21-DAY INSERVICE TRAINING PROGRAMME FOR THE PGT'S IN MATHEMATICS OF THE KENDRIYA VIDYALAYA SANGHATHAN, NEW DELHI

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Report

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1. INTRODUCTION

21-day Inservice Training Programme for the PGTs in Mathematics of the Kendriya Vidyalaya Sangathan, New Delhi

Rationale :

For most adults in past years, mathematics has probably meant memorizing certain facts, specific techniques, and thereafter, recalling them and using them as necessary. Even today, this is probably still true for many people. But for Mathematicians, engineers, scientists and computer specialists mathematics is an expandable tool for solving novel problems for which no previously learned algorithm will be entirely sufficient. An automobile engineer designing a more fuel efficient engine or a computer specialist designing a machine translator from one Indian Language to another and vice-versa is not merely plodding along by stepping in someone else's footprints. He/She is exploring new territory and thus often means exploring new mathematical territory as well. Hence, thoughtfulness, intelligent guessing, insight and shrewd planning are integral parts of the task.

Unfortunately this creative aspect of mathematics has typically been ignored in our curricular or even if it is there, due to various other reasons like administrative or political or due to examinations, this part has been neglected. Thus something very important is thus got lost.

In order to educate these creative aspects of mathematics to the young children, the teachers have to be uptodate with current developments in mathematics, mathematics education and other related areas of knowledge. Besides these, in order to promote and to boost the image of the teachers in the society (i.e. for their vertical growth), Chattopadhyaya Commission has rightly recommended a 21-day Refresher Course in their content areas.

Keeping this in view, Kendriya Vidyalaya Sangathan, to support and develop the mathematical teaching skills of their P.G. teachers and to provide opportunity for their teachers to meet other teachers of the same organization in different parts of the country and with subject experts who share a common professional interest and to establish professional networks with colleagues from other schools, made a request to NCERT, New Delhi to conduct a refresher course in the content for their P.G. teachers. NCERT, in turn, asked its constituent units to do the needful.

Hence the programme has been taken up here at RIE, Mysore from 1 June to 21 June 2002.

Objectives

At the end of the programme, the participants will be able to :

1. acquire reasonable proficiency with the basic facts of the newly introduced concepts like Boolean Algebra – Logic etc.
2. communicate the mathematical ideas to their students, through physical materials, diagrams, pictures etc. (wherever possible).
3. provide opportunities for their students to explore and describe results using graphics, numerical, physical, algebraic and verbal models or representations.
4. develop supplementary instructional materials that are matched with the instructional programmes.
5. provide opportunities for their students to develop increasingly sophisticated concepts like average, simple interest, etc.

Methodology

In order to meet these objectives, we planned a varied and stimulating programme which includes, for example:

1. A forum for staff debate and discussion related to a particular issue or theme or a topic taken up by each and every participant at the end of the day from3.30 pm to 5.00 pm almost everyday. (Ex: Demonstration Lesson followed by the discussions of Dr N M Rao, Dr B S Upadhyaya, Mr B C Basti and Dr B S P Raju).

2. A practical workshop for the participants to familiarize themselves with new resources or equipments and design mathematical lab activities in the existing mathematics lab of the RIE, Mysore. (Ex: 1. Lab activities by Dr N M Rao, 2. Computers in teaching Maths, Dr B S Upadhyaya).

3. Opportunities for the participants in turn to inform other members of the participants of the content and ways in which mathematics is taught in their classroom and to share the successes and difficulties they experience (Ex: 1. The product of a negative number and a negative number is positive by Mr B C Basti. 2. The definition of simple interest by Dr B S P Raju).

4. Inviting members of the resource persons and the participants to present innovations that have proved to be successful in their classrooms : (Ex: 1. Teaching of Logarithms by Dr B S P Raju, 2. Structural Approach to Teaching of Mathematics by Dr K Dorasami).

5. It is broadly agreed among the teachers and researchers on education that the heart of the pedagogical knowledge is the nature of the subject being taught. (Ex: A session on Nature of Mathematics by Prof Ravindra).

The course began with a pre-test and concluded with a post-test.

Epilogues :

We have planned the programme for fifty participants but for the reasons not known to the Coordinator, only twenty one participants and one Principal of K.V. attended the programme. Inspite of poor attendance, there was no change in the academic inputs.

