Mid Semester Examination
HUL479
Algorithms in Ancient India

Date: 03.03.2017 Time: 3:00 pm - 5:00 pm

Max marks: 100

Instructions:

- All questions are compulsory
- Numbers to the right of each question indicate the marks.

1. Write a note on 3 Prakṛti and 8 Vikṛti pāṭhas.
   Write down all the 11 pāṭhas for the input sequance `1234', where 1,2,3 and 4 are the four distinct padas. (10)

2. What is a De Bruijn sequence? Explain how the sequence
   यमाताराजभानसलगा forms a De Bruijn sequence of binary alphabet of length three. (10)

3. Classify each akṣara in the following śloka into laghu and guru.
   या सृष्टिः स्रष्टुराद्या वहति विधिहुतं या हविर्या च होत्री
   ये द्वे कालं विधत्तः श्रुतिविषयगुणा या स्थिता व्याप्य विश्वम्
   यामाहुः सर्वबीजप्रकृतिरिति यया प्राणिनः प्राणवन्तः
   प्रत्यक्षाभिः प्रसन्नस्तनुभिरवतु वस्ताभिरष्टाभिरीशः (10)

4. Explain Piṅgala's sūtras
   ल अर्द्धे (8.24)
   स एके ग (8.25)
   for नष्टं (Conversion from Decimal to Binary).
   Illustrate the conversion of number 7 into binary following this procedure. (5+2)

5. Explain Piṅgalaś sūtras
   द्विकौ ग्लौ 8.20
   मिश्रौ च 8.21
   पृथग्ला मिश्रः 8.22

वसवस्त्रिकाः 8.23
for generating sequences of binary numbers. Explain the recursion involved in the generation. (4+8)

6. Explain Kedar Bhaṭṭa's algorithm, given by the following sūtras, to find the value of 2^n. Illustrate with an example.
ल-ग-क्रियांक संदोहे भवेत् संख्या विमिश्रिते
उद्दिष्ट-अंक समाहाराः सः एकः वा जनयेद् इमाम्
English Translation:
One can get the total combinations in two different ways:
   - by adding the numbers of eka-dvi-ādi-l-g-kriyā, or
   - by adding the numbers at the top in the uddiṣṭa kriyā and then adding 1 to it.

   Note: You should explain what are the numbers in eka-dvi-ādi-l-g-kriyā, and what are the numbers at the top in the uddiṣṭa, with an example. What these two formulae resemble to in the modern Mathematical notation? (3+3+2)

7. Give the construction of a square of given length as described in the Śulbasutras. (5)

8. Explain the formula $\sqrt{2} = 1 + \frac{1}{3} + \frac{1}{3.4} - \frac{1}{3.4.34}$, geometrically following the procedure of conversion of a rectangle into a square. (10)

9. कति मूर्तिभेदाः भवन्ति अन्योन्य-हस्त-कलितैः
पाश-अङ्कुश-अहि-डमरूक-कपाल-शूलैः-खट्वाङ्ग-शक्ति-शर-चाप-युतैः शम्भो
How many different idols can be formed by exchanging weapons noose, goad, snake, drum, skull, trident, staff with skull at the top, miscile, arrow and bow in the hands of Śiva? (2)

10. Explain why total number of meters with n mātrās is equal to the sum of total number of meters with $n-1$ mātrās and total number of meters with $n-2$ mātrās. (5)

11. For each of the following linear Diophantine equations either find all the solutions using Kuṭṭaka method or explain why there is no integral solution. (8)

$$12x - 50 = 18y$$

$$47x + 11 = 30y$$

12. Using Kuṭṭaka method, tell me, if it is possible to have 50 coins, a mix of 1 paisa, 10 paisa, and 25 paisa coinsa with a total of 2 Rs.? If yes, solve by Kuṭṭka method. (8)

13. If (α, β) is the solution of the kuṭṭaka $ax + 1 = by$, then prove that $(c * \alpha, c * \beta)$ is the solution of $ax + c = by$. (5)