L2/01-037

Unicode for Kannada Script

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Unicode for Kannada

1.1 Introduction

The Kannada script is a South Indian script. It is used to write Kannada language of Karnataka State in India. This is also used in many parts of Tamil Nadu, Kerala, Andhra Pradesh and Maharashtra. The Writing system that employs Kannada script constitutes a cross between syllabic writing systems and phonemic writing systems (alphabets). The effective unit of writing Kannada is the orthographic syllable consisting of a consonant and vowel (CV) core and optionally, one or more preceding consonants, with a canonical structure of (CC) CCV. The orthographic syllable need not correspond exactly with a phonological syllable, especially when a consonant cluster is involved, but the writing system is built on phonological principles and tends to correspond quite closely to pronunciation.

The orthographic syllable is built up of alphabetic pieces, the actual letters of Kannada script. These consist of distinct character types: Consonant letters, independent vowels and the corresponding dependent vowel signs. In a text sequence, these characters are stored in logical phonetic order.

1.2 Rendering Kannada Characters

Kannada characters can combine or change shape depending on their context. A character's appearance is affected by its ordering with respect to other characters and the application or system environment. This variable can cause the appearance of Kannada characters to be different from nominal glyphs (used in the code charts).

1.3 Vowels (*Swaras*)

1.3.1 Independent vowel letters

The independent vowels (*Swaras*) in Kannada are letters that stand on their own. The writing system treats independent vowels as orthographic CV syllables in which the consonant is null. The independent vowel letters are used to write syllables, which start with a vowel.

The Unicode character encoding for Kannada uses a distinct set of naming conventions for some mid vowels of the fourteen vowels in Kannada. Of these fourteen vowels, twelve vowels have been divided into six sets, each set consisting of a short vowel, followed by a corresponding long vowel.

1.3.2 Dependent vowel signs (*Matras*)

The dependent vowels, also known as *Swaras* in Kannada, serve as the common manner of writing non-inherent vowels and are generally referred to as *Swara Chinhas* or *Matras* in Kannada. The dependent vowels do not appear stand-alone; rather, they are visibly depicted in combination with a base-letter form (generally a consonant). A single consonant or a consonant cluster may have a dependent vowel applied to it to indicate the vowel quality of the syllable, when it is different from the inherent vowel. Explicit appearance of a dependent vowel in a syllable overrides the inherent vowel ಅ (U+0C85) of a single consonant letter.

There are several variations with which the dependent vowels are applied to the base letterforms. Most of them appear as non-spacing dependent vowel signs when applied to base letterforms; above or to the right side of a consonant letter or a consonant cluster. The following are the exceptions and variations for the above rule:

- The two dependent vowel signs (U+0CC3 & U+0CC4) appear one level below and to the right of the consonant or the consonant cluster, separated by a small white space.
- Each of the five dependent vowels (U+0CC0, U+0CC7, U+0CC8, U+0CCA & U+0CCB) are depicted by two or three glyph components (two part or three part vowel signs) with one component appearing with a space to the right of the consonant or the consonant cluster.
  i) In the case of three of the above-mentioned two/three-part dependent vowels (at U+0CC0, U+0CC7, U+0CCB), the non-spacing component(s) of each of them is(are) the same as the vowel sign(s) of the corresponding preceding short vowels. The spacing component for each of these dependent vowels is the same 'length mark U+0CD5 (ೕ) given in Unicode version 3. The logic for this is that these dependent vowels are nothing but the long forms (independent and phonetically distinct) of the preceding short vowels.
  ii) The first component of the dependent vowel (U+0CC8) mentioned above, is the same as the dependent vowel (ೈ, U+0CC6) with the second component (ೖ, U+0CD6) defined independently in Unicode version 3. The second part appears slightly below and to the right of the consonant or the consonant clusters.
- **In view of this, it is important to note that the two glyphs (the length mark ೕ and the second component of ೈ i.e. ೖ) represented with the codes at U+0CD5 and U+0CD6 in Unicode version 3 have no independent existence and do not play any part as independent codes in the collation algorithm.**
- Unlike Devanagari, the Kannada script does not have any character with a left-side dependent vowel sign.
- A one-to-one correspondence exists between independent vowels and dependent vowel signs.

1.4 Consonant letters

Each of the consonant letters represents a single consonantal sound but also has the peculiarity of having an inherent vowel, generally the short vowel ಅ (U+0C85).