By the reactions of the participants, we felt that the objectives we set for this programme are realistic and manageable. In the beginning of the programme, the participants felt that it is difficult to spend the 21-days but at the end, they felt that it went so soon and were unwilling to leave this place. We hope we have brought a lot of change in their knowledge in the content, knowledge in mathematics education, attitudes and beliefs in teaching mathematics. Moreover, the evaluation of pretest and the post-test performance revealed a significant growth in their mean score (over 35%).

We further hope that this change will certainly reflect in teaching their students.

At the end the Coordinator would like to acknowledge with due reverence to all the individuals and the organizations that helped him in completing the programme successfully.

2. MATHEMATICS

Prof G Ravindra

- Mathematics is the study of assertions of the form 'p implies q' where p and q are each statements about objects that live in the mathematical world (Bertrand Russel, 1917).
- Whatever there is, in all the three worlds, which are possessed of moving and non moving beings, cannot exist as apart from GANITA (Mahavira AD 850).
- One of the things that mathematicians know and the rest of us do not is that all of mathematics follows inevitably from a small collection of fundamental rules (called axioms) [Bertrand Russel, 1902).

  [Note: If you ask a mathematician 'What is 2 plus 2', he will say that he does not know. But he does know that if 1 plus 1 equals 2, then 2 plus 2 equals 4].
- The great book of nature can be read only by those who know the language in which it was written. And this language is Mathematics. [Galileo].
- God made the natural numbers; all else is the work of man (Leopold Kronecker).
- One reason why mathematics enjoys special esteem, above all other sciences, is that its laws are absolutely certain and indisputable, while those of other sciences are to some extent debatable (Albert Einstein).
- It is not abstraction which makes mathematics difficult. Rather it is precision. Mathematics is difficult because, unlike any other discipline, it demands COMPLETE PRECISION (Jerry P King 1992).
- One of the vastest areas of the world of contemplative beauty is mathematics. This alone is sufficient reason for the study of mathematics (King, 1992).
- Mathematics is the abstract key which turns lock of the physical universe (Polkinghorne).

- What is in a name ?

  That which we call a rose

  By any other name would smell the same.

  (William Shakespeare)

  [Note: Call natural numbers by any name – positive integers or non-negative whole numbers; they smell the same. THEY ARE IMPORTANT AS A CONCEPT (content)].

- One picture is worth more than tent thousand words (anonymous).

3. PROBLEMS : LINEAR PROGRAMMING

Prof G Ravindra

Examples:

1. The end points of a line segment are extreme points.
2. Vertices or corners of a cube in R^3 are extreme points.
3. Every point of the boundary of a circular region is an extreme point.
4. All the interior points of a circular region are not extreme points.
5. No point of a xy-plane is extreme in the plane.
6. The extreme points of a polygonal region are its vertices.
7. Any point in xy-plane is an extreme point of the singleton set containing the point.
8. The point of intersection of two line segments is not an extreme point of the line segments.

The extreme points play a very significant role in the solution of a LPP. In fact, the objective function of a LPP attains its optimum at atleast one of the extreme points of its feasible region which is always convex.

Exercises :

1. Which of the give points belong to the graph of the given inequations ?

   (i) $x + y < 5$ (0,0); (3,2)
   (ii) $x - y > 6$ (4,3); (11,4)
   (iii) $3x + y \leq 2$ (0,0); (0,4)

2. State whether the solution set of the following system of linear inequations is a null set or not.

   (i) $x \leq 0$ and $x \leq 2$
   (ii) $x < 2$ and $x > 2$
   (iii) $y > 1$ and $y > -1$

3. State true or false

   (i) The line $y = 10x + 50$ separates the xy-plane in two half planes.
   (ii) A half plane is the graph of the inequation.
   (iii) The graph of a linear inequation is a convex set.
   (iv) The union of two convex sets in xy-plane is also a convex set in xy-plane.
   (v) The intersection of two convex sets in xy-plane is a convex set in xy-plane.
   (vi) If A and B are two sets in R^2 which are not convex, their intersection is also not convex in R^2.
   (vii) Vertices of a cube are extreme points.

(viii) If m is the number of linear inequations in two variables and if the intersection of their graphs is a polygonal region with n sides then m = n.

(ix) If a point (x,y) in xy-plane is a convex combination of two points (r,s) and (p,q) in the plane, then it lies on the line joining the two points (p,q) and (r,s).

(x) The converse of the above statement is generally not valid.

(xi) The intersection of two convex sets could possibly be disjoint union of two convex sets.

