU-TIGALARI LETTER VOCALIC LL;Lo;0;L;;;;;N;;;;;
1138B;TULU-TIGALARI LETTER EE;Lo;0;L;;;;;N;;;;;
1138E;TULU-TIGALARI LETTER AI;Lo;0;L;;;;;N;;;;;
11390;TULU-TIGALARI LETTER OO;Lo;0;L;;;;;N;;;;;
11391;TULU-TIGALARI LETTER AU;Lo;0;L;;;;;N;;;;;
11392;TULU-TIGALARI LETTER KA;Lo;0;L;;;;;N;;;;;
11393;TULU-TIGALARI LETTER KHA;Lo;0;L;;;;;N;;;;;
11394;TULU-TIGALARI LETTER GA;Lo;0;L;;;;;N;;;;;
11395;TULU-TIGALARI LETTER GHA;Lo;0;L;;;;;N;;;;;
11396;TULU-TIGALARI LETTER NGA;Lo;0;L;;;;;N;;;;;
11397;TULU-TIGALARI LETTER CA;Lo;0;L;;;;;N;;;;;
11398;TULU-TIGALARI LETTER CHA;Lo;0;L;;;;;N;;;;;
11399;TULU-TIGALARI LETTER JA;Lo;0;L;;;;;N;;;;;
1139A;TULU-TIGALARI LETTER JHA;Lo;0;L;;;;;N;;;;;
1139B;TULU-TIGALARI LETTER NYA;Lo;0;L;;;;;N;;;;;
1139C;TULU-TIGALARI LETTER TTA;Lo;0;L;;;;;N;;;;;
1139D;TULU-TIGALARI LETTER TTHA;Lo;0;L;;;;;N;;;;;
1139E;TULU-TIGALARI LETTER DDA;Lo;0;L;;;;;N;;;;;
1139F;TULU-TIGALARI LETTER DDHA;Lo;0;L;;;;;N;;;;;
113A0;TULU-TIGALARI LETTER NNA;Lo;0;L;;;;;N;;;;;
113A1;TULU-TIGALARI LETTER TA;Lo;0;L;;;;;N;;;;;
113A2;TULU-TIGALARI LETTER THA;Lo;0;L;;;;;N;;;;;
113A3;TULU-TIGALARI LETTER DA;Lo;0;L;;;;;N;;;;;
113A5;TULU-TIGALARI LETTER DHA;Lo;0;L;;;;;N;;;;;
113A5;TULU-TIGALARI LETTER NA;Lo;0;L;;;;;N;;;;;
113A6;TULU-TIGALARI LETTER PA;Lo;0;L;;;;;N;;;;;
113A7;TULU-TIGALARI LETTER PHA;Lo;0;L;;;;;N;;;;;
113A8;TULU-TIGALARI LETTER BA;Lo;0;L;;;;;N;;;;;
113A9;TULU-TIGALARI LETTER BHA;Lo;0;L;;;;;N;;;;;
113AA;TULU-TIGALARI LETTER MA;Lo;0;L;;;;;N;;;;;
113AB;TULU-TIGALARI LETTER YA;Lo;0;L;;;;;N;;;;;
113AC;TULU-TIGALARI LETTER RA;Lo;0;L;;;;;N;;;;;
113AD;TULU-TIGALARI LETTER LA;Lo;0;L;;;;;N;;;;;
113AE;TULU-TIGALARI LETTER VA;Lo;0;L;;;;;N;;;;;
```

```
113AF;TULU-TIGALARI LETTER SHA;Lo;0;L;;;;;N;;;;;
113B0;TULU-TIGALARI LETTER SSA;Lo;0;L;;;;;N;;;;;
113B1;TULU-TIGALARI LETTER SA;Lo;0;L;;;;;N;;;;;
113B2;TULU-TIGALARI LETTER HA;Lo;0;L;;;;;N;;;;;
113B3;TULU-TIGALARI LETTER LLA;Lo;0;L;;;;;N;;;;;
113B4;TULU-TIGALARI LETTER RRA;Lo;0;L;;;;;N;;;;;
113B5;TULU-TIGALARI LETTER LLLA;Lo;0;L;;;;;N;;;;;
113B7;TULU-TIGALARI SIGN AVAGRAHA;Lo;0;L;;;;;N;;;;;
113B8;TULU-TIGALARI VOWEL SIGN AA;Mc;0;L;;;;;N;;;;;
113B9;TULU-TIGALARI VOWEL SIGN I;Mc;0;L;;;;;N;;;;;
113BA;TULU-TIGALARI VOWEL SIGN II;Mc;0;L;;;;;N;;;;;
113BB;TULU-TIGALARI VOWEL SIGN U;Mn;0;NSM;;;;;N;;;;;
113BC;TULU-TIGALARI VOWEL SIGN UU;Mn;0;NSM;;;;;N;;;;;
113BD;TULU-TIGALARI VOWEL SIGN VOCALIC R;Mn;0;NSM;;;;;N;;;;;
113BE;TULU-TIGALARI VOWEL SIGN VOCALIC RR;Mn;0;NSM;;;;;N;;;;;
113BF;TULU-TIGALARI VOWEL SIGN VOCALIC L;Mn;0;NSM;;;;;N;;;;;
113C0;TULU-TIGALARI VOWEL SIGN VOCALIC LL;Mn;0;NSM;;;;;N;;;;;
113C2;TULU-TIGALARI VOWEL SIGN EE;Mc;0;L;;;;;N;;;;;
113C5;TULU-TIGALARI VOWEL SIGN AI;Mc;0;L;;;;;N;;;;;
113C7;TULU-TIGALARI VOWEL SIGN OO;Mc;0;L;113C2 113B8;;;;N;;;;;
113C8;TULU-TIGALARI VOWEL SIGN AU;Mc;0;L;113C2 113C9;;;;N;;;;;
113C9;TULU-TIGALARI AU LENGTH MARK;Mc;0;L;;;;;N;;;;;
113CA;TULU-TIGALARI SIGN CANDRA ANUNASIKA;Mc;0;L;;;;;N;;;;;
113CC;TULU-TIGALARI SIGN ANUSVARA;Mc;0;L;;;;;N;;;;;
113CD;TULU-TIGALARI SIGN VISARGA;Mc;0;L;;;;;N;;;;;
113CE;TULU-TIGALARI SIGN VIRAMA;Mn;9;NSM;;;;;N;;;;;
113CF;TULU-TIGALARI SIGN LOOPED VIRAMA;Mc;9;L;;;;;N;;;;;
113D0;TULU-TIGALARI CONJOINER;Mn;9;NSM;;;;;N;;;;;
113D1;TULU-TIGALARI REPHA;Lo;0;L;;;;;N;;;;;
113D3;TULU-TIGALARI SIGN TIDDU;Po;0;L;;;;;N;;;;;
113D4;TULU-TIGALARI DANDA;Po;0;L;;;;;N;;;;;
113D5;TULU-TIGALARI DOUBLE DANDA;Po;0;L;;;;;N;;;;;
113D7;TULU-TIGALARI SIGN OM PUSHPIKA;Po;0;L;;;;;N;;;;;
113D8;TULU-TIGALARI SIGN SHRII PUSHPIKA;Po;0;L;;;;;N;;;;;
113D9;TULU-TIGALARI SIGN PUSHPA;Po;0;L;;;;;N;;;;;
113E1;TULU-TIGALARI VEDIC TONE SVARITA;Mn;0;NSM;;;;;N;;;;;
113E2;TULU-TIGALARI VEDIC TONE ANUDATTA;Mn;0;NSM;;;;;N;;;;;
```

10.3 Indic Syllabic Category

```
# Indic_Syllabic_Category=Bindu
113CA        ; Bindu # Mc      TULU-TIGALARI SIGN CANDRA ANUNASIKA
113CC        ; Bindu # Mc      TULU-TIGALARI SIGN ANUSVARA

# Indic_Syllabic_Category=Visarga
113CD        ; Visarga # Mc  TULU-TIGALARI SIGN VISARGA

# Indic_Syllabic_Category=Avagraha
113B7        ; Avagraha # Lo TULU-TIGALARI SIGN AVAGRAHA

# Indic_Syllabic_Category=Pure_Killer
113CE..113CF ; Pure_Killer # Mn  [2]  TULU-TIGALARI SIGN VIRAMA..TULU-TIGALARI SIGN LOOPED VIRAMA

# Indic_Syllabic_Category=Invisible_Stacker
113D0        ; Invisible_Stacker # Mn  TULU-TIGALARI CONJOINER

# Indic_Syllabic_Category=Vowel_Independent
11380..11389 ; Vowel_Independent # Lo [10] TULU-TIGALARI LETTER A..TULU-TIGALARI LETTER VOCALIC LL
1138B        ; Vowel_Independent # Lo      TULU-TIGALARI LETTER EE
1138E        ; Vowel_Independent # Lo      TULU-TIGALARI LETTER AI
11390..11391 ; Vowel_Independent # Lo [2]  TULU-TIGALARI LETTER OO..TULU-TIGALARI LETTER VOCALIC AU

# Indic_Syllabic_Category=Vowel_Dependent
13B8..113BA  ; Vowel_Dependent # Mc [3] TULU-TIGALARI VOWEL SIGN AA..TIGALARI VOWEL SIGN VOCALIC II
113BB..113C0 ; Vowel_Dependent # Mn [6] TULU-TIGALARI VOWEL SIGN U..TIGALARI VOWEL SIGN VOCALIC LL
113C2        ; Vowel_Dependent # Mn     TIGALARI VOWEL SIGN EE
113C5        ; Vowel_Dependent # Mn     TIGALARI VOWEL SIGN AI
113C7..113C9 ; Vowel_Dependent # Mc [3] TIGALARI VOWEL SIGN OO..TIGALARI VOWEL AU LENGTH MARK

# Indic_Syllabic_Category=Consonant
11392..113B5 ; Consonant # Lo [36] TULU-TIGALARI LETTER KA..TULU-TIGALARI LETTER LLLA

# Indic_Syllabic_Category=Cantillation_Mark
113E1..113E2 ; Cantillation_Mark # Mn [2] TULU-TIGALARI VEDIC TONE SVARITA..TULU-TIGALARI VEDIC TONE ANUDATTA

# Indic_Syllabic_Category=Consonant_Preceding_Repha
113D1        ; Consonant_Preceding_Repha # Lo       TULU-TIGALARI REPHA
```

10.4 Indic Positional Category

```
# Indic_Positional_Category=Right
113B8           ; Right # Mc   [3] TULU-TIGALARI VOWEL SIGN AA
113C9..113CA    ; Right # Mc   [2] TULU-TIGALARI AU LENGTH MARK..TULU-TIGALARI SIGN CANDRA ANUNASIKA
113CC..113CD    ; Right # Mc   [2] TULU-TIGALARI SIGN ANUSVARA..TULU-TIGALARI SIGN VISARGA
113CF           ; Right # Mc       TULU-TIGALARI SIGN LOOPED VIRAMA

# Indic_Positional_Category=Left
113C2           ; Left # Mc      TULU-TIGALARI VOWEL SIGN EE
113C5           ; Left # Mc      TULU-TIGALARI VOWEL SIGN AI

# Indic_Positional_Category=Left_And_Right
113C7..113C8    ; Left_And_Right # Mc   [2] TULU-TIGALARI VOWEL SIGN OO..TULU-TIGALARI VOWEL SIGN AU

# Indic_Positional_Category=Top
113CE           ; Top # Mn       TULU-TIGALARI SIGN VIRAMA
113D1           ; Top # Lo       TULU-TIGALARI REPHA
113E1           ; Top # Mn       TULU-TIGALARI VEDIC TONE SVARITA

# Indic_Positional_Category=Bottom
113BB..113C0    ; Bottom # Mn   [6] TULU-TIGALARI VOWEL SIGN U..TULU-TIGALARI VOWEL SIGN VOCALIC LL
113E2           ; Bottom # Mn TULU-TIGALARI VEDIC TONE ANUDATTA

