VM006-Doc022

Vedic Mathematics, Science & Technology
Teacher Course

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BASIC OPERATION

This day the course focus is upon 'basic operation'. It four folds aspects being taken up are as follows:

77. Basic operation
78. Shift from base to index
79. Transformation of nine numerals of ten place value system
80. Tabulation of double digit numbers of different place values systems

The values being covered are to be taught as lessons numbers 77 to 80 to the students of 3-space Vedic Mathematics, Science & Technology.

LESSON-77

BASIC OPERATION

1. Ganita Sutra 1 **एकाधिकेन पूर्वेण** *Ekadhiken Purvena* approaches arithmetic operation in terms of values features **एकाधिकेन** *Ekadhiken* 'more than'.
2. This approach is inherently having comparative distinctive between a pair of values, with second value being more than the first value. That way, this

approach, also brings in the ordering for the values as, first, second and so on.

3. With it, the ordering becomes of the features as that the second value is more than the first value.
4. Ganita Sutra 1 approach is further of the feature that the 'more than feature is to be taken as number value एक Ek / one '1'.
5. Ganita Sutra 1 text, as it is compose, also poses a question as that 'one is more than what'? and answer of this poser is also there in the second word formulation of the text, namely 'पूर्वेण *Purvena* , which means: 'that is before' (the one).
6. Let us have a pause here and to revisit the above poser and its answer embedded in the text of Ganita Sutra 1 itself.
7. Let us very gently phase out the chase of the above poser and its answer, being of following steps:
   - (i) Step 1 poser is: 'one is more than what'?
   - (ii) Step 2 means, the urge of the poser is to reach at, as to what is the value before one.
   - (iii) Step 3 the comparative reach from the value which is before one, and between 'one' itself.
   - (iv) Step 4 the comparison rule is of principle 'more than'.
   - (v) Step 5 this more feature, as it is, is of value unit 'एक Ek / one '1'
8. One shall have a pause here and take note that:
   - (i) 'The first value here together with more than value unit 'one', takes to the second value being 'one'.

(ii) With it, the first value becomes Nul, of value 'Nil', void state, as such, It is designated and is taken as Sunya (zero).

9. With it, the basic operation comes to be as of a reach from 'one', two', while 'one' itself, is of a reach from value immediately before being '0'.
10. This two folds reach from '1' to '2', is of increase feature, and is designated as addition, while the reach from '1' to its previous value state zero is of opposite orientation and the same being of decrease feature, it is designated as subtraction/ minus operation.
11. The repeated addition is designated as multiplication operations, while the repeated subtraction is designated as division operation.
12. With it, addition & subtraction and multiplication & division as paired pairs become quadruple basic operation.
13. One shall sit comfortably and to permit the transcending mind to revisit the above flow and manifestation of above four folds basic arithmetic operations from the basic working rule of Ganita Sutra 1. 'One more than before'. ■

LESSON-78

SHIFT FROM BASE TO INDEX

1. With a shift from base to index, the working rule of Ganita Sutra 1: 'one more than before', leads to a different mathematical value.
2. Reach at base of working rule 'one more than before' is of a sequence of values (1, 2, 3, 4 …).

3. However the reach at value to at the base is of expression 2^1.
4. The value 2^1 will have its previous value 2^0 while the sub sequent value 2^2.
5. One may have a pause here and take note that reach at the base of value 2 and its previous and subsequent values, makes the values triple (1, 2, 3).
6. However the value 2^1 together with its previous and subsequent values lead to values triples $(2^0, 2^1, 2^2)$ / (1, 2, 4).
7. One may further have a pause here and to have a revisit of triple pair (1, 2, 3) and 1, 2, 4).
8. It is this difference of mathematical value ranges being attained by the working rule one more than before', of Ganita Sutra 1, which deserves to be comprehended well for its complete appreciation to have imbibing of the difference of mathematical values reach at while working at the base and while working at the index.
9. One may have a pause here and take note that the repeated addition at the base and repeated addition at the index make different mathematical domain.
10. Repeated addition at base, retains progression along the base line itself.
11. However repeated addition at the index sequentially transits from given a dimensional order set up to the next higher dimensional set ups.
12. Value 2^1 accept a single axis format of 2 units, while the value 2^{1+1} accepts a geometric format within a dimensional frame of a pair of axis of 2 unit each, making a surface area of four units.
13. One shall sit comfortably and to permit the transcending mind to distinctively glimpse and imbibe the

distinguishing features of mathematics of working rule of Ganita Sutra 1 at base from that of mathematics of working rule of Ganita Sutra 1 at the index.

14. One shall specifically glimpsed and imbibe the distinguishing mathematical value of multiplication as repeated addition at the base from that of multiplication s repeated addition at the index.
15. Parallel to it, one shall also distinctively glimpse and imbibe the difference of mathematical values of division as repeated subtraction at the base from that of division as repeated subtraction at the index.