(xii) Union of two convex sets is convex.

(xiii) Every point in a convex set is a convex combination of two other points in it.

4. Find two points in xy-plane that satisfy each of the following:

(i) $y = 5x$, (ii) $y < 5x$; (iii) $y > 5x$

5. Mark the region which represents the graph of the following inequations.

(a) $x < 3$
(b) $y > 3$
(c) $2x + 4y \leq 8$
(d) $x + y \leq 4$

6. State whether the region representing the following is bounded or unbounded.

$x \geq 0$, $y \geq 0$ and $x + y \leq 8$.

7. Let ABCD is a square in the first quadrant of xy-plane.

(i) If $x + y = 1$ is the equation of the side AB, find the equations of the sides, BC, CD and DA.

(ii) Write the inequations whose intersection is the *interior* of the square.

8. Let ABCDEF be a regular hexagon with length of each of its sides equal to 1 unit. Write the inequations whose intersection is the given hexagon.

9. Prove or disprove :

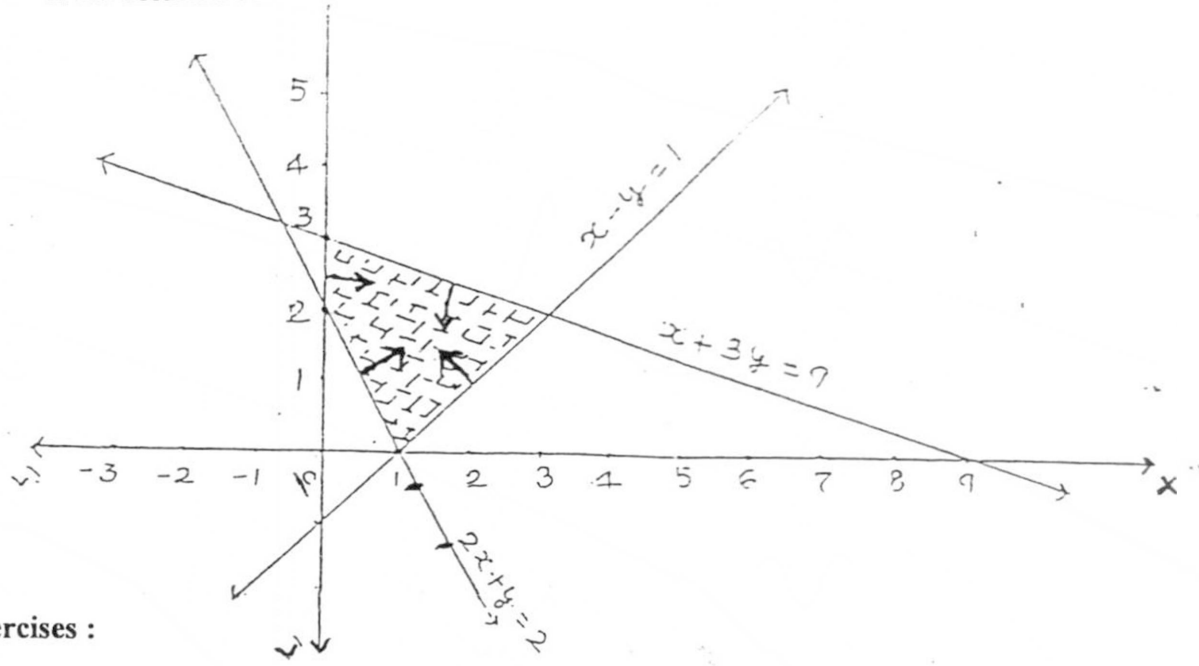
(i) The circle $x^2 + y^2 = a^2$ (a is a given real number) is a convex set.

(ii) Every point on the boundary of a circular region is an extreme point.

(iii) If G is the graph satisfying m linear inequations simultaneously, then G is a polygonal region having m sides.

(iv) A set consisting of single element of R^2 is a convex set in R^2.