# Indic_Positional_Category=Top_And_Right
113B9..113BA    ; Top_And_Right # Mc   [2] TULU-TIGALARI VOWEL SIGN I..TULU-TIGALARI VOWEL SIGN II
```

11 Similar characters (Confusables)

Tulu-Tigalari script has a few characters that look similar to each other. All efforts have been made to make them as unambiguous as possible while not straying away from the original script. However, some characters might still create confusion in their hand-written forms.

Key : Tulu-Tigalari (Ti.), Kannada (Ka.)

1.–		2.–		3.–	
KHA	ಖ / ಖ	E	ೞ	TA	ത
CA	ಬ	BHA	ഩ	NA	ന
PA	ഩ	HA	ഗ		
VA	ವ	8 (Ti.)	ഺ		
MA	മ				

4.–		5.–		6.–	
DHA	ദ/ദ	SHA	ശ	2 (Ti.)	೭
3	3	GA	ഗ	U	ೞ
				2	2

7.–		8.–		9.–	
TTA	◌		Anusvara	ം	Virama	◌്
Anudatta	◌		0	0	Anunasika	◌ ം
			0 (Ti.)	ഠ	Repha + Virama	◌്

10.–		11.–		12.–	
Vocalic R	ൠ	7 (Ti.)	൭	10 (Ti.)	ഡ
4 (Kan.)	೪	EE-v.s.	൭◌	DA	ഩ
				DDA	ഩ/ ഩ

13.–		14.–	
3 (Ti.)	൩	GA+Virama	ഗ
I	൷	SHA+Repha	ഗ

12 Script Extensions

Kannada digits U+0CE6..U+0CEF should be extended for use with Tulu-Tigalari as indicated under section 7.

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Taraprakashana, Bangalore
Poornaprajna Vidyapeetha, Bangalore
Oriental Research Institute, Mysore
Keladi Museum
Shrii Bannanje Govindacharya
Dr S R Vighnaraj
Shrii Ramanath Acharya
Srinidhi (srinidhi.pinkpetals24@gmail.com)
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Figures

FIGURE 1.
Initials: PU (*Danda*) RA (stands for Puttige Ramakrishna), written on a copper vessel.
SOURCE
Private collection, Udupi District.

FIGURE 2.
Stone inscriptions in Tulu-Tigalari script from Kodipadi Janardana Temple, Puttur Taluk.
SOURCE
Kodipay Janardhana Temple, Mangalore district.

FIGURE 3.
Tulu-Tigalari script, Tulu language (top) and Kannada language (bottom) manuscripts.
SOURCE
(Top) Punyahavidhi, Govind Pai Research Centre, Udupi. (Bottom) Srinidhi A

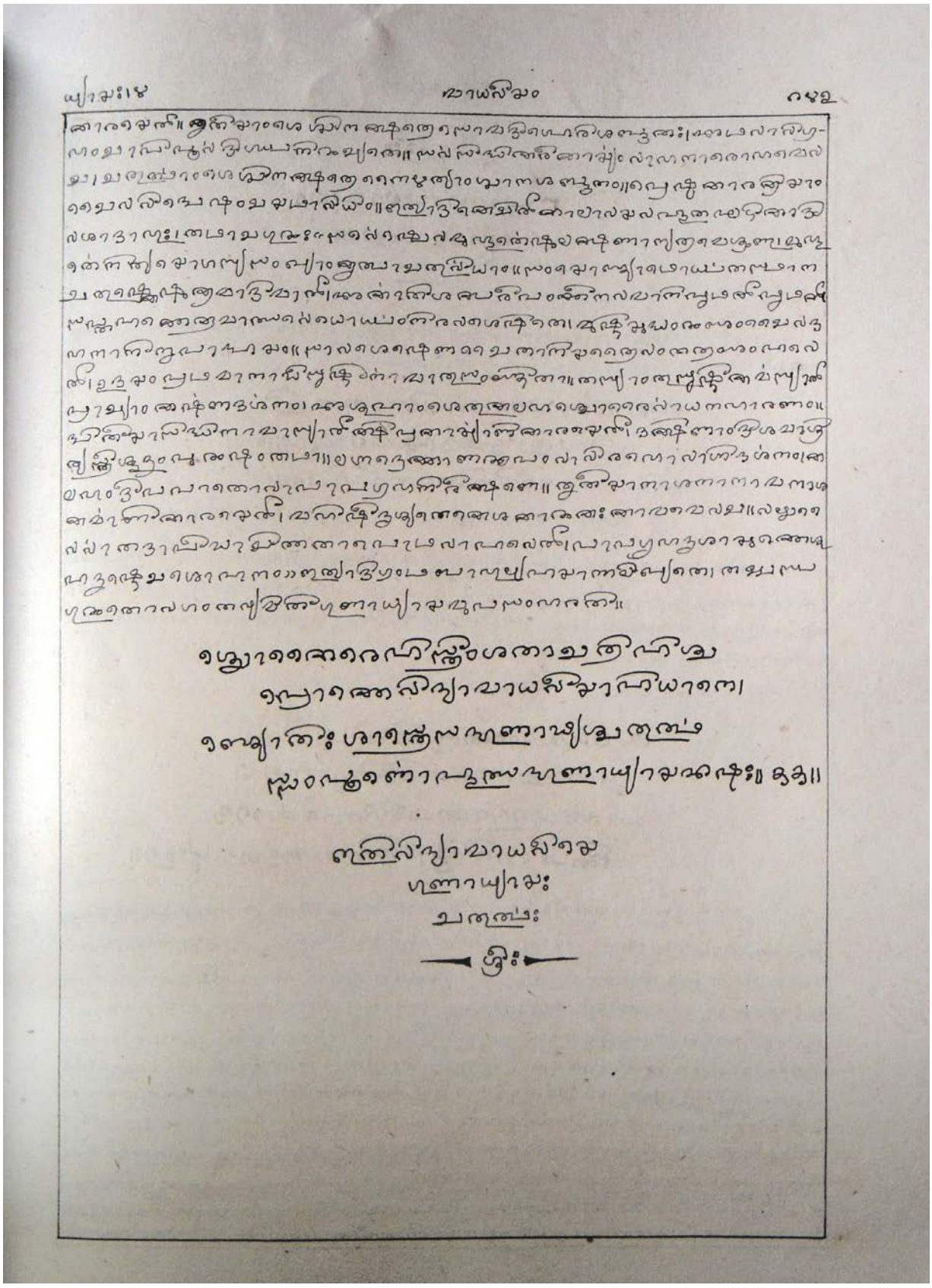
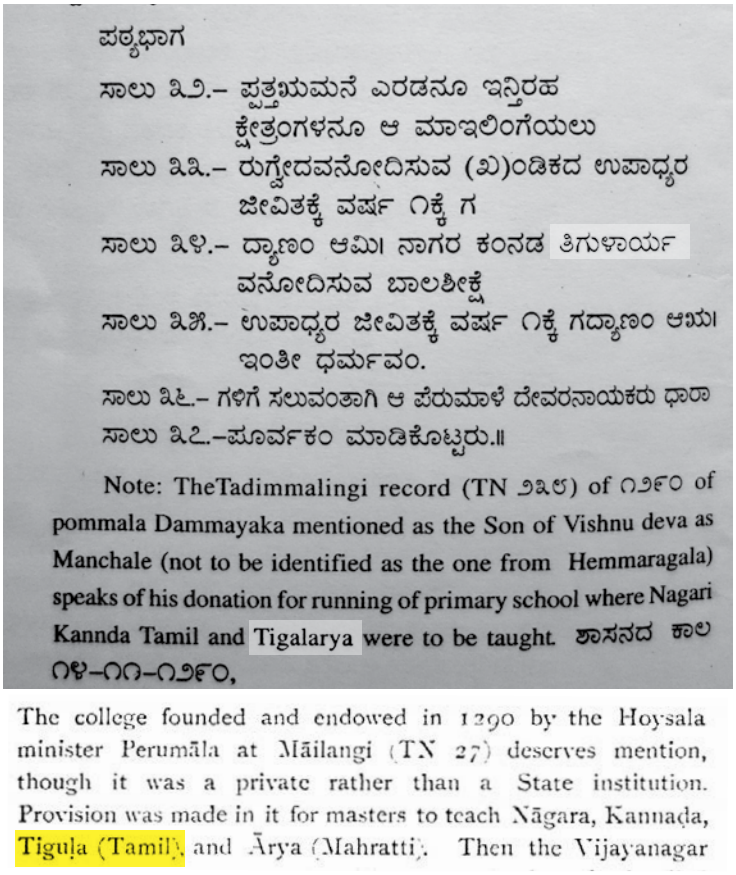


FIGURE 4.
A 20th century paper manuscript in Tulu-Tigalari script.
SOURCE
Dharmasthala Samshodana Pratishtana, Dharmasthala. Handwritten on machine-made paper.



ಪಶ್ಚಭಾಗ

ಸಾಲು ೩೨.– ಪ್ಪತ್ತಖುಮನೆ ಎರಡನೂ ಇನ್ತಿರಹ
ಕ್ಷೇತ್ರಂಗಳನೂ ಆ ಮಾಇಲಿಂಗೆಯಲು
ಸಾಲು ೩೩.– ರುಗ್ವೇದವನೋದಿಸುವ (ಖ)ಂಡಿಕದ ಉಪಾಧ್ಯರ
ಜೀವಿತಕ್ಕೆ ವರ್ಷ ೧ಕ್ಕೆ ಗ
ಸಾಲು ೩೪.– ದ್ಯಾಣಂ ೆಮಿ। ನಾಗರ ಕಂನಡ ತಿಗುಳಾರ್ಯ
ವನೋದಿಸುವ ಬಾಲಶೀಕ್ಷೆ
ಸಾಲು ೩೫.– ಉಪಾಧ್ಯರ ಜೀವಿತಕ್ಕೆ ವರ್ಷ ೧ಕ್ಕೆ ಗದ್ಯಾಣಂ ೆಖು।
ಇಂತೀ ಧರ್ಮವಂ.
ಸಾಲು ೩೬.– ಗಳಿಗೆ ಸಲುವಂತಾಗಿ ಆ ಪೆರುಮಾಳೆ ದೇವರನಾಯಕರು ಧಾರಾ
ಸಾಲು ೩೭.–ಪೂರ್ವಕಂ ಮಾಡಿಕೊಟ್ಟರು.॥

Note: TheTadimmalingi record (TN ೨೩೮) of ೧೨೯೦ of pommala Dammayaka mentioned as the Son of Vishnu deva as Manchale (not to be identified as the one from Hemmaragala) speaks of his donation for running of primary school where Nagari Kannda Tamil and Tigalarya were to be taught. ಶಾಸನದ ಕಾಲ ೧೪–೧೧–೧೨೯೦,

The college founded and endowed in 1290 by the Hoysala minister Perumāla at Māilangi (TN 27) deserves mention, though it was a private rather than a State institution. Provision was made in it for masters to teach Nāgara, Kannaḍa, Tiguḷa (Tamil), and Ārya (Mahratti). Then the Vijayanagar

FIGURE 5.
Gunda Jois mentions an epigraphical reading from a stone inscription dated 14th November 1290 uses the term ‘Tigalarya’ to refer to the Tulu-Tigalari script (above). However, on examining the primary source by B L Rice (below), one finds the term 'Tigalarya' referred to here is more likely the Tamil Grantha Script as the inscription belonged to a region where only Tamil Grantha and not Tulu-Tigalari script was used.