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LESSON-79

TRANSFORMATION OF NINE NUMERALS OF TEN PLACE VALUE SYSTEM

1. Ten place value systems accept nine numeral ranges (1, 2, 3, 4, 5, 6, 7, 8, 9).
2. This range of nine numerals (1, 2, 3, 4, 5, 6, 7, 8, 9), with five of its middle placement , help classify the numerals range as of two parts, the first being 1, 2, 3, 4, 5 to be designated as small numerals, while the second part 6, 7, 8, 9 is designated as of bigger numerals.
3. Vedic Mathematics systems reduce bigger numerals (6, 7, 8, 9) into smaller value numeral, by bringing in negative values numerals (-1, -2, -3, -4).
4. This process is known as vinculum systems of conversion of bigger numerals (6, 7, 8, 9) into smaller value positive and negative digit having expression of

numeral (6, 7, 8, 9) of double digit format by the technique 6 = 10-4, 7 = 10-3, 8 = 10-2 and 9 = 10-1.

5. 6 = 10-4 = 1$\bar{4}$, 7 = 10-3 = 1$\bar{3}$, 8 = 10-2 = 1$\bar{2}$ and 9 = 10-1 = 1$\bar{1}$.
6. The above expression 6 = 10-4 = 1$\bar{4}$ is a double digit expression which avail positive numeral 1 and negative numeral $\bar{4}$. Likewise the double digit expression for 7 in terms of positive numeral 1 and negative numeral $\bar{3}$, and the double digit expression for 8 are in terms of positive numeral 1 and negative numeral $\bar{2}$ and so on.
7. One may have a pause here and take note that negative $\bar{1}$ = -1, $\bar{2}$ = -2, $\bar{3}$ = -3, $\bar{4}$ = -4. The conversion of nine numeral ranges (1, 2, 3, 4, 5, 6, 7, 8, 9) into (1, 2, 3, 4, 5, 1$\bar{4}$, 1$\bar{3}$, 1$\bar{2}$, 1$\bar{4}$) will help reduce mental progression as the bigger numerals values stands reduced into smaller number values.
8. Illustratively if we work the table of 9, we can working out by following step:
   Step 1: 9- 09
   Step 2: 09 = 1$\bar{1}$
   Step 3: To have progression of table of nine in two columns in the working rule 1$\bar{1}$ as there would be decrease a value each step in column one while there would be an increase the value one at each step in column 2.

Rule of	Second	First	Rule of

increase	column	column	decrease
	09		
0+1	1	8	9-1
1+1	2	7	8-1

Like that table of nine can be worked out for any number of steps.

9. For table of eight we can reach at $8 = 08 = 1\bar{2}$ which will gives us the rule of decrease by 2 in first column and increase of 1 at each step.
10. Likewise one can write table of any number in sequential steps by reaching at column wise working rule with suitable conversion.
11. Here below is given the conversion for numbers 1 to 99 by replacing bigger digit numbers into smaller number value digit.

Table of numbers 1 to 99 converted into smaller digits, that is by having conversion for the bigger numeral 6, 7, 8, 9, in terms of smaller value digits as under:

001	002	003	004	005	$01\bar{4}$	$01\bar{3}$	$01\bar{2}$	$01\bar{1}$
010	011	012	013	014	015	$02\bar{4}$	$02\bar{3}$	$02\bar{2}$
$02\bar{1}$	020	021	022	023	024	025	$03\bar{4}$	$03\bar{3}$
$03\bar{2}$	$03\bar{1}$	030	031	032	033	034	035	$04\bar{4}$
$04\bar{3}$	$04\bar{2}$	$04\bar{1}$	040	041	042	043	044	045
$05\bar{4}$	$05\bar{3}$	$05\bar{2}$	$05\bar{1}$	050	051	052	053	054
055	$1\bar{4}\bar{4}$	$1\bar{4}\bar{3}$	$1\bar{4}\bar{2}$	$1\bar{4}\bar{1}$	$1\bar{4}0$	$1\bar{4}1$	$1\bar{4}2$	$1\bar{4}3$
$1\bar{4}4$	$1\bar{4}5$	$1\bar{3}\bar{4}$	$1\bar{3}\bar{3}$	$1\bar{3}\bar{2}$	$1\bar{3}\bar{1}$	$1\bar{3}0$	$1\bar{3}1$	$1\bar{3}2$

$1\bar{3}3$	$1\bar{3}4$	$1\bar{3}5$	$1\bar{2}\bar{4}$	$1\bar{2}\bar{3}$	$1\bar{2}\bar{2}$	$1\bar{2}\bar{1}$	$1\bar{2}0$	$1\bar{2}1$
$1\bar{2}2$	$1\bar{2}3$	$1\bar{2}4$	$1\bar{2}5$	$1\bar{1}\bar{4}$	$1\bar{1}\bar{3}$	$1\bar{1}\bar{2}$	$1\bar{1}\bar{1}$	$1\bar{1}0$
$1\bar{1}1$	$1\bar{1}2$	$1\bar{1}3$	$1\bar{1}4$	$1\bar{1}5$	$10\bar{4}$	$10\bar{3}$	$10\bar{2}$	$10\bar{1}$