10. Find the linear constraints for which the shaded region in the following figure is the solution set.



Exercises :

1. Choose the most appropriate answer.

(i) The set of feasible solutions of a linear programming problem is

(a) convex
(b) not a convex set
(c) convex or concave
(d) bounded and convex

(ii) The minimum number of inequations needed to find a feasible region in a linear programming problem is

(a) 1 (b) 2 (c) 3 (d) 4

(iii) The maximum value of the objective function of a linear programming problem always occurs

(a) exactly at one vertex of the feasibility region
(b) everywhere in the feasibility region
(c) at all the vertices of the feasibility region
(d) at some vertices of the feasibility region

(iv) The feasible region of a linear programming problem intersects

(a) first quadrant
(b) second quadrant
(c) third quadrant
(d) fourth quadrant

(v) A factory has an auto lathe which when used to produce screws of larger size produces 400 items per week and when used to produce screws of smaller size produces 300 items per week. Supply of rods used in making these screws limitsthe total production of both types per week to 380 items in all. The factory makes a profit of 25 paise per large screw and 10 paise per small

screw. How much of each type should be produced to get a maximum profit ? (Ans: 80,300).

(vi) Using graphical method
Maximize $Z = 3x + 4y$
Subject to $4x + 2y \leq 80$
$2x + 5y \leq 180$,
$x \geq 0,\ y \geq 0$
(Ans: $x = 2.5;\ y = 35,$ maximum value = 147.5).

(vii) Using graphical method
Minimise $Z = 4x + 2y$
subject to $x + 2y \geq 3$
$3x + y \geq 3$
$4x + 3y \geq 6$
$x \geq 0,\ y \geq 0$
(Ans: $x = 0.6,\ y = 1.2,$ minimum value = 4.8)

(viii) Consider the following problem :

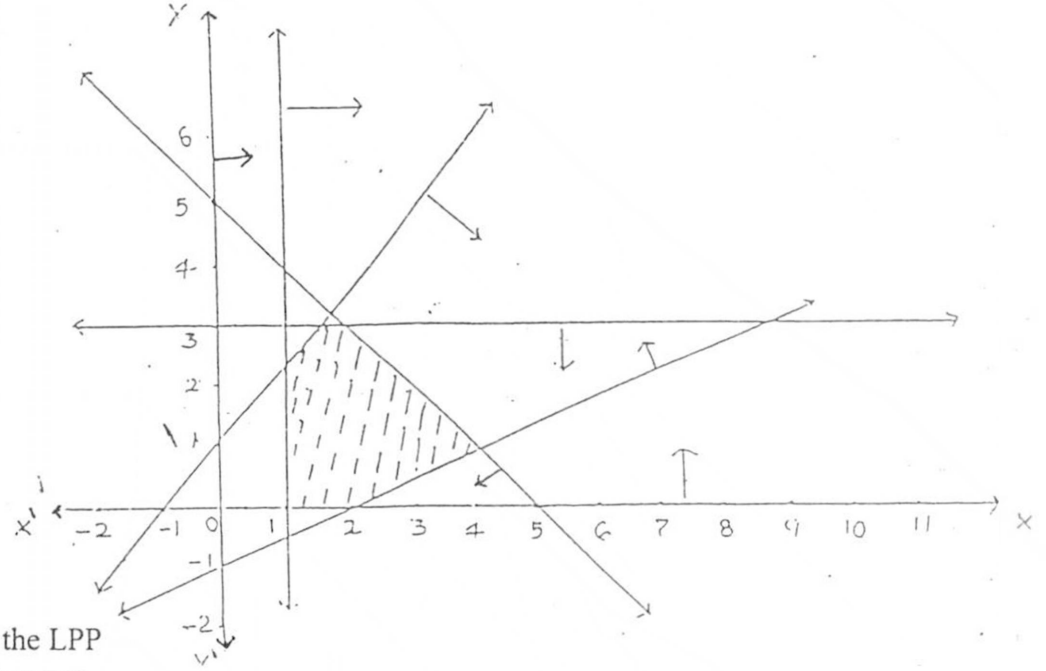
Maximize $Z = 6x_1 - 2x_2$
Subject to $x_1 - x_2 \leq 1;\ 3x_1 - x_2 \leq 6;\ x_1, x_2 \geq 0.$
Show graphically that at the optimal solution the variables x_1, x_2 can be increased indefinitely, while the value of the objective function remains constant.

(ix) Consider the following LPP :
Maximize $Z = 4x + 4y$
Subject to $2x + 7y \leq 21;$
$7x + 2y \leq 49;\ x,y \geq 0.$
Find the optimal solution (x,y) graphically. What are the ranges of variation of the coefficients of the objective function that will keep (x,y) optimal ?

(x) Consider the following problem :
Maximize $z = 3x + 2y$ subject to $2x + y \leq 2,\ 3x + 4y \geq 12,\ x,y \geq 0.$
Show graphically that the problem has no feasible extreme points. What can one conclude concerning the solution of the problem ?