SOURCE
Jois, Gunda. '*Havyaka Guudhalipi Tigalari Hasthaprathi Granthagalu*' Ananta Krishna Carita. 114. Print.

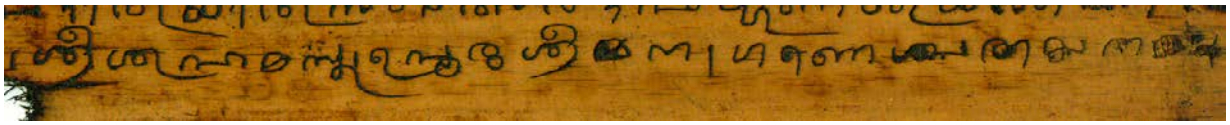
PRIMARY SOURCE
(Ctsy. Srinidhi A) “Inscription No.: TN. 27.” Epigraphia Carnatica, by B. Lewis Rice, vol. 3, Mysore Govt. Central Press, 1886, pp. 216–217. (http://idb.ub.uni-tuebingen.de/opendigi/EC_03_1894_B)

	Tamil	Grantha	Tulu-Tigalari	Malayalam	Kannada
ANUSVARA	–	◌ം	◌ം	◌ം	◌ಂ
VISARGA	–	◌ഃ	◌ಃ	◌ഃ	◌ಃ
LETTER A	அ	𑌅	𑍾𑍰	അ	ಅ
LETTER AA	ஆ	𑌆	𑍾𑍱	ആ	ಆ
LETTER I	இ	𑌇	𑍾𑍲	ഇ	ಇ
LETTER II	ஈ	𑌈	𑍾𑍳	ഈ	ಈ
LETTER U	உ	𑌉	𑍾𑍴	ഉ	ಉ
LETTER UU	ஊ	𑌊	𑍾𑍵	ഊ	ಊ
LETTER VOCALIC R	–	𑌋	𑍾𑍶	ഋ	ಋ
LETTER VOCALIC RR	–	𑌌	𑍾𑍷	ൠ	ೠ
LETTER VOCALIC L	–	𑌌	𑍾𑍸	ഌ	ಌ
LETTER VOCALIC LL	–	𑌡	𑍾𑍹	ൡ	ೡ
LETTER E	எ	(ഌ്?)	(ಽ?)	എ	ಎ
LETTER EE	ஏ	𑌎	𑍾𑍺	ഏ	ಏ
LETTER AI	ஐ	𑌐	𑍾𑍻	ഐ	ಐ
LETTER O	ஒ	(ഩ്?)	(ಾ?)	ഒ	ಒ
LETTER OO	ஓ	𑌒	𑍾𑍼	ഓ	ಓ
LETTER AU	ஔ	𑌔	𑍾𑍽	ഔ	ಔ
LETTER KA	க	𑌕	𑍾𑍾	ക	ಕ
LETTER KHA	–	𑌖	𑍾𑍿	ഖ	ಖ
LETTER GA	–	𑌗	𑍾𑌀	ഗ	ಗ
LETTER GHA	–	𑌘	𑍾𑌁	ഘ	ಘ
LETTER NGA	ங	𑌙	𑍾𑌂	ങ	ಙ
LETTER CA	ச	𑌚	𑍾𑌃	ച	ಚ
LETTER CHA	–	𑌛	𑍾𑌄	ഛ	ಛ
LETTER JA	ஜ	𑌜	𑍾𑌅	ജ	ಜ
LETTER JHA	–	𑌝	𑍾𑌆	ഝ	ಝ
LETTER NYA	ஞ	𑌞	𑍾𑌇	ഞ	ಞ
LETTER TTA	ட	𑌟	𑍾𑌈	ട	ಟ

LETTER TTHA	–	ഠ	ಀ	ಠ	ఠ
LETTER DDA	–	ഡ	ಁ	ಡ	డ
LETTER DDHA	–	ഢ	ಂ	ಢ	ఢ
LETTER NNA	ண	ണ	ಃ	ಣ	ణ
LETTER TA	த	ത	಄	ತ	త
LETTER THA	–	ഥ	ಅ	ಥ	థ
LETTER DA	–	ദ	ಆ	ದ	ద
LETTER DHA	–	ധ	ಇ	ಧ	ధ
LETTER NA	ந	ന	ಈ	ನ	న
LETTER PA	ப	പ	ಉ	ಪ	ప
LETTER PHA	–	ഫ	ಊ	ಫ	ఫ
LETTER BA	–	ബ	ಋ	ಬ	బ
LETTER BHA	–	ഭ	ಌ	ಭ	భ
LETTER MA	ம	മ	಍	ಮ	మ
LETTER YA	ய	യ	ಎ	ಯ	య
LETTER RA	ர	ര	ಏ	ರ	ర
LETTER RRA	ற	റ	ಐ	ಱ	ఱ
LETTER LA	ல	ല	಑	ಲ	ల
LETTER LLA	ள	ള	ಒ	ಳ	ళ
LETTER LLLA	ழ	ഴ	ಓ	ೞ	ఴ
LETTER VA	வ	വ	ಔ	ವ	వ
LETTER SHA	ஶ	ശ	ಕ	ಶ	శ
LETTER SSA	ஷ	ഷ	ಖ	ಷ	ష
LETTER SA	ஸ	സ	ಗ	ಸ	స
LETTER HA	ஹ	ഹ	ಘ	ಹ	హ
VOWEL SIGN AA	ா	ാ	ಙ	ಾ	ా
VOWEL SIGN I	ி	ി	ಚ	ಿ	ి
VOWEL SIGN II	ீ	ീ	ಛ	ೀ	ీ
VOWEL SIGN U	ு	ു	ಜ	ು	ు
VOWEL SIGN UU	ூ	ൂ	ಝ	ೂ	ూ

VOWEL SIGN VOCALIC R	–	◌ൃ	◌ೃ	◌ൃ	◌ൃ
VOWEL SIGN VOCALIC RR	–	◌ൄ	◌ೄ	◌ൄ	◌ൄ
VOWEL SIGN VOCALIC L	–	◌ഌ	◌ಌ	◌ഌ	◌ൢ
VOWEL SIGN VOCALIC LL	–	◌ൡ	◌ೡ	◌ൡ	◌ൣ
VOWEL SIGN E	◌ெ	◌െ	◌ೆ	◌െ	◌ൂ
VOWEL SIGN EE	◌ே	◌െ	◌ೇ	◌േ	◌ൗ
VOWEL SIGN AI	◌ை	◌ൈ	◌ೈ	◌ൈ	◌ൃൂ
VOWEL SIGN O	◌ொ	◌ൊ	◌ೊ	◌ൊ	◌ൌ
VOWEL SIGN OO	◌ோ	◌ോ	◌ೋ	◌ോ	◌ൗൗ
VOWEL SIGN AU	◌ௌ	◌ൌ	◌ೌ	◌ൗ	◌ൗ
VIRAMA	◌்	◌്	◌್	◌്	◌്
AVAGRAHA	–	ऽ	ऽ	ऽ	ऽ
REPHA	–	◌ൎ / ◌ൢ	◌ൎ	◌ൎ	◌ൎ
0	০	൦	೦ / ൦	൦	০
1	க	ക	೧ / ൧	ക	೧
2	உ	ഉ	೨ / ഉ	ഉ	೨
3	ங	ങ	೩ / ൩	ണ	೩
4	ச	ച	೪ / ഛ	ൺ	೪
5	ரு	ഋ	೫ / ഒ	ഒ	೫
6	சூ	ചൂ	೬ / ൟ	ന	೬
7	எ	എ	೭ / ഭ	ഭ	೭
8	அ	അ	೮ / ഫ	വ	೮
9	கூ	കൂ	೯ / ൈ	ൻ	೯
10	ൠ	ൠ	೧೦ / ൡ	ൡ	೧೦
100	ന	ന	೧೦೦ / ൟ	ന	೧೦೦

FIGURE 6.
Comparison of Tamil, Grantha, Tulu-Tigalari, Malayalam and Kannada scripts.
FONTS USED
Tamil : Noto Sans Tamil, Grantha : e-Grantamil 7, Tulu-Tigalari : Mokay (Designed by the Author), Malayalam : Meera, Kannada : Baloo Tamma



ಶ್ರೀ	ಶು	ಭ	ಮ	ಸ್ತು	।	ಉ	ಪೂ	ರು	ಶ್ರೀ	ಮ	ಹಾ	ಗ	ಣೇ	ಶ್ವ	ರಾ	ಯ	ನ	ಮಃ ।
श्रीं	शु	भ	म	स्तु	।	उ	पू	रु	श्री	म	हा	ग	णे	श्व	रा	य	न	मः ।
Shri	*Shu*	*Bha*	*Ma*	*Stu*	.	*U*	*Puu*	*Ru*	*Shri*	*Ma*	*Haa*	*Ga*	*Nnee*	*Shva*	*Raa*	*Ya*	*Na*	*Maha.*

FIGURE 7.
Transcribing Tulu-Tigalari characters into Kannada, Devanagari and Latin scripts from a manuscript source.
SOURCE
Dodmane. Uppoor. Udupi.

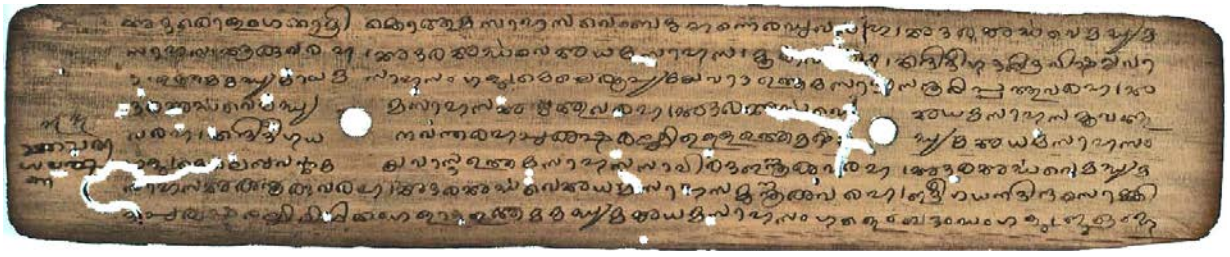


FIGURE 8.1.
Kannada language, Tulu-Tigalari script manuscript.
SOURCE
Yajnavalkya Vyavaharadhiyaya, Srinidhi

FIGURE 8.2.