12. As the above table is expression of numbers values 1 to 99 in smaller digit expression of three digits of values (0, 1, 2, 3, 4, 5), ($\bar{4}$, $\bar{3}$, $\bar{2}$, $\bar{1}$) as such the tables of numbers 1 to 99 can be written in 3 column progression. Illustratively a table of 75 would be the table of $1\bar{3}5$. As such, first column will have addition of value 5 at each step, while the second column of will have decrease of value 3 at each step and third column have will increase of value 1 at each step. Accordingly the table of 75 will have flow chart as under:

Rule of increase	Third column	Second column	First column	Rule of decrease
	0	7	5	
0+1 = 1	10	4	1	5+5 = 10

From first column there would be a carry of value 1 for the second column. As such, the value for the second column will become 7-3 +1 = 5, and accordingly the value of the table at second step will be 150.

Like that further steps of the table can be reach at just by the arts of addition and subtraction of column wise values.

13. One can practice computation of table.

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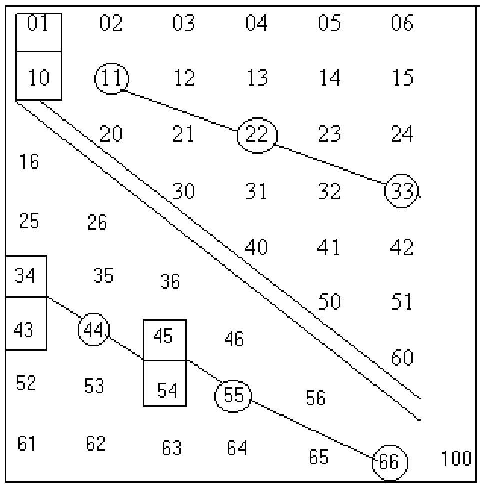
LESSON-80

TABULATION OF DOUBLE DIGIT NUMBERS OF DIFFERENT PLACE VALUES SYSTEMS

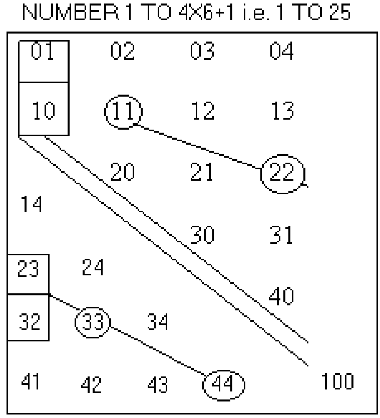
1. Double digit numbers of N place value system are accommodated by (N-1) x (N+1) grid / matrixes.
2. This (N-1) x (N+1) grid format splits into upper and lower part as if these are embedded with mirrors.
3. Firstly the format splits into 2 distinct parts, and secondly each of these parts, organizes numbers as reflection pairs along their mirror lines.
4. This features of organization of double digit numbers deserves to be comprehended well, particularly of 10, 9, 8, 7, 6, 5, 4, 3 and 2 place value systems.
5. Here below being tabulated (10, 7, 5, 4, 3 and 2) place value double digit numbers and one shall revisit the same, and to tabulate double digit number of (9, 8 and 6) place value systems:

01	02	03	04	05	06	07	08	09
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54
55	56	57	58	59	60	61	62	63
64	65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80	81
82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99

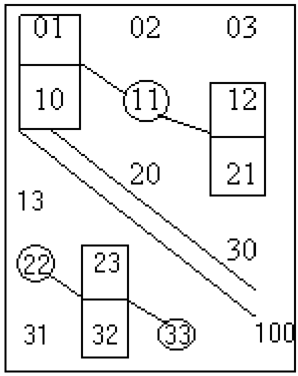
ON SEVEN PLACE VALUE SYSTEM
NUMBERS 1TO 6X8+1 i.e. 1 TO 49



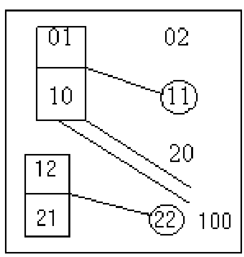
ON FIVE PLACE VALUE SYSTEM
NUMBER 1 TO 4X6+1 i.e. 1 TO 25



ON FOUR PLACE VALUE
NUMBERS 1 TO 3X5+1



ON THREE PLACE VALUE
NUMBERS 1 TO 2x4+1=9



ON TWO PLACE VALUE
NUMBER 1 TO 1X3+1
i.e. 1 to 4