Thus, U+0C95 Kannada letter KA represents not just K (ಕ್) but KA (ಕ). In the presence of a dependent vowel, however, the inherent vowel associated with a consonant letter is overridden by the dependent vowel.

1.5 Encoding order

The traditional Kannada alphabetic encoding order for consonants follows articulatory phonetic principles, starting with velar consonants and moving forward to bilabial consonants, followed by liquids and then fricatives. ISCII (Indian Script Code for Information Interchange) & the Unicode standard both observe this traditional order.

1.6 *Halant* (*Virama*)

Like Devanagari, Kannada script also employs a sign known as *halant*, *virama* or vowel omission sign. A halant sign (್, U+0CCD) nominally serves to cancel (or kill) the inherent vowel of the consonant to which it is applied.

The *halant* functions as a combining character. When a consonant has lost its inherent vowel by the application of *halant*, it is known as a dead consonant. The dead consonants are

the presentation forms used to depict the consonants without an inherent vowel. Their rendered forms in Kannada resemble the full consonant with the vertical stem replaced by the *halant* sign, which marks a character core. The stem glyph is graphically and historically related to the sign denoting the inherent /a/ (ಅ) vowel (U+0C85). In contrast, a live consonant is a consonant that retains its inherent vowel or is written with an explicit dependent vowel sign. The dead consonant is defined as a sequence consisting of a consonant letter followed by a *halant* (*virama*). The default rendering for a dead consonant is to position the *halant* as a combining mark bound to the consonant letterform.

1.7 Consonant conjuncts

Like any other Indian script, Kannada is also noted for a large number of consonant conjunct forms that serve as orthographic abbreviations (ligatures) of two or more adjacent forms. This abbreviation takes place only in the context of a consonant cluster. An orthographic consonant cluster is defined as a sequence of characters that represent one or more dead consonants (denoted by C_d) followed by a normal live consonant (denoted by C_l).

Corresponding to each Kannada consonant, there exists a separate and unique glyph, which is specially used to represent the corresponding consonant in a consonant cluster. Most of these conjunct consonant glyphs resemble their original consonant forms (many without the implicit vowel sign, wherever applicable).

In Kannada, there is only one type of conjunct formation (consonant cluster) and it is depicted as follows:

- The first consonant of the consonant cluster is rendered with the implicit or a different dependant vowel appearing as the terminal element of the consonant cluster.
- The remaining consonants (consonants in between the first consonant and the terminal vowel element) appear in conjunct consonant glyph forms in the phonetic order. They are generally depicted directly below or sometimes below but to the right of the first consonant.

Thus, the systematically designed Kannada script font contains the conjunct glyph components, but they are not encoded as Unicode characters, because they are the resultant of ligation of distinct letters. Kannada script rendering software must be able to map appropriate combinations of characters in context to the appropriate conjunct glyphs in fonts.

1.8 Memory Representations and Rendering Order

The order for storage of plain text in Kannada generally follows the phonetic order, that is, a CV syllable with a dependant vowel is always encoded as a consonant letter C followed by a vowel sign V in the memory representation. This order is employed by the ISCII standard and corresponds with phonetic and keying order of textual data. Unlike Devanagari and some other Indian Scripts, all the dependent vowels in Kannada are depicted to the right of their consonant letters. Hence there is no need to reorder the elements in mapping from the logical (character) store to the presentation (glyph) rendering and vice versa.

Character order		Glyph order
$KA_n + I_{ivs}$	⟶	$KA_n + I_{ivs}$
ಕ + ೃ	⟶	ಕೃ

Further, Kannada script does not allow half-consonants, ligatures and half ligature forms.

1.9 Rules for Rendering

The following provides more formal and complete rules for minimal rendering of Kannada as part of a plain text sequence. It describes the mapping between Unicode

characters and the glyphs in a Kannada font. It also describes the combining and ordering of those glyphs.

ಕ → ಕ kA$_l$

ಕ + ್ → ಕ್ kA$_d$

ಕ + ್ + ಕ → ಕ್ಕ (Conjunct consonant glyph is ್ಕ)

The rules provide minimal requirements for legibly rendering Kannada text. As with any script, a more complex procedure can add rendering characteristics, depending on the font and application.

It is important to emphasize that in a font that is capable of rendering Kannada, the set of glyphs is greater than the number of Kannada Unicode characters.

1.10 Invisible consonant INV

There is a need to have a consonant, which provides an invisible base for the display of dependant vowels without any consonant base. This can be the Unicode Standard Zero Width Non-Joiner at U+200C. This can also be used to provide proper collation of the words containing dead consonants.