A sample of both Kannada and Tulu-Tigalari scripts used on the same leaf of a manuscript. Its common to see Kannada or Nandinagari scripts used in the last few pages of the Tulu-Tigalari manuscripts.
SOURCE
Yajnavalkya Vyavaharadhiyaya, Srinidhi

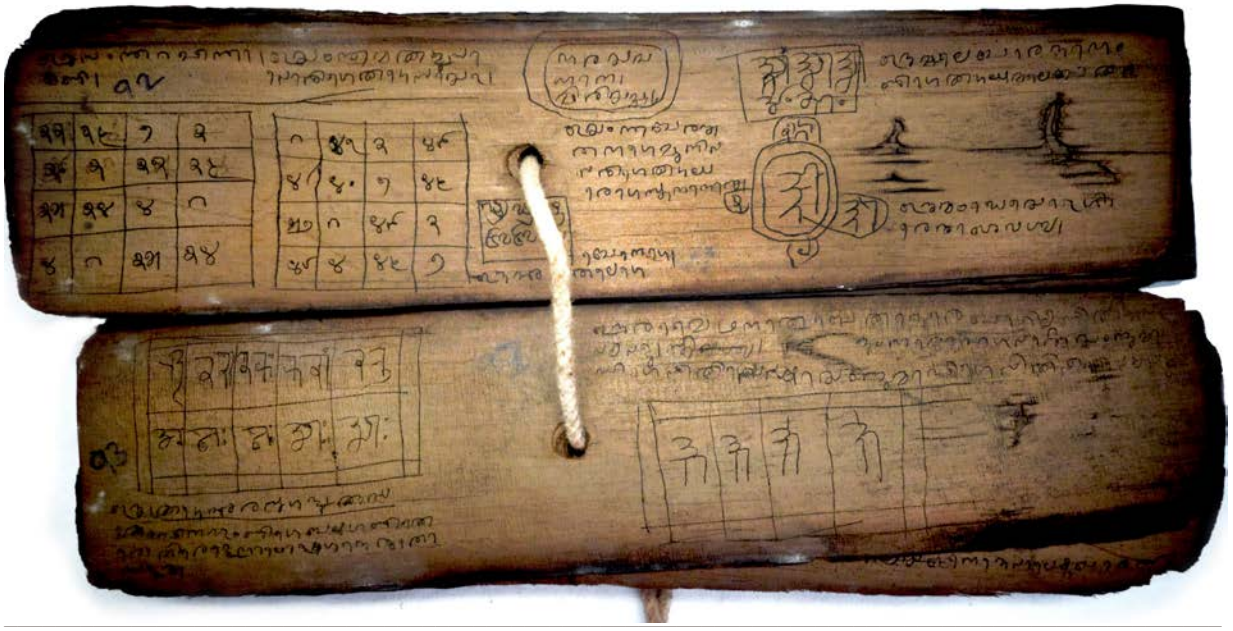


FIGURE 8.3.
A tantric plam leaf manuscript that has Kannada, Nagari and Tulu-Tigalari scripts.
SOURCE
Keladi Museum, Keladi.

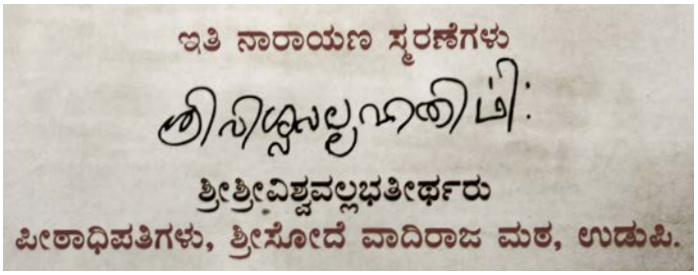


FIGURE 9.
Signature of a prominent seer from Udupi in Tulu-Tigalari that reads ‘Shrii Vishwa Vallabha Teertha’ of Sōdé Mutt. Rest of the text surrounding it is in Kannada language and script.
SOURCE
Printed on an invitation card.

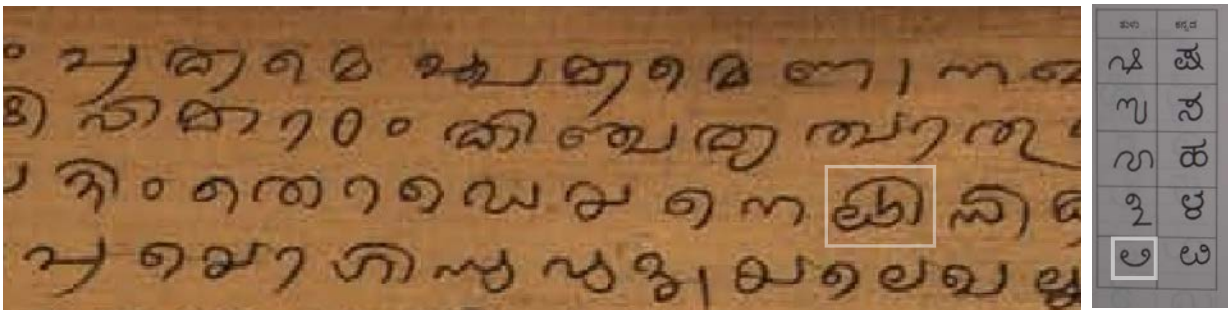


FIGURE 10.

(LEFT)
RRA+I-v.s found in a Kannada language, Tulu-Tigalari script manuscript. This character has been recently found by Srinidhi in several other such Kannada language manuscripts.
SOURCE
Srinidhi.

(RIGHT)
Tulu-Tigalari letter LLLA as documented by Venkataraja Puninchathaya.
SOURCE
Puninchathaya Venkataraja, Tulu Lipi, Tuḷu Sahitya Academy, Mangalore.

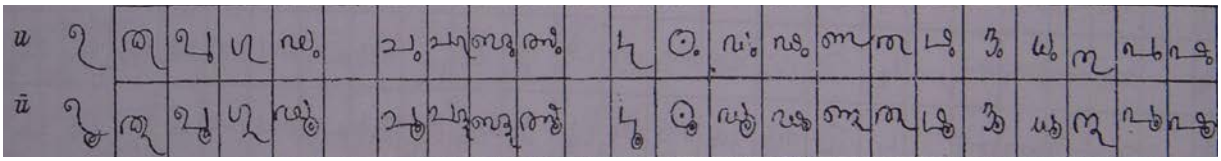


FIGURE 11.
Vowel sign U & UU change according to the character they are combining with.
SOURCE
A C Burnell, Elements of South Indian Palaeography

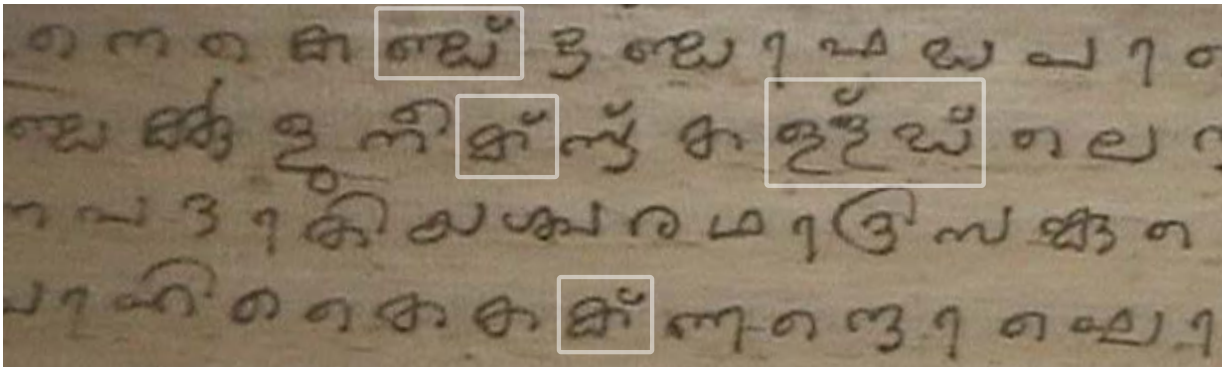


FIGURE 12.
A manuscript of Tuḷu language and Tulu-Tigalari script. Here we see a sequence of letters with *Virama* representing the short un-rounded ‘u’.
SOURCE
Dharmasthala Samshodana Pratishtana, Dharmasthala.

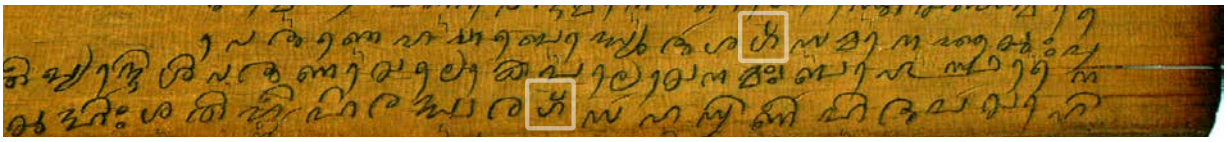


FIGURE 13.
A manuscript of Sanskrit language which uses the semi-circular *Virama* form denoting the negation of the inherent vowel 'A'.
SOURCE
Taraprakashana, Bangalore.

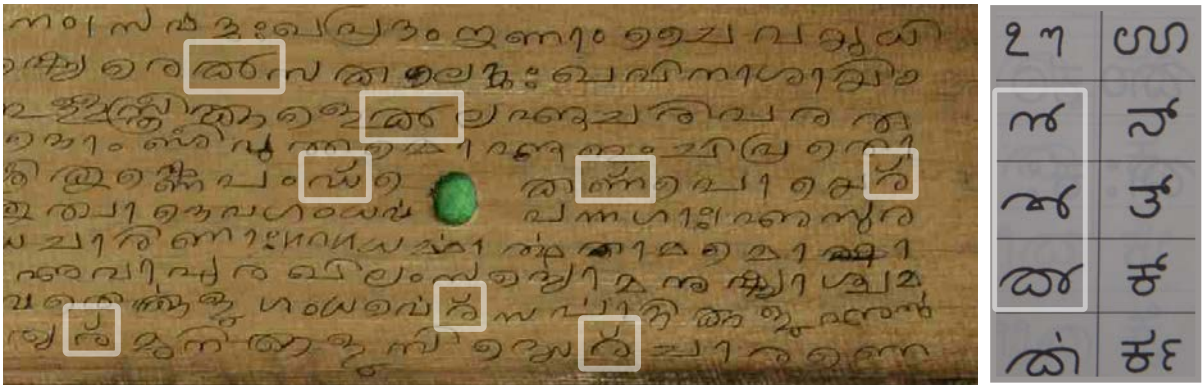


FIGURE 14.
(LEFT)
Both the *Virama* forms seen used in a Tulu language, Tulu-Tigalari script manuscript. Note Ra+*Virama* does not form *Repha*. The combining *Virama* indicates a special vowel that is distinct from a *Repha*.
SOURCE
Anantavruta Kathe, S.A.Krishnaiah, Govinda Pai Research Centre, Udupi

(RIGHT)
Virama ligatures in a Tulu-Tigalari script text book.
SOURCE
Tuḷu Sahitya Academy, Mangalore.

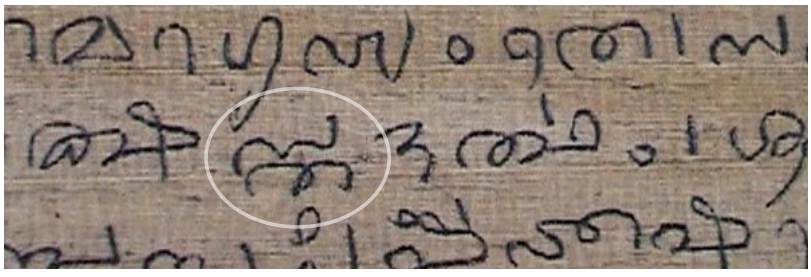


FIGURE 15.
Here, we can see the common practice of drawing post-base forms the same size as the base consonant. It is also interesting to note that most vertical conjuncts shift slightly above the base-line, reducing the interlinear space.
SOURCE
Oriental Research Institute, Mysore.

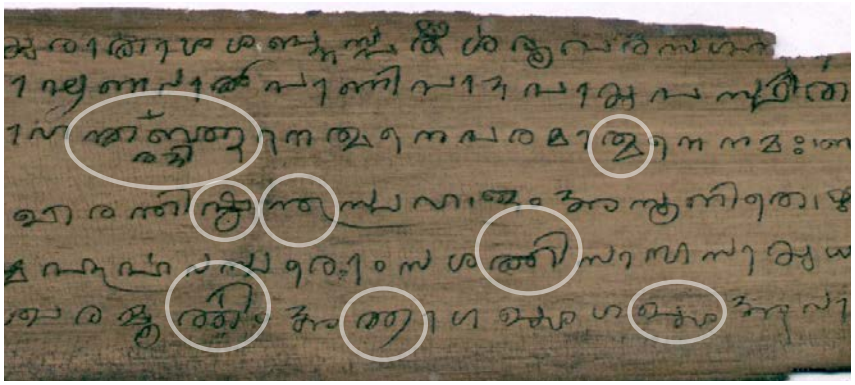


FIGURE 16.
Various forms of ligatures found on a manuscript.
SOURCE
Private collection, Tamil Nadu.

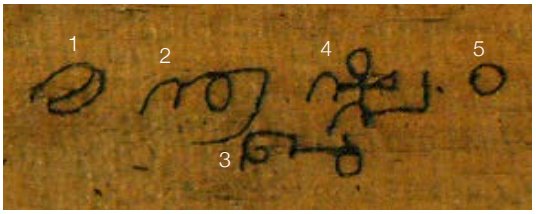


FIGURE 17.
1. Consonant MA,
2. Horizontal Conjunct [NTRA = NA+TA+RA],
3. Consonant + Vowel Sign [PU = PA+U*(v.s.)*],
4. Vertical Conjunct [SSPA = SSA+PA],
5. *Anusvara*. The word reads *Mantrapushpam*.
SOURCE
Private Collection, Puttur.

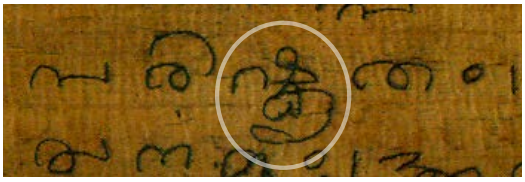


FIGURE 18.
An example of Vertical Ligature combining with a vowel sign [SSA+KA+Vocalic R].
SOURCE
Private Collection, Bangalore.

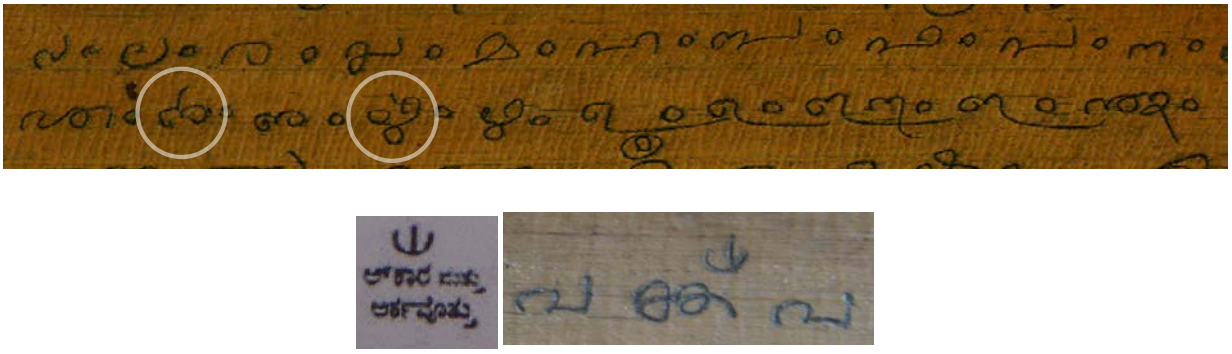


FIGURE 19.

(ABOVE)
Vowels Vocalic RR and Vocalic LL are represented with a *Repha.*
SOURCE