(xi) Prove or disprove :
(a) For some LPP, the set of feasible solutions is a disjoint union of convex sets.
(b) The set of feasible solutions of every LPP is non empty.
(c) Every LPP is a mathematical model.

(xii) Write the constraints associated with the solution space shown in the following figure and identify all redundant constraints.



(xiii) Consider the LPP

Minimize $z = x$

Subject to $x + y \leq 1$

$-x + y \leq -1$

$x, y \leq 0$

Prove that the LPP has a feasible solution iff $l \geq 1$ and solve the problem.

Exercises

1. A company makes two kinds of leather belts A, B. Belt A is of higher quality and belt B is of lower quality. The respective profits are Rs.4 and Rs.3 per belt. Each belt of type A requires twice as much time as a belt of type B, and if all belts were of type B, the company could make 1000 per day. The supply of leather is sufficient for only 800 belts per day (both A and B combined). Belt A requires a fancy buckle and only 400 per day are available. There are only 700 buckles a day available for belt B. Formulate this as a linear programming model.

2. Give an example of a real situation (other than those mentioned in this lesson) whose mathematical model is a linear programming model.

3. Give an example of a mathematical model which is not a linear programming model.

4. An Advertising company wishes to plan an advertising campaign in three different media – television, radio and magazines. The purpose of the advertising company is to reach as many potential customers as possible. Results of the market study are given below:

	Television		Radio Rs.	Magazine Rs.
	Day Time Rs.	Prime Time Rs.		
Cost of an advertising unit	40,000	75,000	30,000	15,000
Number of potential customers reached per unit	400,000	900,000	500,000	200,000
Number of women customers reached per unit	300,000	400,000	200,000	100,000

The company does not want to spend more than Rs.800,000 on advertising. It further requires that (i) atleast 2 million exposures take place among women, (ii) advertising on television be limited to Rs.500,000, (iii) atleast 3 advertising units be bought on day time television and two units during prime time; and (iv) the number of advertising units on radio and magazine should each be between 5 and 10.

Find different types of advertising units which minimize the total number of potential customers reached is maximum.
(Note: The problem involves four decision variables).

4. BUSINESS MATHEMATICS

Dr B S P Raju

Sinking Fund

Sinking fund is a kind of reserve by which a provision is made to

a) reduce a liability i.e. redemption of debentures or repayment of loan,
b) replace depreciating assets,
c) renew a lease,
d) replace wasting assets i.e. mines.

Let the amount of debt be A; E be the installment amount to credit to sinking fund and 'r' be the interest rate per annum in decimal form that accrues to sinking fund.

Let us consider the case for 3 years.

At the end of the first year, the amount in S.F. (Sinking Fund) is Rs.E.

At the end of II year, this becomes $E(1 + r)$ rupees. (by compound interest formula).

At the beginning of III year, he adds another E rupees so the amount in S.F. is $E(1 + r) + E$.

At the end of III year, this becomes

$$\{ E(1 + r) + E \} \{ 1 + r \}$$

At the beginning of the IV year again he adds E Rupees.

Hence S.F. $= [\{ E(1 + r) + E \} \{ 1 + r \}] + E.$

But this is equal to A.

i.e. $E(1 + r)^2 + E(1 + r) + E = A.$

$E \{ 1 + (1 + r) + (1 + r)^2 = A.$

$$\therefore E = \frac{A}{1 + (1+r) + (1+r)^2}$$

But $1 + (1 + r) + (1 + r)^2$

$$= 1 \left\{ \frac{(1+r)^3 - 1}{1 + r - 1} \right\}$$

$$= 1 \left\{\frac{(1+r)^3 - 1}{r}\right\}$$

$$\therefore E = \frac{Ar}{(1+r)^3 - 1}$$

In general for n years,

$$E = \frac{A}{1 + (1+r) + (1+r)^2 + (1+r)^3 + \ldots + (1+r^n)}$$

$$= \frac{A}{1\left\{\frac{(1+r)^n - 1}{1+r-1}\right\}} = \frac{A}{\left(\frac{(1+r)^n - 1}{r}\right)}$$

$$= \frac{A\ r}{(1+r)^n - 1}$$

Problem :

A mortgage of Rs.10,000/- is due in 5 years. It calls for interest payments of 8% payable annually to the creditor. What is the annual payment ? The debtor decides to make equal payments at the end of each year for 5 years into a sinking fund investment that earns 4% compounded annually, to accumulate Rs.10,000/- in 5 years. What is the annual payment to the sinking fund, construct a sinking fund schedule.