1.11 Explicit *Halant* (*Virama*)

Normally, a halant character serves to create dead consonants, which, in turn, combine with subsequent consonants in order to form conjuncts. This behavior usually results in a *halant* sign not being depicted visually. Occasionally, however, this default behavior is not desired when a dead consonant should be excluded from conjunct formation, in which case the *halant* sign is visibly rendered.

In order to accomplish this, the Unicode Standard character U+200C (Zero Width Non-Joiner) is introduced immediately after the encoded dead consonant that is to be excluded from conjunct formation.

For example, the use of Zero Width Non-Joiner prevents the default formation of the conjunct form ್ಗ, resulting in ್‌ಗ.

The Kannada script adopts the convention of depicting the character (in this case the halant sign) as appropriate for the consonant to which it is attached.

In summary, each Kannada consonant may be encoded such that it denotes a live consonant, a dead consonant or a conjunct consonant glyph.

1.12 Consonant Clusters with two different display forms

Whenever a consonant cluster is formed with the Kannada consonant letter RA (ರ, U + 0CB0) as the first component of the consonant cluster, this letter RA is depicted with two different presentation forms: one as the initial and the other as the final display element of the consonant cluster as detailed below.

- **Consonant RA rules:**
  Whenever a conjunct of consonant clusters is formed with the consonant character ರ (U+0CB0) as the first element of the conjugate cluster, there exist the following two different display forms of the conjunct.
  1. As explained before, the character ರ is rendered with the terminal vowel (implicit or dependent) and the in-between consonants are rendered below and/or to the right of ರ, in conjunct consonant glyph forms (ರ್ , ರ್‌ etc.).

2. In the alternate representation method also, the above procedure is followed assuming ರ is absent (which means that the conjunct formation starts from the second consonant) to obtain the conjunct (consonant cluster). This is followed by another distinct glyph ಽ for ರ್ and this new glyph is depicted to the extreme right of the conjunct formed above. As per this representation, the conjuncts ರ್ಕ and ರ್ಗ are rendered as ಕಽ and ಗಽ. This procedure is applied for all the conjuncts with the consonant ರ as the first element, but with an exception. The exception for this rule is that, whenever a conjunct is formed using ರ with ರ itself, the first method of rendering the conjunct is followed. This means, only ರ್ರ is allowed (method 1) and not ರಽ (method 2).

- The second case of rendering the same character in two different display forms is the dead consonant ನ್(0CA8 with *halant*). It is also written in a second form as ಌ.

Sorting issue in these two cases is discussed in the sorting section of this document.

1.13 Modifier Mark Rules

In addition to the vowel signs, one more type of combining mark may be applied to a component of an orthographic syllable or the syllable as a whole. The *NUKTA* sign, which modifies a consonant form, is placed immediately after the consonant (after the terminating vowel in case of a dependent vowel appearing after the consonant) in the memory representation and is attached to that consonant in rendering. If the consonant represents a dead consonant, then the *nukta* should precede halant in the memory representation. The *nukta* is represented by a double-dot mark placed at the location U+0CBC. Two such modified consonants used in Kannada are ಫ಼ (Pronounced as ZA) and ಜ಼ (Pronounced as FA).

1.14 Diacritics

Diacritics are the principle class of non-spacing combining characters used with the Indian scripts. Diacritic is defined very broadly to include accents as well as other non-spacing marks. Kannada has a number of combining marks that could be considered diacritic. A set of five combining marks *Anudattha* (@N® below the character), *Swaritha* (#N® above the character), *Deergha Swaritha* ($N® above the character), *Guru* (&N® above the character) and *Laghu* (^N® above the character) located at 0CD0, 0CD1, 0CD2, 0CD3 and 0CD4 are used in the transcription of Sanskrit texts (where ever needed) and for Kannada grammatical notations.

1.15 *Avagraha* sign

A spacing mark ऽ, called *avagraha* sign is used while rendering Sanskrit texts. This is located at U+0CBD**.**

Part-2
Sorting issues in Kannada

The sorting sequence for Kannada in Unicode is as per the collation chart enclosed with this document. However, the following are some important issues, which have to be addressed separately for proper sorting of data in Kannada.