Private collection, Udupi.

(BELOW)
Virama and *Repha* ligature.
SOURCE
(LEFT)
15th century specimen isolated by Dr Venkataraja Puninchathaya.
(RIGHT)
Tulu Ramayana, Dharmasthala Samshodana Pratishtana, Dharmasthala.

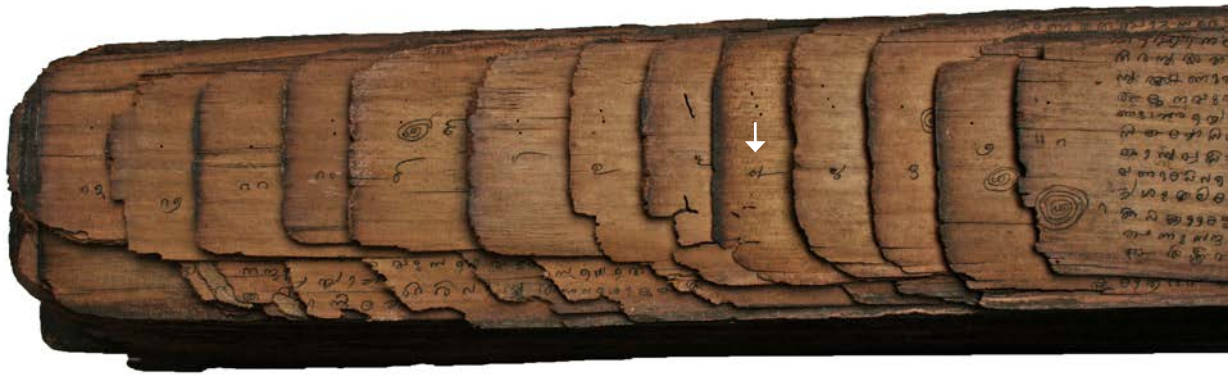


FIGURE 20.
Telugu-Kanarese numerals are used in most Tulu-Tigalari manuscripts. In the above example, these numbers are seen used to number the pages on a palm leaf manuscript. Its interesting to note however that 5 (arrow indicator) is sometimes written in the above style which is slightly different from the current Telugu-Kannada style.
SOURCE
Private collection. Udupi.

FIGURE 21.
'Tulu Numbers' page numbering examples :
1, 2, 3, 5, 6
7, 8, 9, 10, 17
SOURCE
Dharmasthala Samshodana Pratishtana, Dharmasthala.

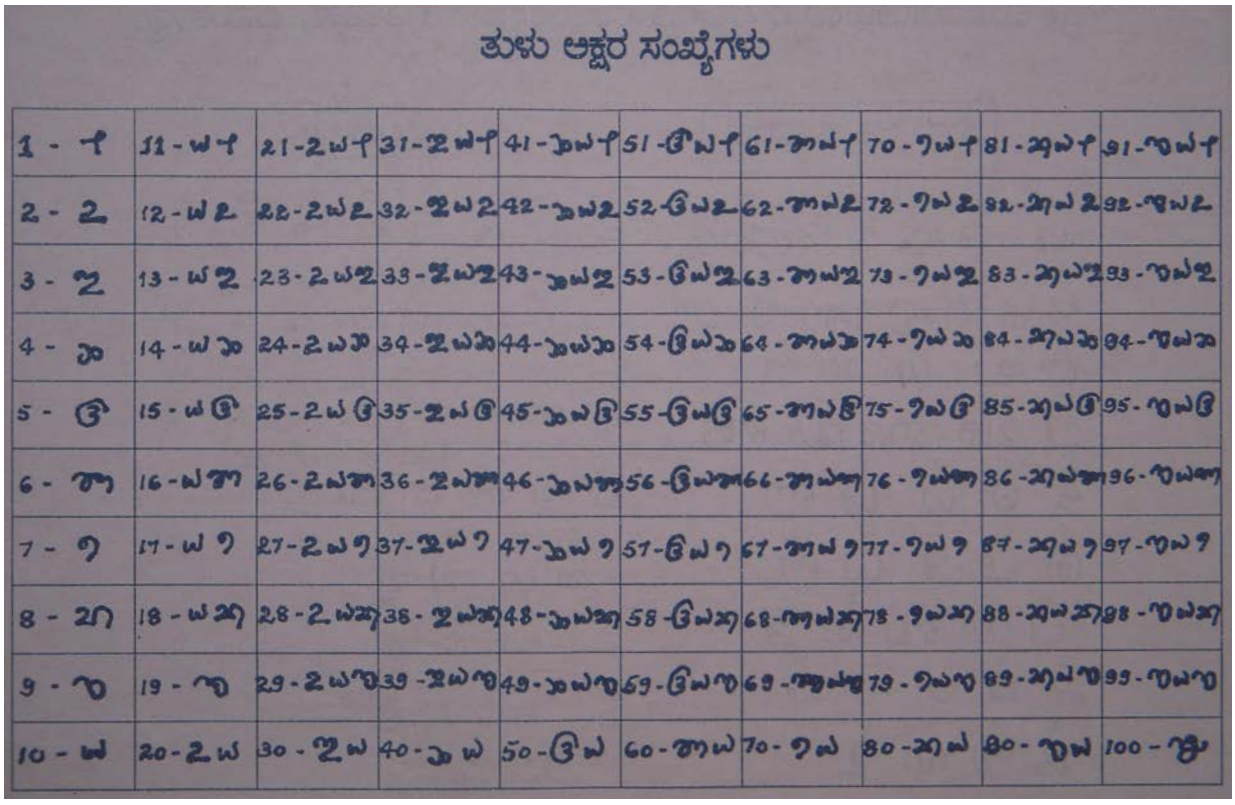


FIGURE 22.
Tulu-Tigalari Number system. The title reads 'Tulu numbers' as its commonly referred to by this name by the scholars of the Tulu speaking region today. These characters are extremely rare an needs further research. They are not proposed as of now.
SOURCE
Dr S R Vighnaraj, Dharmasthala Samshodana Pratishtana, Dharmasthala. Published by Tulu Sahitya Academy, Mangalore. 2006.

FIGURE 23.
Examples of *Pushpika* '𑐬'.
SOURCE
Private collection, Mangalore district.

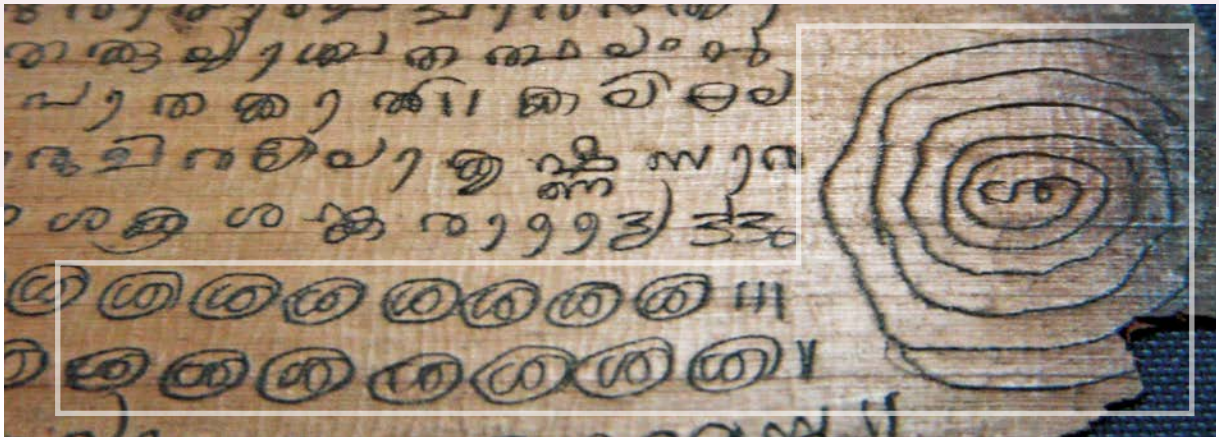


FIGURE 24.
Example of *Shrii* '𑐦' used as space filler and an ornament.
SOURCE
Private collection, Mangalore district.

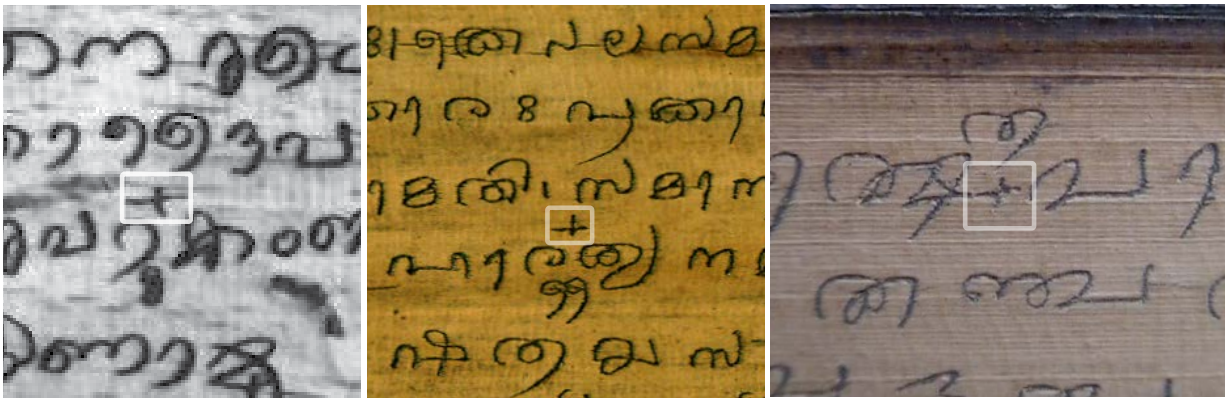


FIGURE 25.
Example of *Tiddu* marks with corrections appearing above and below the baseline.
SOURCE
Mahaitarayopanishatt Bhashya, Location: Udupi Mutt. Digitised by Taraprakahana, Bangalore.

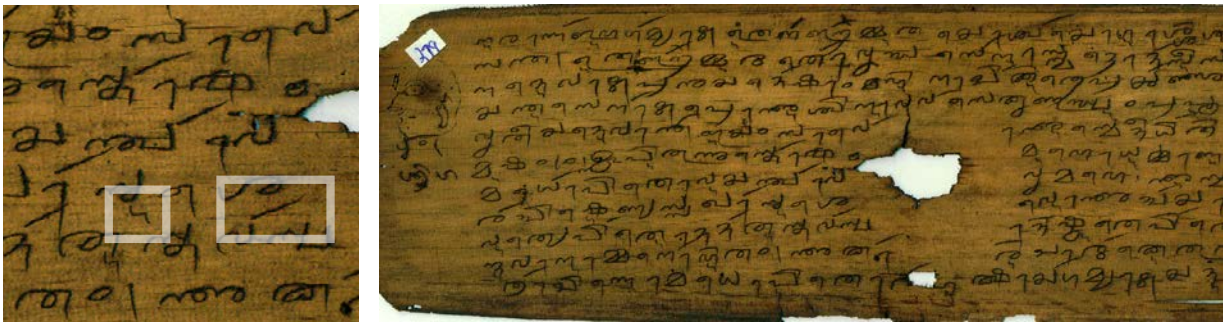


FIGURE 26.
Svarita (◌́) and *Anudatta (◌̍)* are marked in the close-up of the above manuscript (left). They can be seen used sevral times across the manuscript page (right).
SOURCE
Private collection, Mangalore district.

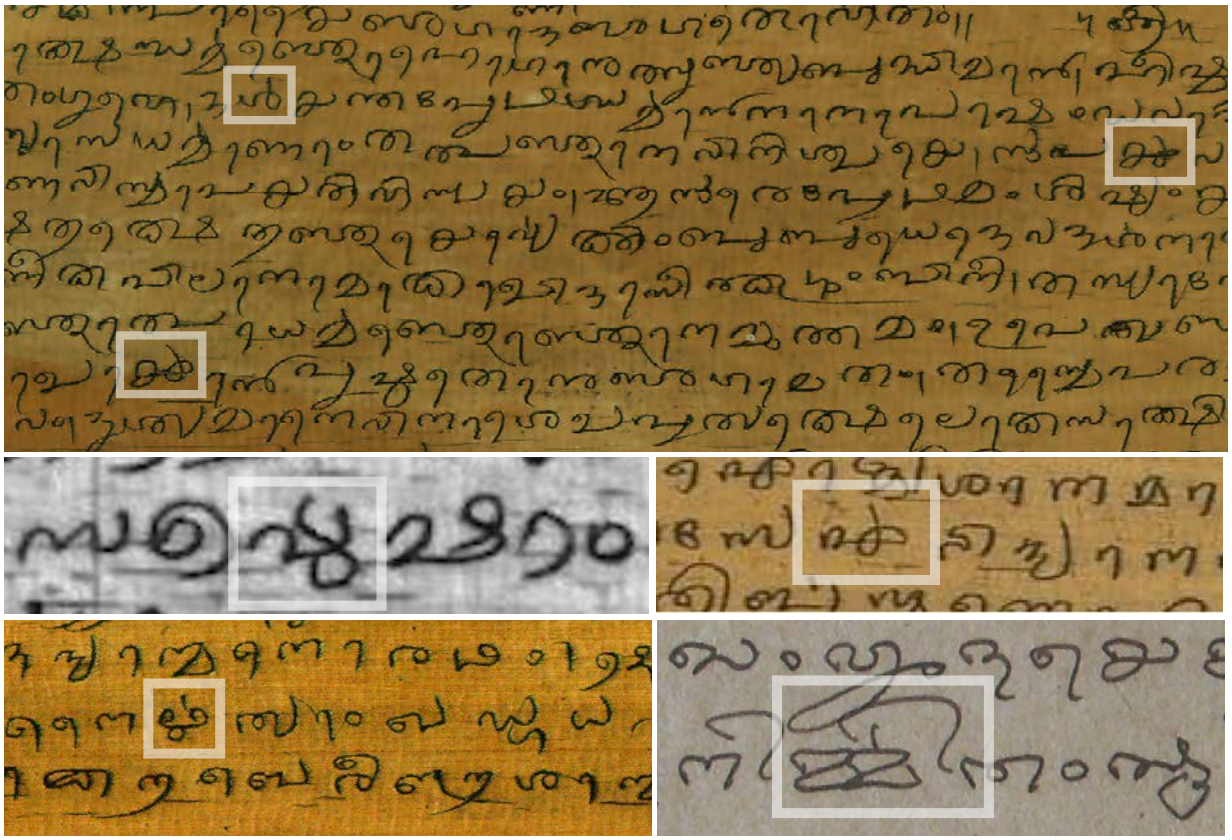


FIGURE 27.
(TOP)
Ligature form YA+*Repha* (ൟ). Also note the Tulu-Tigalari Letter SHA forms a ligature with *Repha* here. Not to be confused with a SHA+*Virama chillu* form as seen in Malayalam U+0D7E. Since the occurance of SHA+Repha ligature is rare, this form is not recommended.
SOURCE
Private Collection, Kasaragod.

(MIDDLE RIGHT AND LEFT)
The two forms of VA+*Repha* (വ്ര / വ്ഴ) ligature fond in Tulu-Tigalari.
SOURCE
Left : Sarvamoola Grantha, Udupi Mutt. Digitised by Taraprakashana, Bangalore
Right : Srinidhi

(BELOW LEFT)
Repha combining with Vocalic R. From the word NAIRRTYAAM **नैर्ऋत्यां.**
SOURCE
Private Collection, Udupi.

(BELOW RIGHT)
[MA+MA]+*Repha*+I
SOURCE
Dharmasthala Samshodana Pratishtana, Dharmasthala.

FIGURE 28.
Candrabindu style *Anunasika* character seen used in a Tulu language manuscript. This symbol is used experimentally here in an attempt to indicate the half unrounded U sound which is otherwise associated with a *Candra Virama* form.
SOURCE
Tulu Ramayana, Dharmasthala Samshodana Pratishtana, Dharmasthala.

NOTE — *Figures : 29, 30, 31, 32, 33, 34, 35, 36, 37, 42, 43, 44, 44.1, 45 & 46 are samples of the Tulu-Tigalari alphabet from individuals and institutions. There are inconsistencies in several of these figures. The character representations will differ, at times, from what is proposed in this paper. However, it makes for an interesting collection to study the various representations and are therefore included here.*

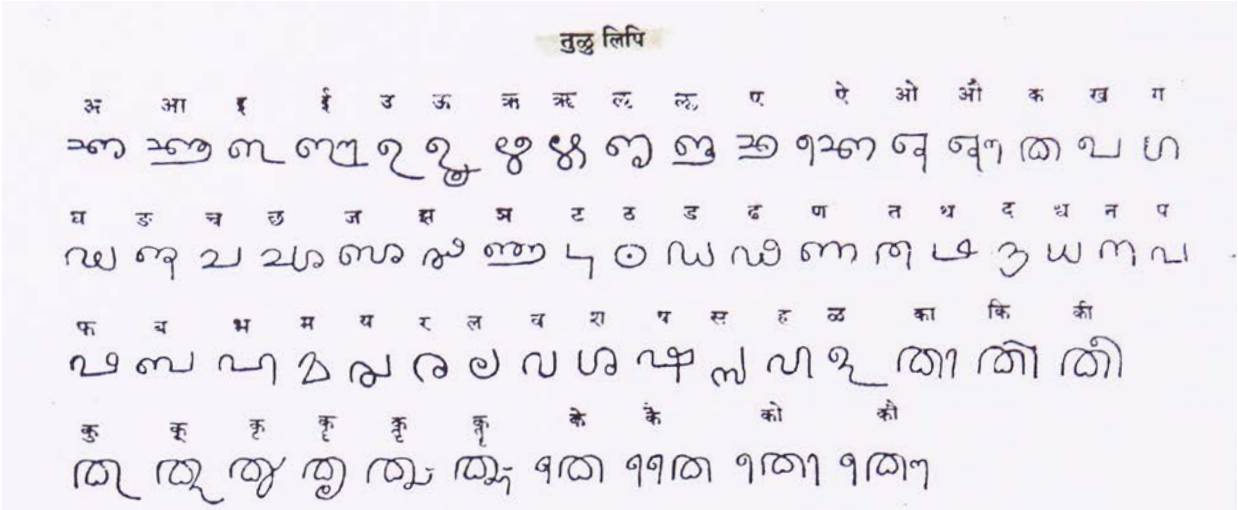


FIGURE 29.
Tulu-Tigalari alphabet
SOURCE
Ojha, Gauri Shankar Hirachand. Bharatiya Prachin Lipimala (The Palaeography of India). Delhi : Munshiram Manoharlal, 1918. Print.

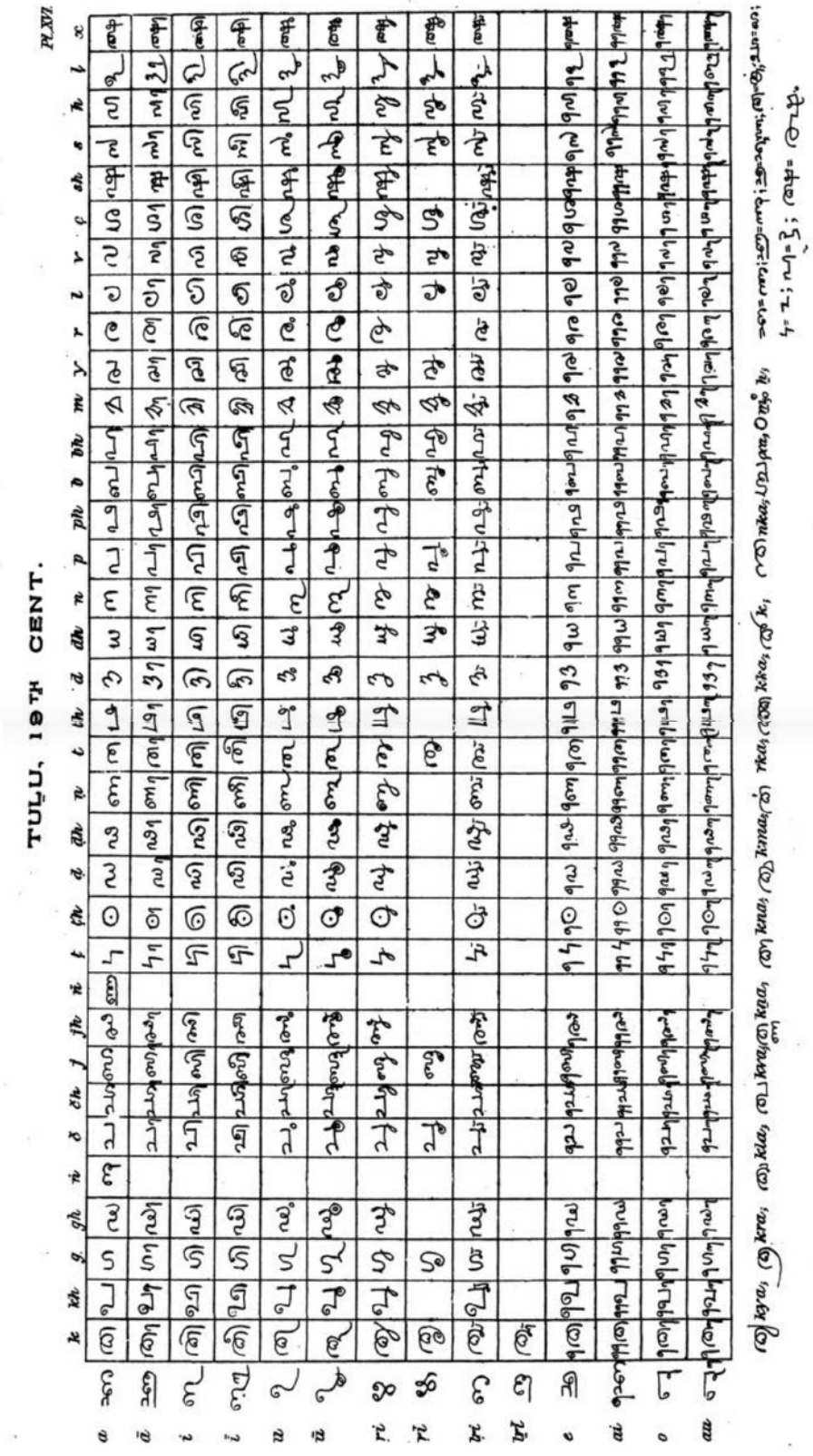


FIGURE 30.
Tulu-Tigalari (Tulu) script as recorded by A C Burnell. (This book has heavily influenced several scholarly works on Tulu-Tigalari.)

SOURCE
Burnell, Arthur Coke. Elements of South-Indian Palæography, from the Fourth to the Seventeenth Century, A. D.; Being an Introduction to the Study of South-Indian Inscriptions and Mss.;. London: Trübner &; [Mangalore, Basel Mission], 1878. Plate XVI. Internet Archive. Web. 31 July 2015.

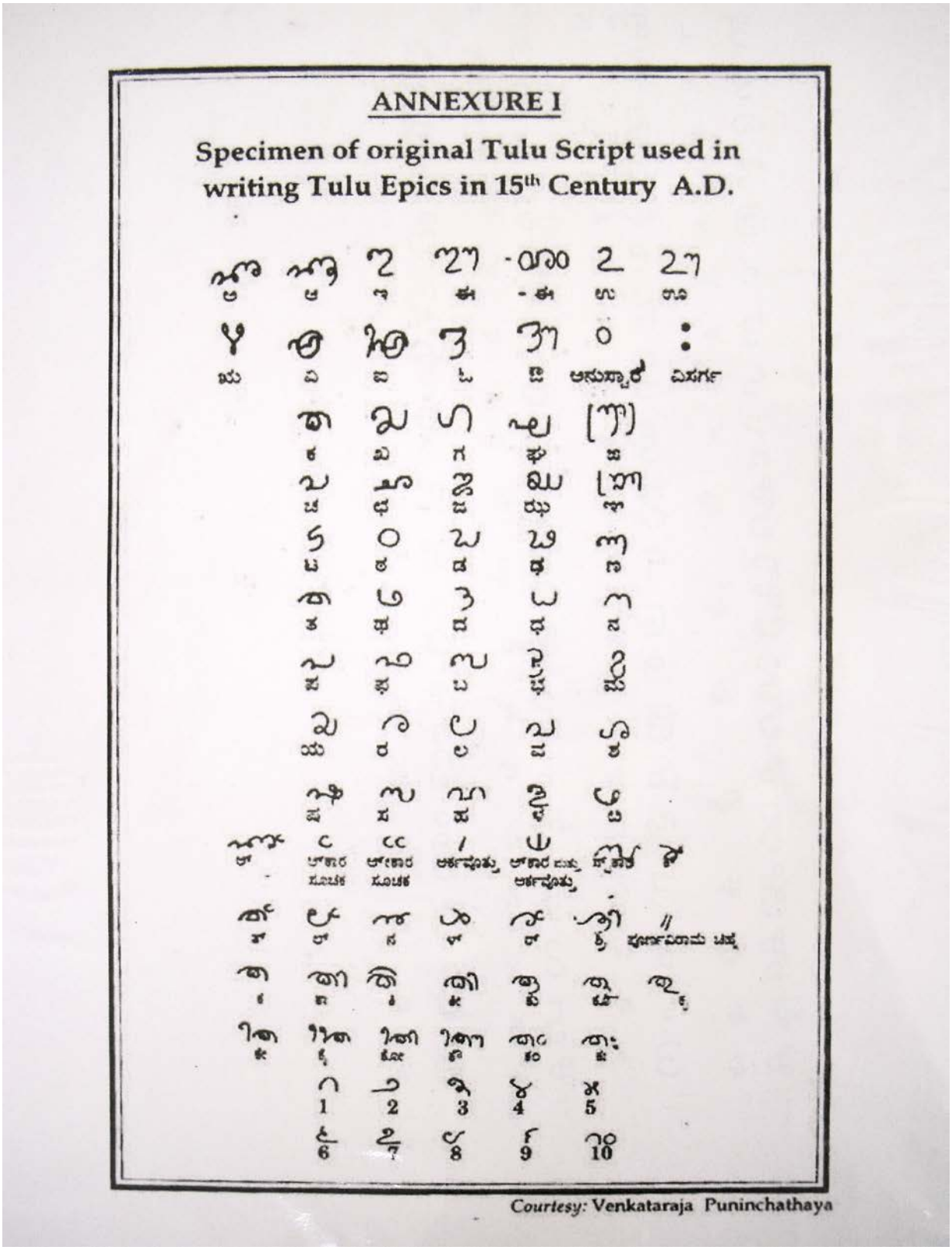


FIGURE 31.
Dr Venkataraja Puninchathaya was one of the early scholars to study this script closely in the recent times. He called this script Tulu script and was also responsible for translating several Tulu-Tigalari script, Tulu language original literature into Kannada. Tulu-Tigalari script taught in schools today by Tulu Sahitya Academy follows his style of writing Tulu-Tigalari.

SOURCE
Venkataraja Puninchathaya, Unknown Publication.

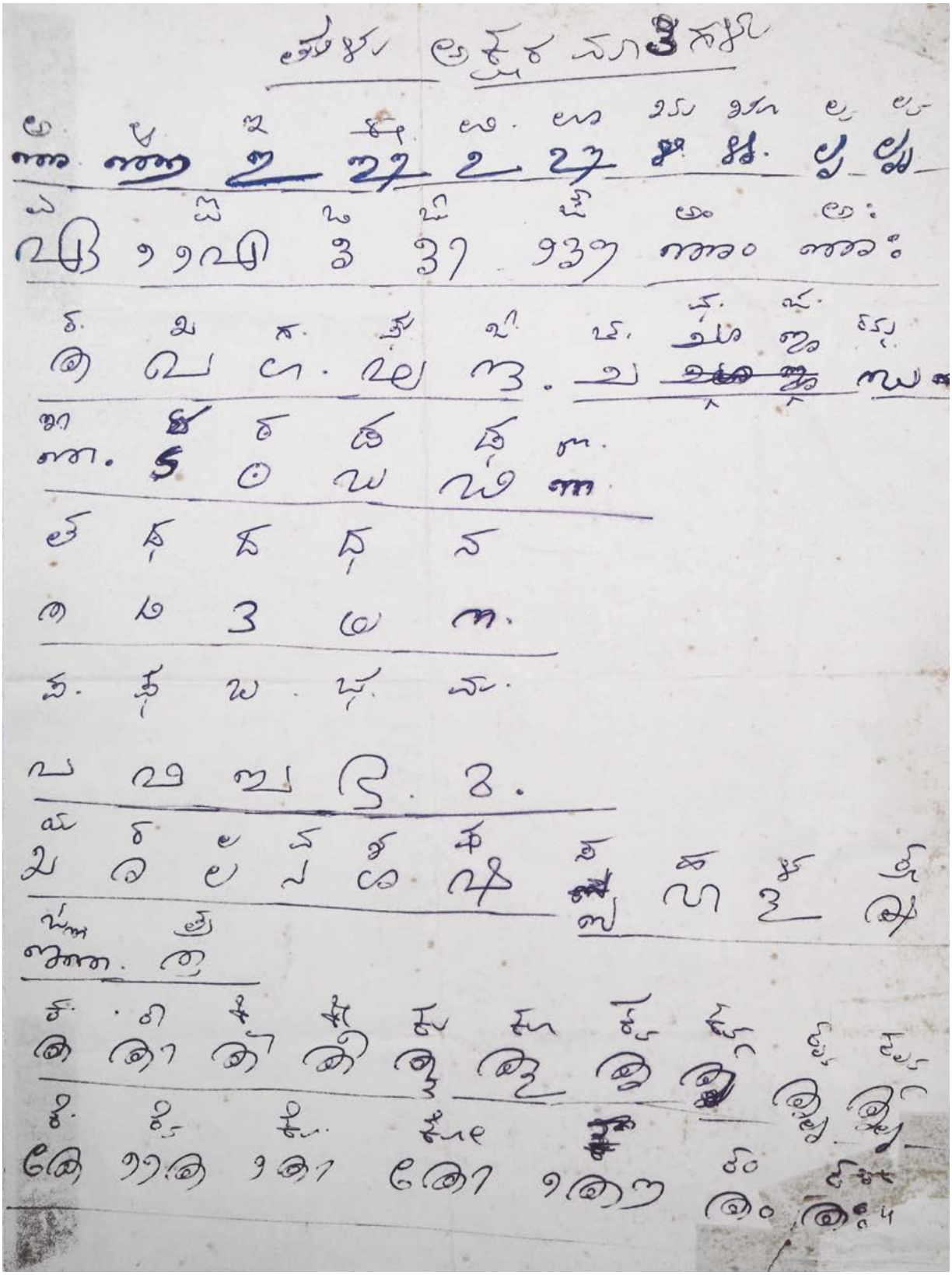


FIGURE 32.
Handwriting Sample of the Tulu-Tigalari character-set and vowel marks.
SOURCE
Poornaprajna Vidyapeetha, Bangalore.

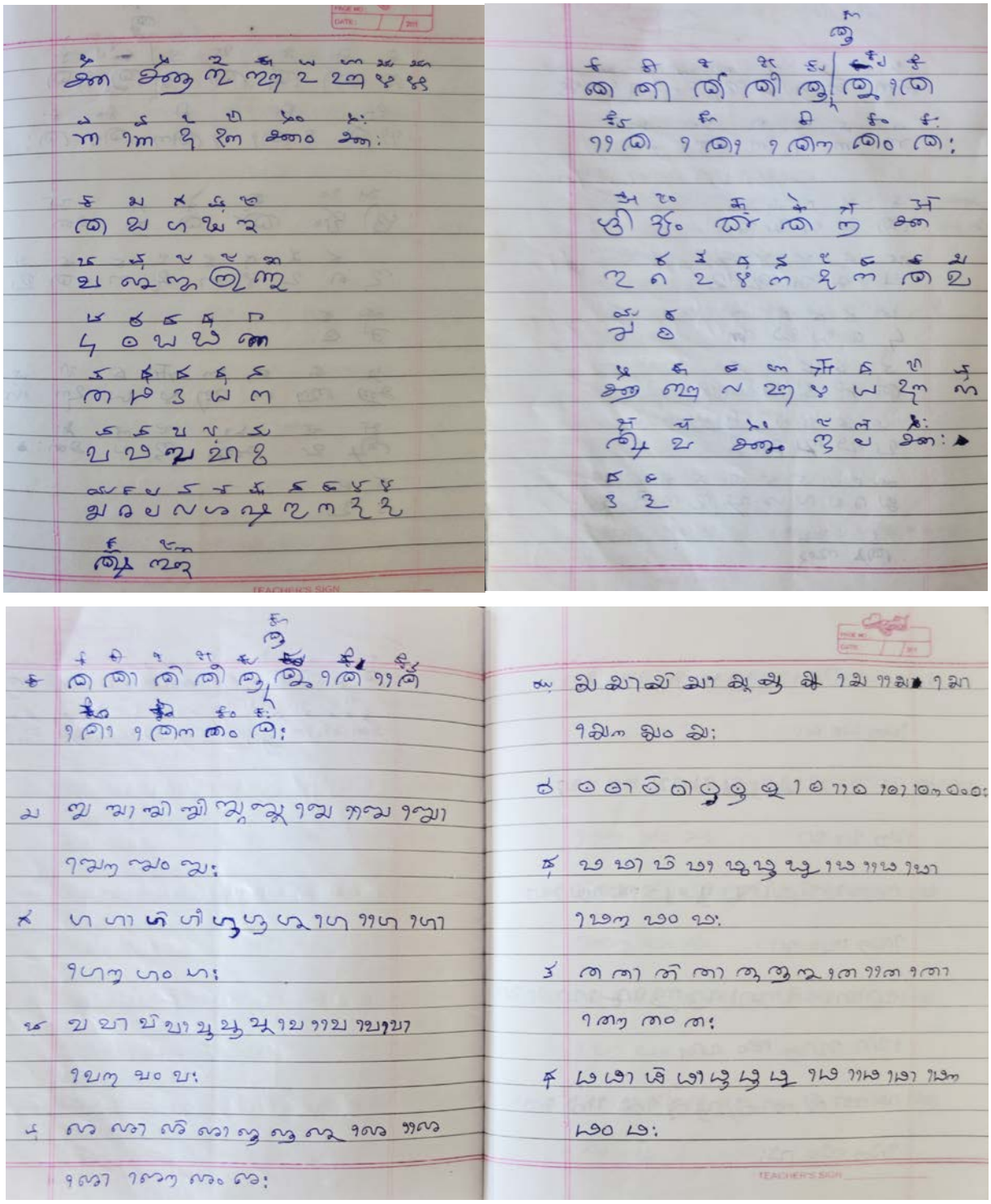


FIGURE 33.
Gunda Jois and his son, Venkatesh Jois established a Museum a Keladi that houses several Tigalarai manuscripts. They have studied this script for several years now. Images 33, 34 & 35 capture the Tulu-Tigalari orthography as seen in several manuscripts that were read by them.

SOURCE
From the personal notes of Dr Keladi Venkatesh Jois, Keladi Museum, Keladi.

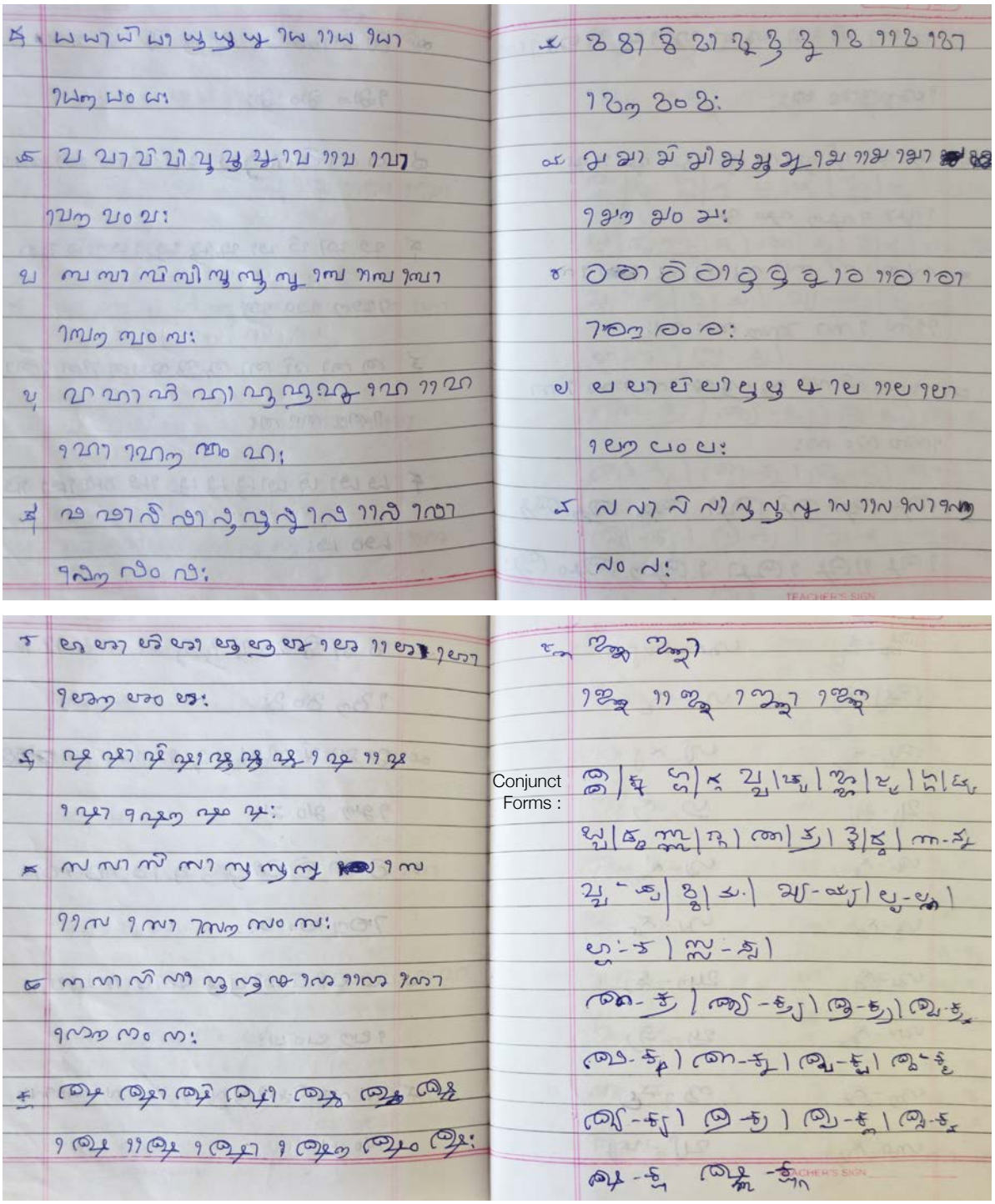


FIGURE 34.
Consonant+Vowel mark combinations and Conjunct forms in Tulu-Tigalari.
SOURCE
From the personal notes of Dr Keladi Venkatesh Jois, Keladi Museum, Keladi.

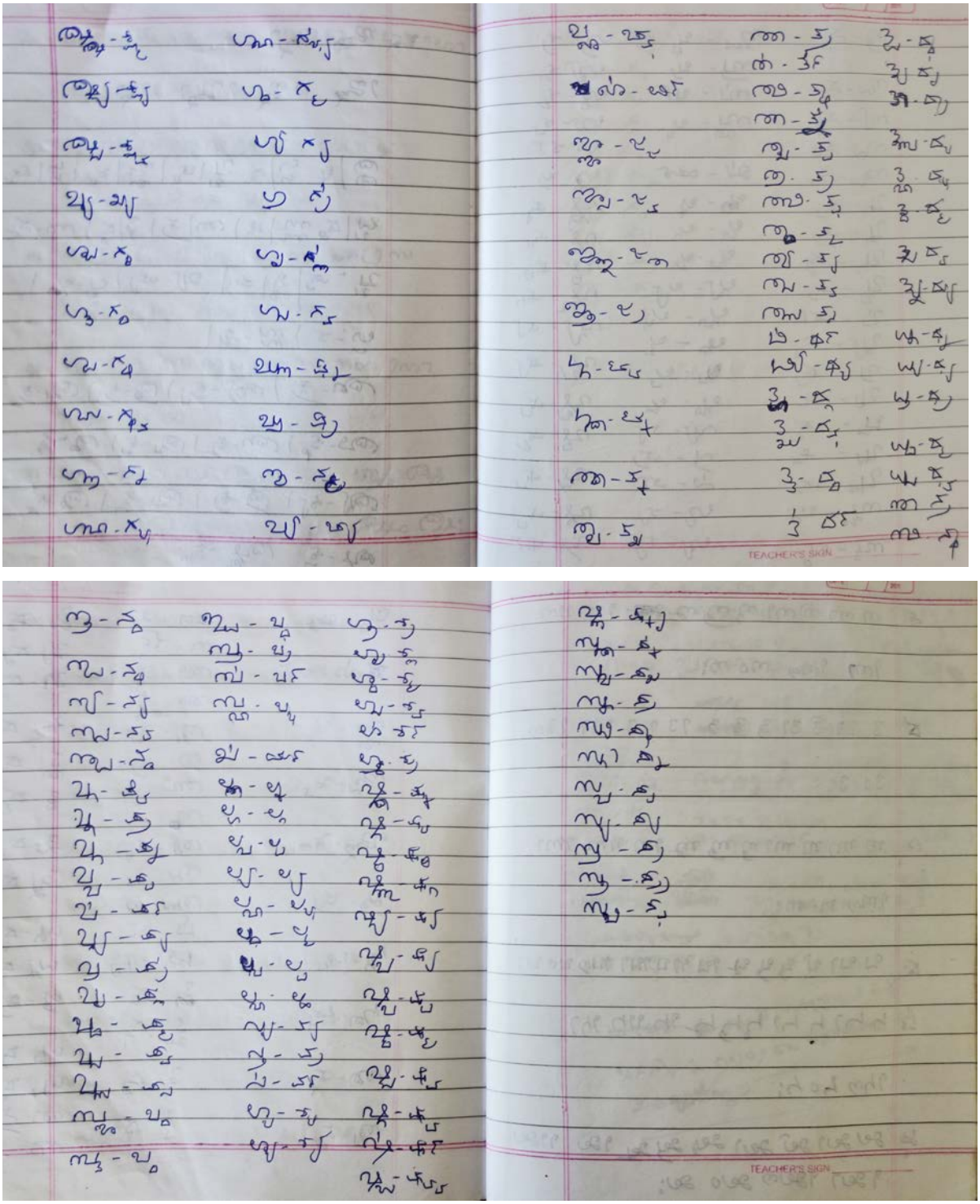


FIGURE 35.
Listing the conjunct forms in Tulu-Tigalari.
SOURCE
From the personal notes of Dr Keladi Venkatesh Jois, Keladi Museum, Keladi.

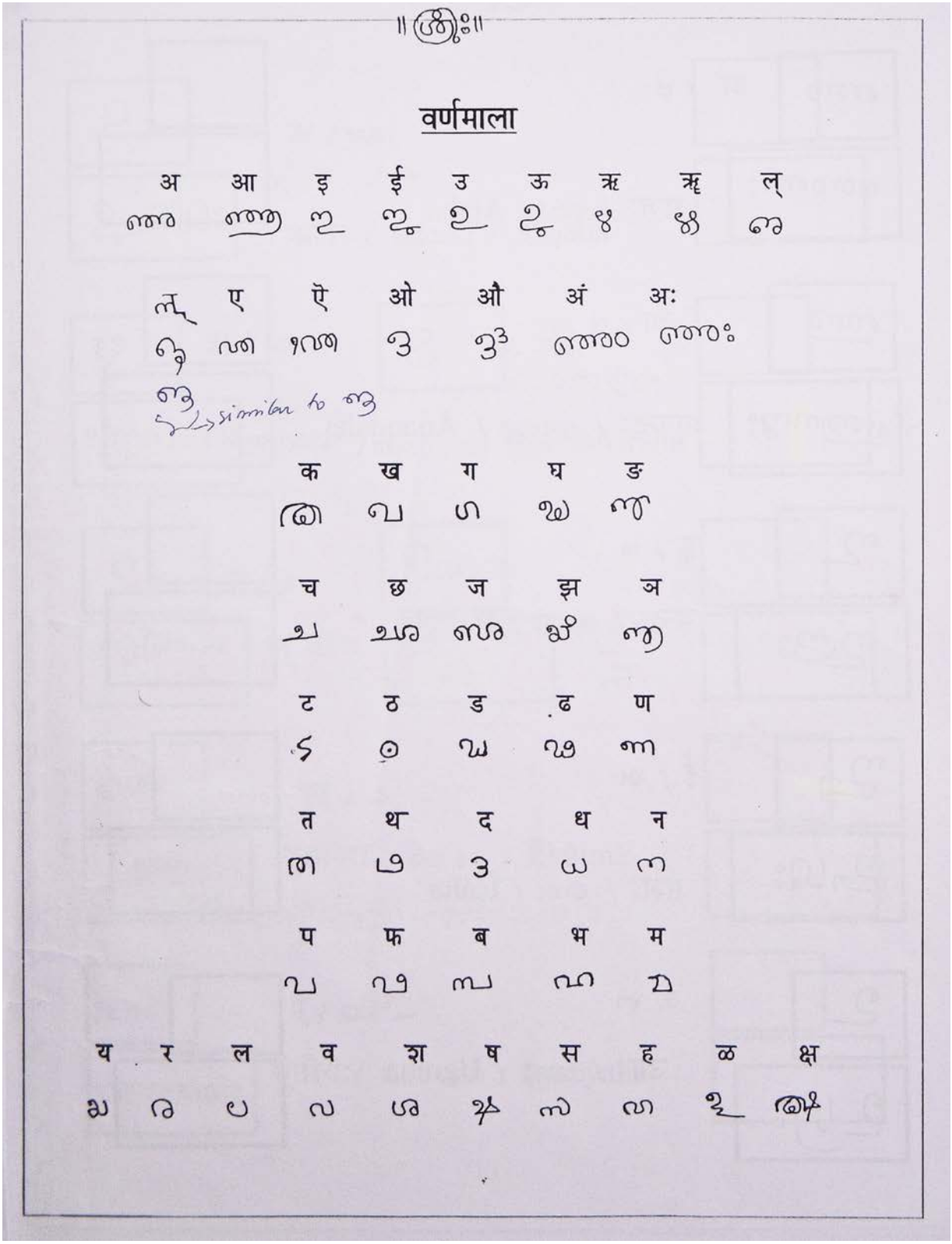


FIGURE 36.
Tulu-Tigalari script is being taught is several places in Bangalore and coastal Karnataka. The image above is a part of the teaching material used in one of these workshops conducted in Bangalore by ***Shrii*** Krishnaraja Bhat. His workshops are aimed at teaching this script primarily for Sanskrit language.
SOURCE
The Poornaprajna Samshodhana Mandiram, Bangalore.

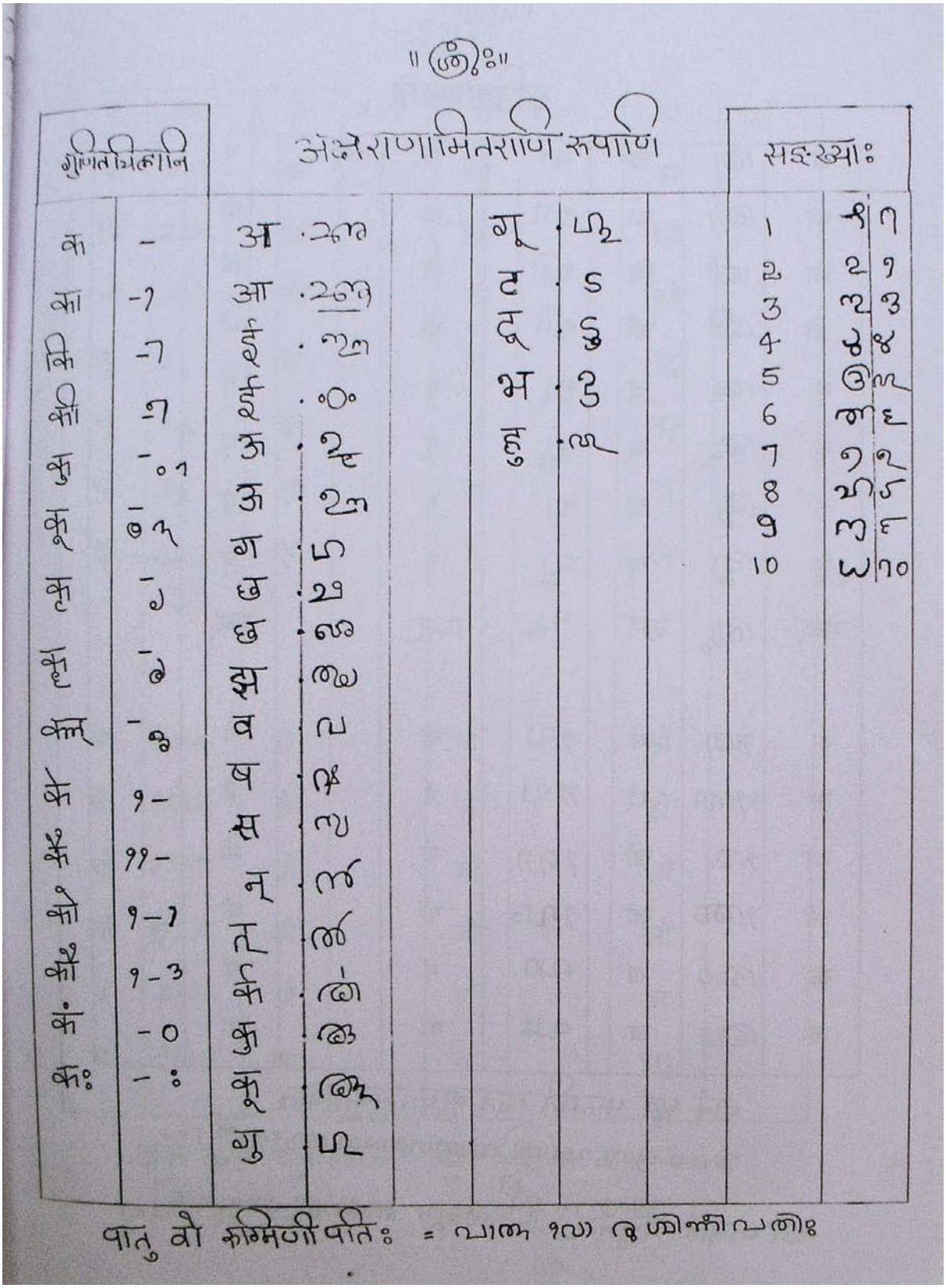


FIGURE 37.
Tulu-Tigalari vowel marks and ligatures. Belongs to the workshop hand-out set seen in the previous page.
SOURCE
The Poornaprajna Samshodhana Mandiram, Bangalore.

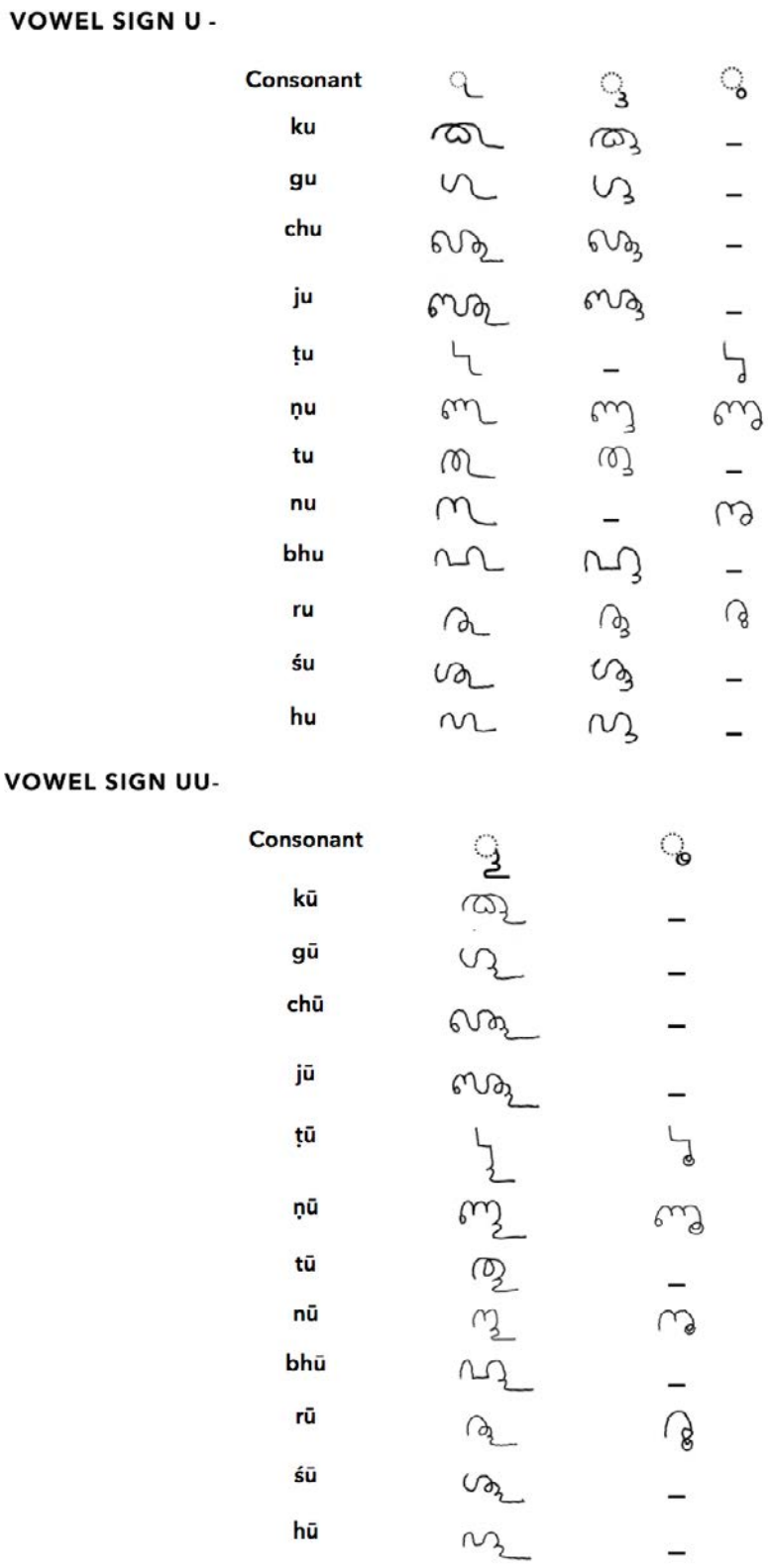


FIGURE 38.
Tulu-Tigalari vowel marks U and UU vary according to the characters they combine with. Also these forms change across manuscripts. This is a tabulated form of these variations put-together by Srinidhi A.

SOURCE
Srinidhi A.