ISCII – 91 provides direct sorting through its codes. It is the natural sorting method just based on code values. There are no special algorithms for language specific issues for sorting the data. This results in non-conventional sorting in some specific cases. The scholars in Kannada have specified the sorting standards in Kannada. These standards are being followed in all dictionaries and other documents in Kannada. With this in view, the following four special cases have been identified.

2.1 **Sorting of *Nukta* characters**

The modifying mark or *Nukta* located at 0CBC and included in the collation table is enough to take care of the sorting issues of characters ಜ಼ (modified ಜ) and ಫ಼ (modified ಫ). It also takes care of any other consonant, which may be modified using *Nukta.*

2.2 **Sorting the data records containing *anuswara*** and ***visarga***

- Sorting a data set containing words **terminating with *anuswara, Visraga* together with other words.** In such cases, words without terminating dependent vowels are placed in wrong positions. The following list compares the sorting of a sample set of data containing 10 words using Unicode table with and the acceptable sorting.

Sorted data as per Unicode		Acceptable sorting	
1	ನಯಕಃ	1	ನಯಕಃ
2	ನಯಗ	2	ನಯಗ
3	ನರಕ	5	ನರಕಂ
4	ನರಗ	6	ನರಕಃ
5	ನರಕಂ	3	ನರಕ
6	ನರಕಃ	7	ನರಕಾ
7	ನರಕಾ	8	ನರಗಂ
8	ನರಗಂ	9	ನರಗಃ
9	ನರಗಃ	4	ನರಗ
A	ನರಗೈ	A	ನರಗೈ

- Sorting sequence as per the Unicode is according to the specified standards if the *anuswara* and *visarga* appear within a word.

2.3 Sorting of words with dead consonants

- **Sorting of words terminating with dead consonants**
  Sorting in this case also violates the sorting rules of Kannada. The Unicode sorting places the word terminating with the dead consonant at the end of the list. The following list compares the sorting of a sample data using Unicode table and the acceptable sorting for this case.

Sorted data as per Unicode	Acceptable sorting
ರಾಕ	ರಾಕ್
ರಾಕ್	ರಾಕ
ರಾಗ	ರಾಗ್
ರಾಗೋ	ರಾಗ
ರಾಗ್	ರಾಗೋ

- **Dead consonants within words**
  Proper sorting of data with such words can be achieved by using the invisible zero width consonant just after the dead consonant.

To circumvent unacceptable situations mentioned in sections 2.2 and 2.3 above, the Unicode Standard character U+200C (Zero Width Non-Joiner) can be used appropriately in the pre-processor and collation algorithms.

2.4 **Sorting of Conjuncts having two different display forms**

Two such conjuncts are rendered in Kannada at present.

- **Conjuncts with ರ (U+0CB0) as the first consonant**

  This has been explained at an earlier section as **Consonant Ra rules (section 1.12).** Words containing both the display forms of the same consonant cluster with ರ (U+0CB0) as the first consonant of the cluster has to be sorted as follows. Even though the display rendering are different, both are identical in all respects. It is therefore natural that they should appear at consecutive positions. Even though a separate glyph and a corresponding glyph code are present in the display/storage codes, such an arrangement in Unicode will not render for proper sorting.

  The only alternative is to represent both the display forms by the same set of codes with a distinguishing code (say the code U+0CCE) within the string for the second display form. In Unicode form, the distinguishing code value within the string of the consonant cluster for the second display form is to be considered as ignorable for the purpose of sorting (Ref. Implementation Guidelines, Section 5.17 of Unicode Standard Version 3 document). This can be achieved through preprocessing software, with specific functions to generate proper glyph codes, storage codes, and the Unicode at different levels. Such a situation-specific code representation guarantees proper sorting of data containing consonant clusters with two different display forms by ignoring the code U+0CCE for ಿ. This condition has to be incorporated at the appropriate place in the sorting algorithm.

- The second case of rendering a same character in two different display forms is the dead consonant ನ್. It is also written in a second form as ಩. Sorting issue in regard to this case is also dealt with the same way as in the previous case.

The Zero Width Non-Joiner at U+200C cannot be used instead of ಿ (U+0CCE), as the same sequence of characters appear both with Zero Width Non-joiner and with ಿ, the two sequences representing two different syllables (conjuncts).

2.5 Sorting of Diacritic characters

Diacritic characters formed using symbols located at 0CD0, 0CD1, 0CD2, 0CD3 and 0CD4 to render accents to consonants, are considered to be equivalent to the corresponding

consonants for sorting purposes and hence the above procedure can be adopted in such cases also.