ALPHABET

The letters of the alphabet adopted and the method of their transliteration.

	Kannada	Roman	Nearest English equivalent in pronunciation wherever available
Vowels:			
	ಁ	*ṵ*	
	ಂ	*ṵṵ*	
	ಅ	*a*	u of cut
	ಆ	*aa*	a of calm
	ಇ	*i*	i of bit
	ಈ	*ii*	ee of keep
	ಉ	*u*	u of put
	ಊ	*uu*	oo of shoot
	ಋ	*ṛ*	
	ೠ	*ṛṛ*	
	ಎ	*ϵ*	a of man
	ಏ	*ϵϵ*	a of mat
	ಐ	*e*	e of bet
	ಒ	*ee*	a of mate
	ಓ	*o*	o of obedience
	ಔ	*oo*	oa of coat
Dipthongs:			
	ಐ	*ai/ ei*	i of like ai of main
	ಅಯ್	*ayṵ/ ay*	
	ಅಯಿ	*ayi*	
	ಎಯಿ	*eyi*	
	ಔ	*au/ ou*	ov of love ov of stove
	ಅವ್	*avṵ/ av*	
	ಅವು	*avu*	
	ಒವು	*ovu*	
Stops unaspirated:	ಕ	*ka*	k of skin
	ಗ	*ga*	g of get
	ಚ	*ca*	ch of church
	ಜ	*ja*	j of jet
	ಟ	*ṭa*	t of heat (with the tip of the tongue curled back)
	ಡ	*ḍa*	d of curd (with the tip of the tongue curled back)

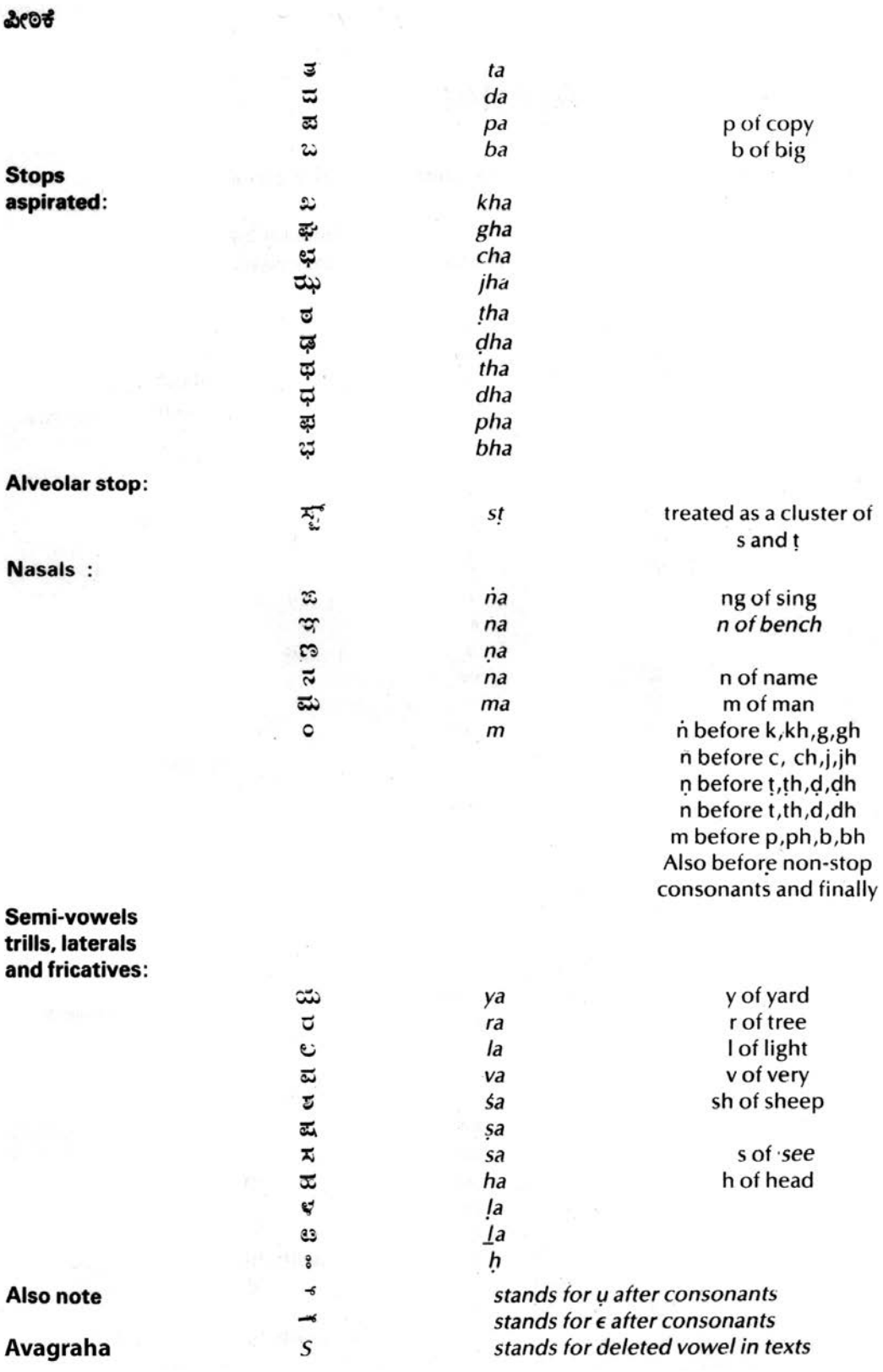
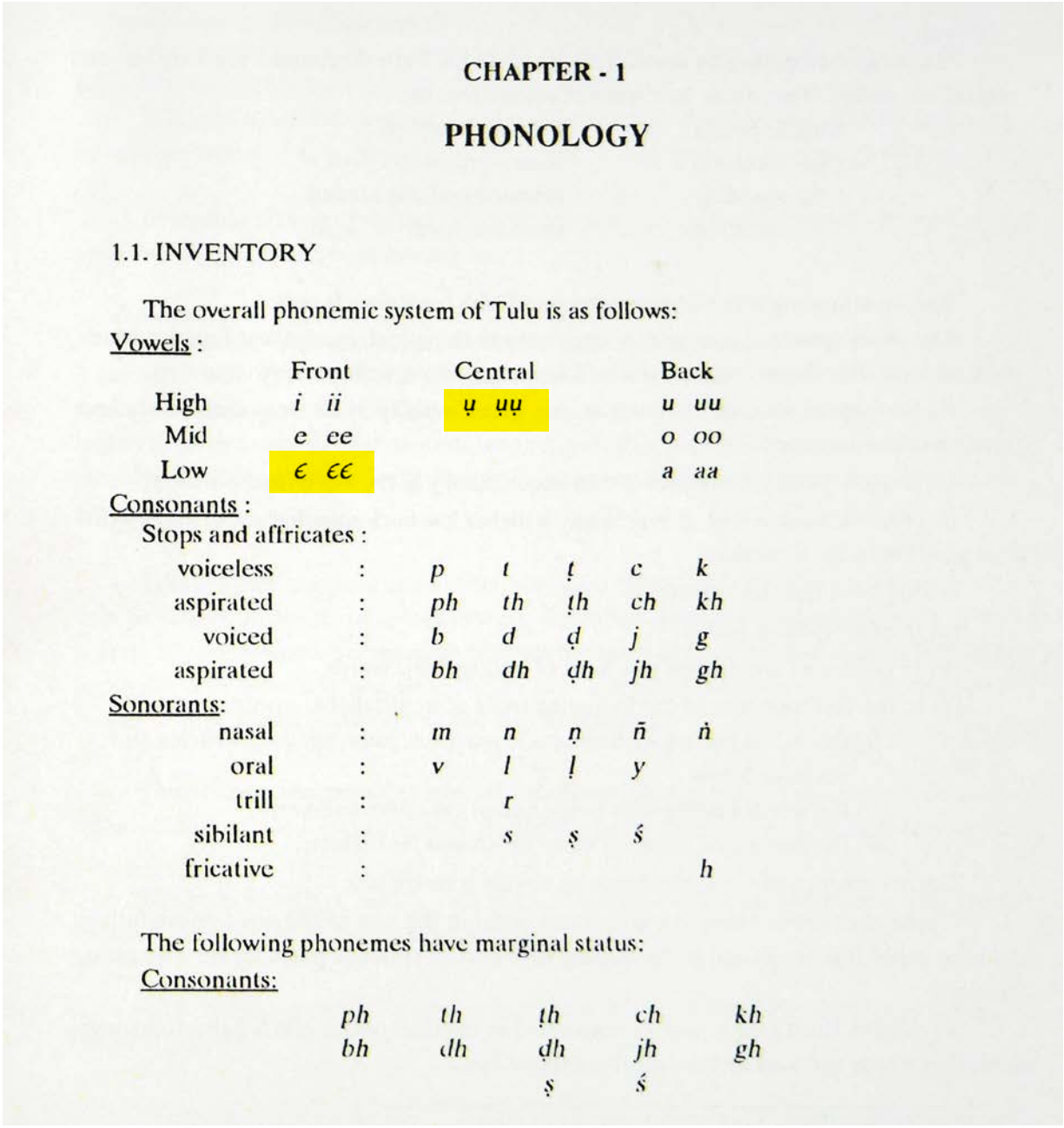


FIGURE 39.
(Previous page & Above) Tulu Orthography in Kannada Script as listed in the Tulu Lexicon. Tuḷu has a few additional vowels which are frequently used as discussed earlier: short un-rounded 'ụ' (A + *Virama*), long un-rounded 'ụụ' (AA + *Virama*) and short 'Ꭼ' (E + *Virama*), long 'ꬴ' (EE + *Virama*). These additional phonemes referred to in the above image are already being used in Kannada script for Tuḷu language.

SOURCE

Tulu Lexicon, Volumes 1-6, Rashtrakavi Govinda Pai Research Centre, M.G.M. College. 1988.



CHAPTER - 1

PHONOLOGY

1.1. INVENTORY

The overall phonemic system of Tulu is as follows:

Vowels :

	Front	Central	Back
High	*i ii*	*ụ ụụ*	*u uu*
Mid	*e ee*		*o oo*
Low	*ϵ ϵϵ*		*a aa*

Consonants :

Stops and affricates :

voiceless :	*p*	*t*	*ṭ*	*c*	*k*
aspirated :	*ph*	*th*	*ṭh*	*ch*	*kh*
voiced :	*b*	*d*	*ḍ*	*j*	*g*
aspirated :	*bh*	*dh*	*ḍh*	*jh*	*gh*

Sonorants:

nasal :	*m*	*n*	*ṇ*	*ñ*	*ṅ*
oral :	*v*	*l*	*ḷ*	*y*	
trill :		*r*			
sibilant :		*s*	*ṣ*	*ś*	
fricative :					*h*

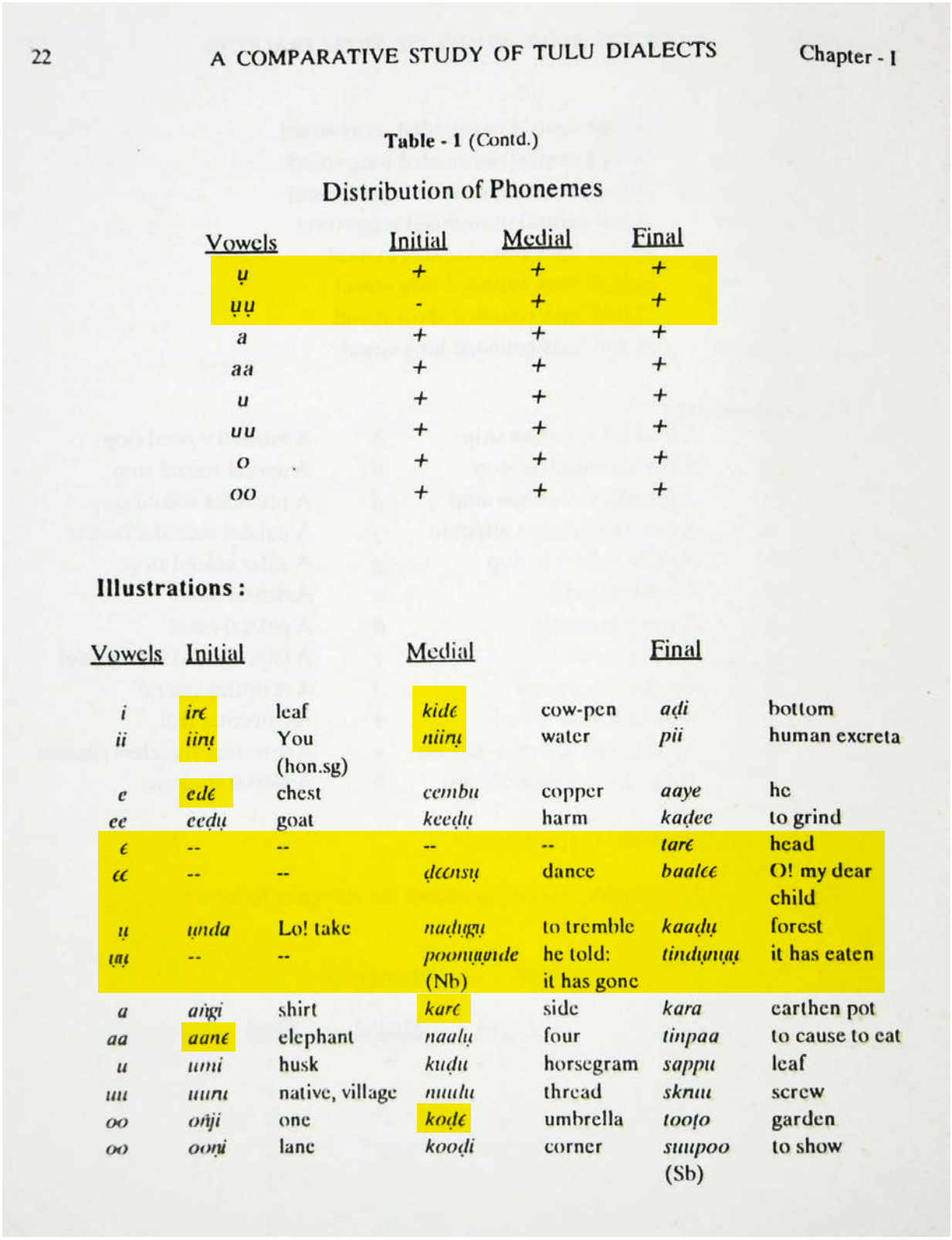
The following phonemes have marginal status:

Consonants:

ph	*th*	*ṭh*	*ch*	*kh*
bh	*dh*	*ḍh*	*jh*	*gh*
		ṣ	*ś*	

FIGURE 40.
Tulu language phonetic system. The additional phonetic values are listed here as-well. It is very useful to have these additional characters included in Tulu-Tigalari as-well.

SOURCE
Kekunnaya, Padmanabha. "Chapter 1." A Comparative Study of Tulu Dialects. Udupi, Karnataka: Rashtrakavi Govinda Pai Research Centre, 1994. 21. Print.



22 A COMPARATIVE STUDY OF TULU DIALECTS Chapter - I

Table - 1 (Contd.)

Distribution of Phonemes

Vowels	Initial	Medial	Final
ụ	+	+	+
ụụ	-	+	+
a	+	+	+
aa	+	+	+
u	+	+	+
uu	+	+	+
o	+	+	+
oo	+	+	+

Illustrations :

Vowels	Initial		Medial		Final	
i	*iṛɛ*	leaf	*kidɛ*	cow-pen	*aḍi*	bottom
ii	*iiṛụ*	You (hon.sg)	*niiṛụ*	water	*pii*	human excreta
e	*edɛ*	chest	*cembu*	copper	*aaye*	he
ee	*eeḍụ*	goat	*keeḍụ*	harm	*kaḍee*	to grind
ɛ	--	--	--	--	*taṛɛ*	head
ɛɛ	--	--	*ḍɛɛnsụ*	dance	*baalɛɛ*	O! my dear child
ụ	*ụnda*	Lo! take	*naḍụgụ*	to tremble	*kaaḍụ*	forest
ụụ	--	--	*poonụụnde* (Nb)	he told: it has gone	*tinḍụnụụ*	it has eaten
a	*aṅgi*	shirt	*karɛ*	side	*kara*	earthen pot
aa	*aanɛ*	elephant	*naalụ*	four	*tinpaa*	to cause to eat
u	*umi*	husk	*kuḍu*	horsegram	*sappu*	leaf
uu	*uuru*	native, village	*nuudu*	thread	*skruu*	screw
oo	*oṅji*	one	*koḍɛ*	umbrella	*tooṭo*	garden