2.6 Conclusion

The sorting issues mentioned above may have multiple solutions. Similar issues might have been solved by different methods in respect of other Indian languages. Hence, it is desirable to evolve uniform procedures for issues common to all the Indian languages. The solutions for sorting problems mentioned here may be elaborated to give the actual algorithms and flow charts, if need be.

3 Acknowledgements

Acknowledgements are due from Directorate of Information Technology, Govt. of Karnataka, to the following persons who have taken the responsibility in arriving at the Unicode standard and prepared this document.

- Mr. C V Srinatha Sastry, Assistant Director, National Aerospace Laboratories, Bangalore 560 017, General Secretary, Kannada Ganaka Parishath, Bangalore 560 019 and Member, Technical Advisory Committee on Satndardisation and Usage of Kannada on Computers, Government of Karnataka.
- Dr. U B Pavanaja, Technology Architect, Tally Solutions Private Limited, Bangalore and Member, Technical Advisory Committee on Standardisation and Usage of Kannada on Computers, Government of Karnataka and Member, Kannada Ganaka Parishath, Bangalore.
- Mr. G N Narasimha Murthy, Secretary, Kannada Ganaka Parishath, Bangalore and Manager, State Bank of India.
- Prof. G Venkatasubbiah, Former President, Kannada Sahithya Parishath and Former Professor, Vijaya College, Bangalore.
- Prof M H Krishnaiah, Former Professor, Bangalore University
- Prof. Narahalli Balasubrahmanya, Professor, Bangalore University.

APPENDIX -1

Changes in the Suggested Unicode version as compared with Unicode version 3.0
(Add, remove and relocate)

Code number	Unicode Version 3	Suggested Unicode	Remarks
0C8C	ೌ	-delete-	This is not a Kannada character, not used in Kannada and is not required for Kannada. This can be eliminated.
0CB4	Not used	ೞ	This is the proper position for ೞ
0CBC	Not used	◌	*Nukta* sign.
0CBD	Not used	ऽ	*Avagraha* sign.
0CCE	Not used	೯	Sign used for a different display form of consonant conjunct with ರ as the first consonant.
0CD0 to 0CD4	Not used	Diacritic signs	Diacritic signs required for different accents and grammatical signs
0CDE	ೞ	-relocate-	This character to be relocated at 0CB4 (see row 2 above) and this location is of no use
0CE1	ೣ	-delete-	This is not a Kannada character, not used in Kannada and is not required for Kannada. This can be eliminated.
0CD5	ೕ	-delete-	This has no independent existence. This can be removed
0CD6	ೖ	-delete-	This has no independent existence. This can be removed

Appendix - 2

Unicode for Kannada

Unicode chart and Collation chart if the suggested deletion and relocation of characters are not allowed

	0C8	0C9	0CA	0CB	0CC	0CD	0CE	0CF
0		ಐ	ಠ	ರ	ೀ	^	ೞ	
1			ಡ	ಱ	ು	&	ೱ	
2	ಂ	ಒ	ಢ	ಲ	ೂ	$		
3	ಃ	ಓ	ಣ	ಳ	ೃ	#		
4		ಔ	ತ		ೄ	_		
5	ಅ	ಕ	ಥ	ವ		ೇ		
6	ಆ	ಖ	ದ	ಶ	ೆ	ೈ	೦	
7	ಇ	ಗ	ಧ	ಷ	ೇ		೧	
8	ಈ	ಘ	ನ	ಸ	ೈ		೨	
9	ಉ	ಙ		ಹ			೩	
A	ಊ	ಚ	ಪ		ೊ		೪	
B	ಋ	ಛ	ಫ		ೋ		೫	
C	ೌ	ಜ	ಬ	ಽ	್		೬	
D		ಝ	ಭ	ಾ	ೌ		೭	
E	ಎ	ಞ	ಮ	ಿ	ೕ	ೕ	೮	
F	ಏ	ಟ	ಯ	ೀ			೯	

Suggested Unicode for Kannada if deletion and relocation of characters are not allowed