oo	*ooṇi*	lane	*kooḍi*	corner	*suupoo* (Sb)	to show

FIGURE 41.

Analysis and examples of Tulu special vowels ɵ & ɵ: in Tulu language.

SOURCE

Kekunnaya, Padmanabha. "Chapter 1." A Comparative Study of Tulu Dialects. Udupi, Karnataka: Rashtrakavi Govinda Pai Research Centre, 1994. 22. Print.

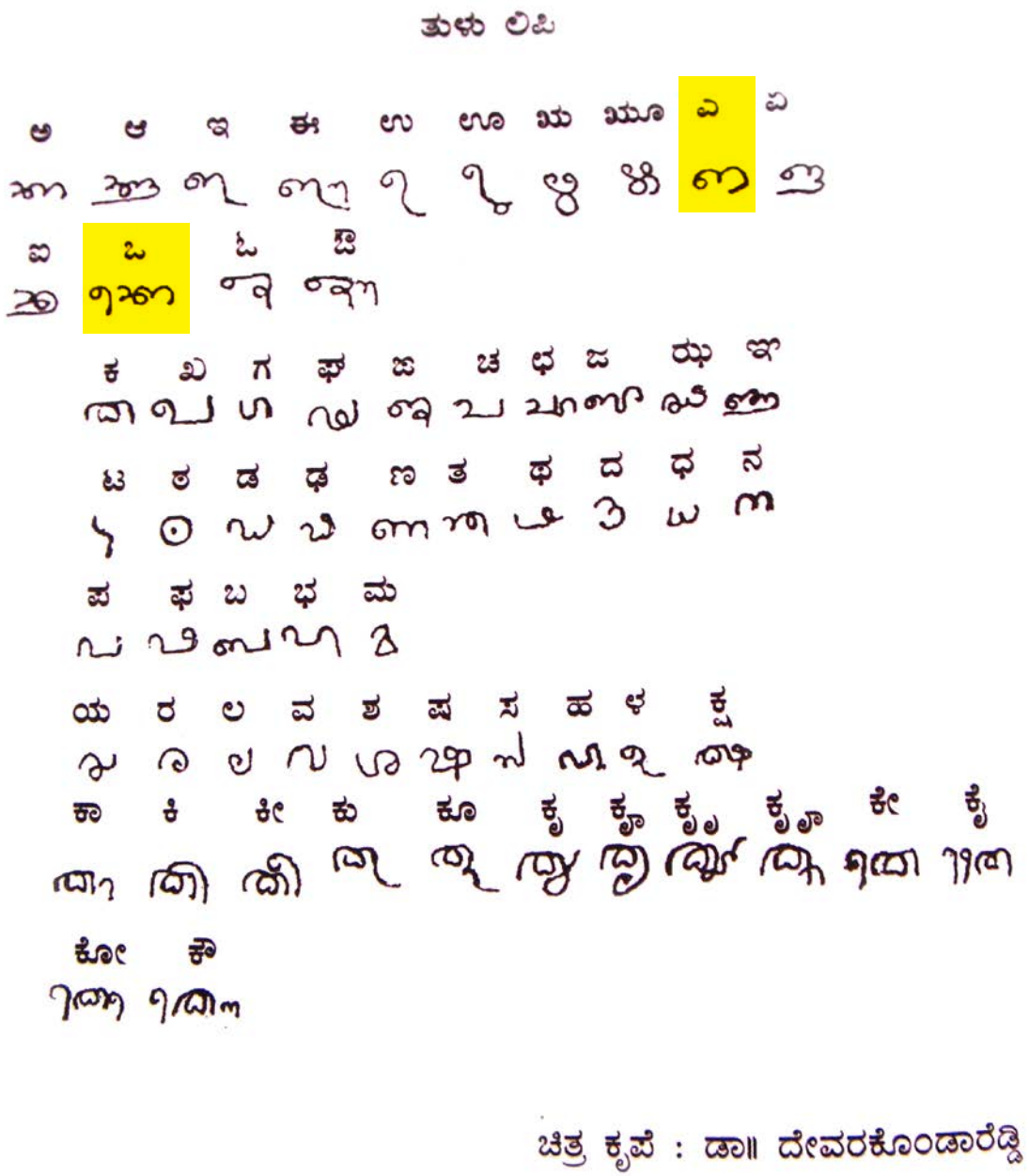


FIGURE 42.
Additional Tulu-Tigalari vowels E and O as proposed by Dr Devarakonda Reddy. The need for these two characters have been clearly stated here. However, the character shapes experimented with in the above image disrupt the traditional Tulu-Tigalari character representation. Vowels EE & AI assume new forms. Vowel O is replaced by AI character shape.

SOURCE
Hasthaprathi Adhyayana, Samavesha Sanghatana, Volume 1, Page 60, 2012.
This image credits (source) for this is given to Dr. Devarakonda Reddy below this publication.

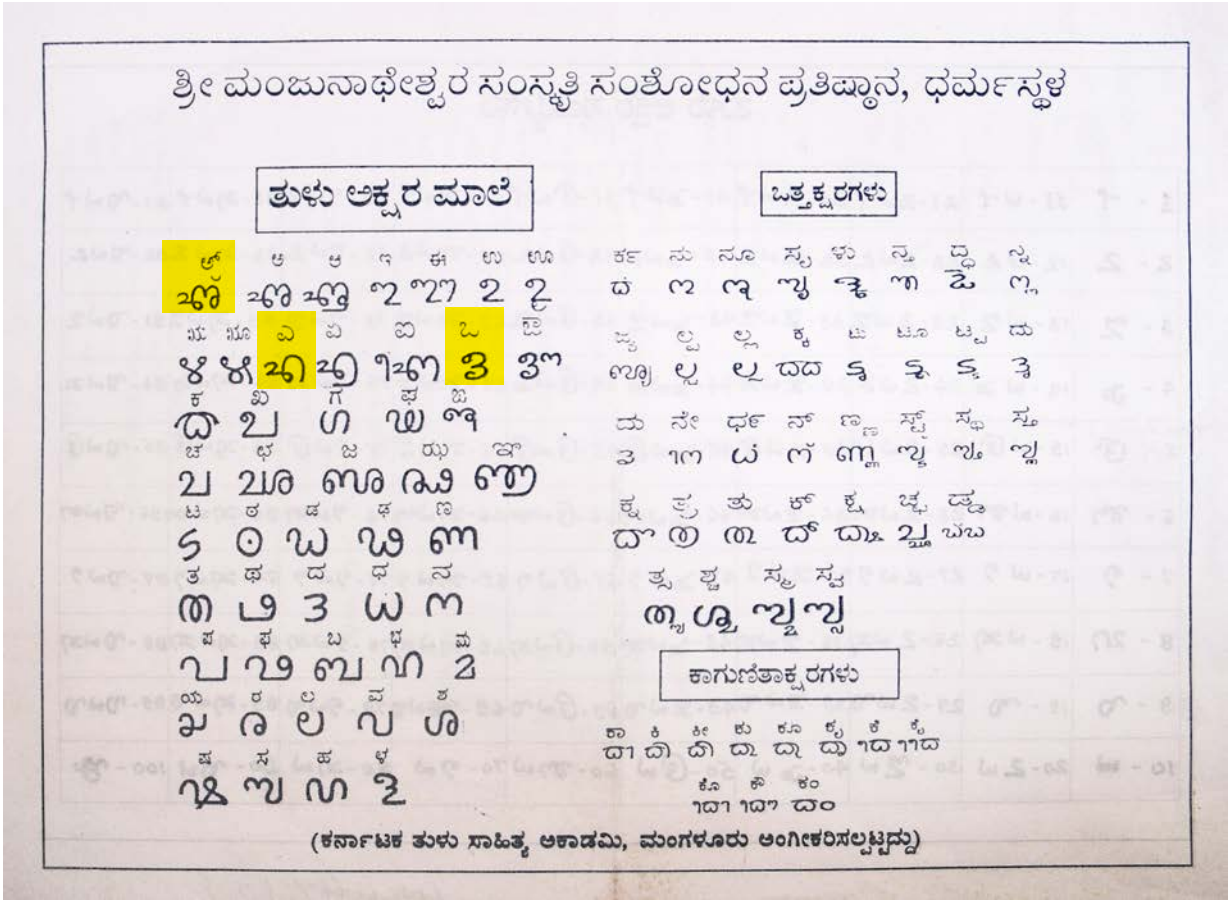


FIGURE 43.
Leaflet distributed by Dharmasthala Samshodana Pratishtana, Dharmasthala to encourage the adoption of Tulu-Tigalari script for Tulu language. Here we see the recently added vowel E as proposed by S R Vighnaraj. Also the Tigalari long vowel OO is interpreted as short vowel O. This is a mistake that might have arisen from the author's familiarity with the Malayalam script. A + *Virama* combination is also included.

SOURCE

Dr S R Vighnaraj, Dharmasthala Samshodana Pratishtana, Dharmasthala.

FIGURE 44.1.
Tulu-Tigalari (Tulu lipi) characters provided as reference along with the digitised Tulu language manuscripts. Here we once again see the characters proposed by S R Vighnaraj.

SOURCE

S.A. Krishnaiah, Oriental Research Centre and Gallery, Udupi.

Parishkrutha Tulu Lipi
By Dr. Radhakrishna Belluru
Kasaragod, 2009

S. A. Krishniah
Udupi

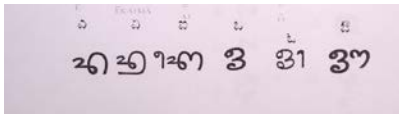


FIGURE 44.2.
E & O

SOURCE

Puninchathaya, Venkataraja. (Cropped scans frrom several pages)
Tulu Lipi. Mangalore, Karnataka Tulu Sahitya Academy. Print.

FIGURE 45.
Tulu-Tigalari (Tulu lipi) primer 'Tulu Aksharamaale' published by Karnataka Tulu Sahithya Academy (Pg. 7, 13, 21, 26); Mangalore. The characters and orthography seen here is once again roughly based on Puninchattaya's work published as a book called 'Tulu Lipi'. The glyph shapes appear to be the similar to Figure 44 and carries forward the same errors.

SOURCE
http://www.tuluacademy.org/en/category/tulu-alphabets/

ಪಾಠ ೧

ತುಳು	ಕನ್ನಡ
ೂ	ಲೂ
ೂ	ಅ
ೂ	ಆ
೧	ಇ
೧೧	ಈ
೭	ಉ
೭	ಊ

ತುಳು	ಕನ್ನಡ
೪	ಯ
ೂ	ಏ
೧ೂ	ಐ
೨	ಓ
೨೧	ಔ
ೂಂ	ಅಂ
ೂಃ	ಅಃ

ತುಳು ಲಿಪಿ / 7

ಪಾಠ ೨

ತುಳು	ಕನ್ನಡ
ಡಾ	ಕ
ಬ	ಖ
ಗ	ಗ
ಘ	ಘ
ಇ	ಙ
ಎ	ಚ
ಏ	ಛ

ತುಳು	ಕನ್ನಡ
೨ೂ	ಜ
೨ಳ	ಝ
೨೧	ಞ
೬	ಟ
೦	ಠ
ಚ	ಡ
ಚಿ	ಢ

ತುಳು ಲಿಪಿ / 9

ಪಾಠ ೩

ತುಳು	ಕನ್ನಡ
೧೧	ಣ
ಠಾ	ತ
ಟಿ	ಥ
ತ	ದ
ಡ	ಧ
೧	ನ
ಒ	ಪ

ತುಳು	ಕನ್ನಡ
ಒ	ಫ
ಒ	ಬ
ಒ	ಭ
೬	ಭ
೭	ಮ

ತುಳು	ಕನ್ನಡ
೫	ಯ
೧	ರ
ಲ	ಲ
ವ	ವ
೨	ಶ

ತುಳು	ಕನ್ನಡ
೫	ಷ
೫	ಸ
೨	ಹ
೫	ಳ
೬	ಱ

ತುಳು ಲಿಪಿ / 11

FIGURE 46.
(Previous Page & Current Page)
The first ever book published solely to teach Tigaglari script by Venkataraja Puninchathaya on which several later Tulu-Tigalari characters were based. This book also popularied the term 'Tulu Script' for Tulu-Tigalari

SOURCE
Puninchathaya, Venkataraja. (Cropped scans frrom several pages) Tulu Lipi. Mangalore, Karnataka Tulu Sahitya Academy. Print.

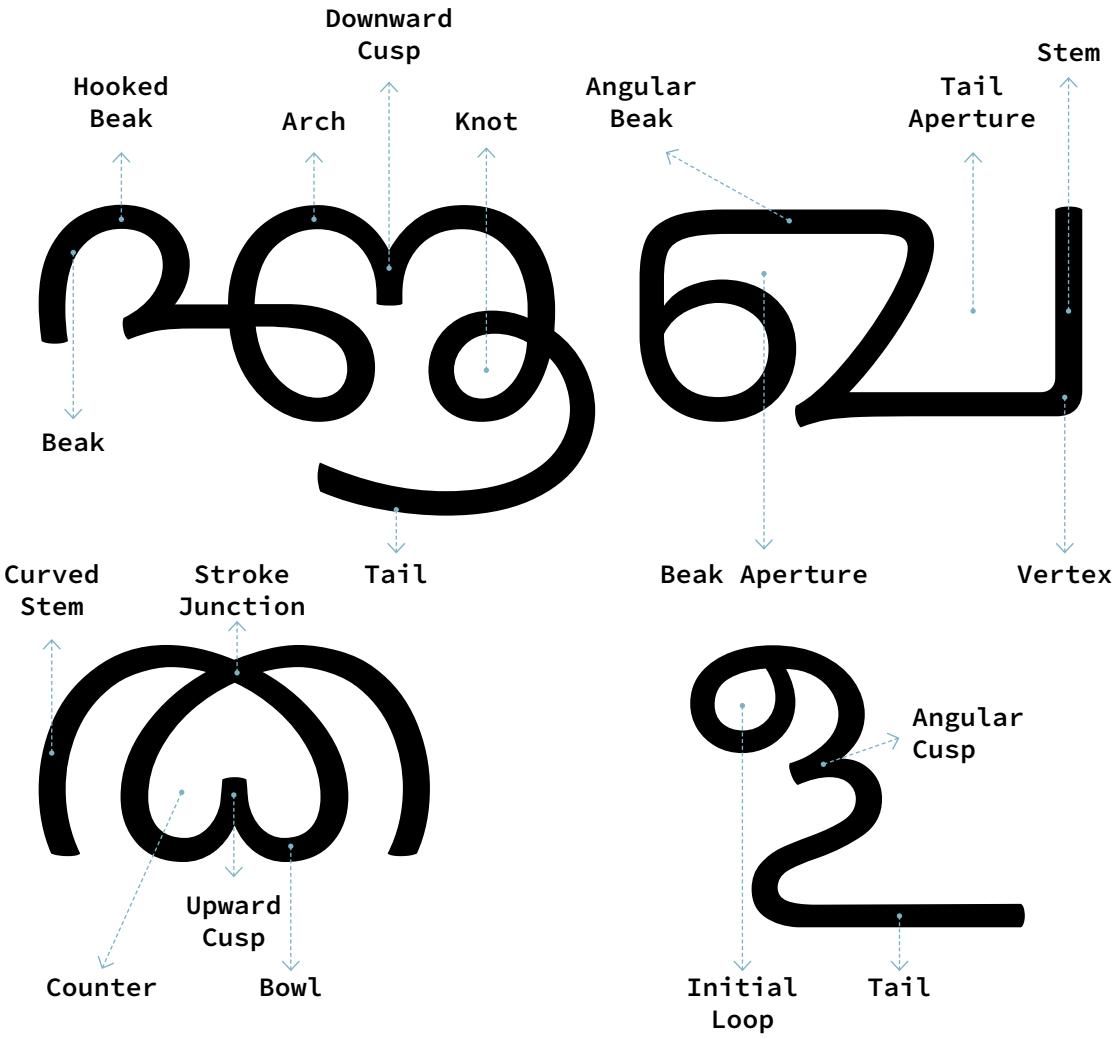


FIGURE 47.
Tulu-Tigalari character anatomy.