Column 1	Column 2	Column 3	Column 4	Column 5
0C82 ಂ	0C95 ಕ	0CA5 ಥ	0CB8 ಸ	0CCB ೊ
0C83 ಃ	0C96 ಖ	0CA6 ದ	0CB9 ಹ	0CCC ೌ
0C85 ಅ	0C97 ಗ	0CA7 ಧ	0CB3 ಳ	0CCD ್
0C86 ಆ	0C98 ಘ	0CA8 ನ	0CDE ೞ	
0C87 ಇ	0C99 ಙ	0CAA ಪ	0CBD ..	
0C88 ಈ	0C9A ಚ	0CAB ಫ	0CBE ಾ	
0C89 ಉ	0C9B ಛ	0CAC ಬ	0CBF ಿ	
0C8A ಊ	0C9C ಜ	0CAD ಭ	0CC0 ೀ	
0C8B ಋ	0C9D ಝ	0CAE ಮ	0CC1 ು	
0CE0 ೠ	0C9E ಞ	0CAF ಯ	0CC2 ೂ	
0C8E ಎ	0C9F ಟ	0CB0 ರ	0CC3 ೃ	
0C8F ಏ	0CA0 ಠ	0CB1 ಱ	0CC4 ೄ	
0C90 ಐ	0CA1 ಡ	0CB2 ಲ	0CC6 ೆ	
0C92 ಒ	0CA2 ಢ	0CB5 ವ	0CC7 ೇ	
0C93 ಓ	0CA3 ಣ	0CB6 ಶ	0CC8 ೈ	
0C94 ಔ	0CA4 ತ	0CB7 ಷ	0CCA ೊ	

Collating sequence of Kannada Unicode characters, if additions and relocations are not allowed. <u>The sequence is column wise, top to bottom.</u>

Appendix - 3

Unicode for Kannada

Unicode chart and Collation chart if the suggested deletion and relocation of characters are allowed

	0C8	0C9	0CA	0CB	0CC	0CD	0CE	0CF
0		ಐ	ಠ	ರ	ೀ	^	ೞ	
1			ಡ	ಱ	ು	&		
2	ಂ	ಒ	ಢ	ಲ	ೂ	$		
3	ಃ	ಓ	ಣ	ಳ	ೃ	#		
4		ಔ	ತ	಴	ೄ	_		
5	ಅ	ಕ	ಥ	ವ				
6	ಆ	ಖ	ದ	ಶ	ೆ		೦	
7	ಇ	ಗ	ಧ	ಷ	ೇ		೧	
8	ಈ	ಘ	ನ	ಸ	ೈ		೨	
9	ಉ	ಙ		ಹ			೩	
A	ಊ	ಚ	ಪ		ೊ		೪	
B	ಋ	ಛ	ಫ		ೋ		೫	
C		ಜ	ಬ	಼	ೌ		೬	
D		ಝ	ಭ	ಽ	್		೭	
E	ಎ	ಞ	ಮ	ಾ	ೕ		೮	
F	ಏ	ಟ	ಯ	ಿ			೯	

Suggested Unicode for Kannada if deletions and relocation of characters are allowed

Column 1	Column 2	Column 3	Column 4	Column 5
0C82 ಂ	0C95 ಕ	0CA5 ಥ	0CB8 ಸ	0CCB ೊ
0C83 ಃ	0C96 ಖ	0CA6 ದ	0CB9 ಹ	0CCC ೌ
0C85 ಅ	0C97 ಗ	0CA7 ಧ	0CB3 ಳ	0CCD ್
0C86 ಆ	0C98 ಘ	0CA8 ನ	0CB4 ಴	
0C87 ಇ	0C99 ಙ	0CAA ಪ	0CBD ..	
0C88 ಈ	0C9A ಚ	0CAB ಫ	0CBE ಾ	
0C89 ಉ	0C9B ಛ	0CAC ಬ	0CBF ಿ	
0C8A ಊ	0C9C ಜ	0CAD ಭ	0CC0 ೀ	
0C8B ಋ	0C9D ಝ	0CAE ಮ	0CC1 ು	
0CE0 ೠ	0C9E ಞ	0CAF ಯ	0CC2 ೂ	
0C8E ಎ	0C9F ಟ	0CB0 ರ	0CC3 ೃ	
0C8F ಏ	0CA0 ಠ	0CB1 ಱ	0CC4 ೄ	
0C90 ಐ	0CA1 ಡ	0CB2 ಲ	0CC6 ೆ	
0C92 ಒ	0CA2 ಢ	0CB5 ವ	0CC7 ೇ	
0C93 ಓ	0CA3 ಣ	0CB6 ಶ	0CC8 ೈ	
0C94 ಔ	0CA4 ತ	0CB7 ಷ	0CCA ೊ	

Collating sequence of Kannada Unicode characters, if additions and relocations <u>are allowed.</u> The sequence is column wise, top to bottom