Interest $\frac{10{,}000 \times 1 \times 8}{100}$ = 800/– payable annually.

Installment for payment to sinking fund = $E = \frac{Ar}{(1+r)^n - 1}$

$$= \frac{10000 \times 0.04}{(1 + 0.04)^5 - 1} = \frac{400}{0.2166528}$$

$$= 1846.272$$

Period	Interest at 4%	Payment to Sinking Fund	Increase in S.F. Col. 2 + 3	Amount in S.F.	Book Value of Debt
0	--	--	--	--	10,000
1	0	1846.272	1846.272	1846.272	8,153.728
2	73.85088	1846.272	1846.272 + 73.85088 = 1920.1228	1846.272 + 1920.1228 = 3766.3948	6233.606
3	3766.3948 $\times \frac{4}{100}$ = 15065579	1846.272	1846.272 + 150.65 = 1996.9277	5763.3225	4236.678
4	230.5329	1846.272	2076.8049	7840.1274	2159.873
5	313.60509	1846.272	2159.877	10000	0000

1. In order to purchase new carpeting and furniture, the Healys decided to deposit Rs.50/- in a S.B. account at the end of each month for 2 years. How much will they have available at that time, if the interest rate is 5% compounded monthly.

Problems on Partnership

X starts a business on 1st January 1987 with Rs.5000/-.
Y joins on 1st May 1987 with Rs.10,000/-.
On 1st July, Z comes in as a partner with Rs.15,000/-.
And on the same date, X contributes Rs.5000/- and Y contributes Rs.10,000/- as further capital.
The profits for the year ended 31st December 1987 amounted to Rs.16,000/-. The partners agree to share the profits in proportion of their capitals. Find their profits.

X :	5000 for 12 months	5000 × 12 = 60,000
	5000 for 6 months	5000 × 6 = 30,000
		90,000
Y :	10,000 for 8 months	10000 × 8 = 80,000
	10,000 for 6 months	10000 × 6 = 60,000
		1,40,000
Z :	15,000 for 6 months	15000 × 6 = 90,000

Their profits should be 90 : 140 : 90 i.e. 9 : 14 : 9

$\therefore$ X's profit is $16{,}000 \times \frac{9}{32} = 4{,}500/-$

Y's profit is $16{,}000 \times \frac{14}{32} = 7{,}000/-$

Z's profit is $16{,}000 \times \frac{9}{32} = 4{,}500/-$

Admission of a Partner

1. Change in the profit sharing ratio.

Ex: If A, B and C are partners sharing in the ratio 6 : 5 : 3 and later they admit D for $\frac{1}{8}$ share. What is the new and sacrificing ratio ?

Solution : Old ratio is 6 : 5 : 3

D's ratio is $\frac{1}{8}$ (given).

A's, B's and C's combined share in the new firm $= 1 - \frac{1}{8} = \frac{7}{8}$.

A will get $\frac{6}{14}$th of the remaining $\frac{6}{14} \times \frac{7}{8} = \frac{6}{16}$.

B will get $\frac{5}{14}$ of the remaining $\frac{5}{14} \times \frac{7}{8} = \frac{5}{16}$.

C will get $\frac{3}{14}$ of the remaining $\frac{3}{14} \times \frac{7}{8} = \frac{3}{16}$.

New profit sharing ratio $\frac{6}{16} : \frac{5}{16} : \frac{3}{16} : \frac{2}{16}$ i.e. 6 : 5 : 3 : 2.

Sacrificing ratio of A is $\frac{6}{14} - \frac{6}{16} = \frac{48 - 42}{112} = \frac{6}{112}$.

Sacrificing ratio of B is $\frac{5}{14} - \frac{5}{16} = \frac{5}{112}$

Sacrificing ratio of C is $\frac{3}{14} - \frac{3}{16} = \frac{24 - 21}{112} = \frac{3}{112}$.

$\therefore$ Sacrificing ratio $= \frac{6}{112} : \frac{5}{112} : \frac{3}{112} = 6 : 5 : 3.$

Goodwill

Goodwill is the attracting force, which attracts the customers towards products of the firm. It is the value of customer's confidence in the business. It is an intangible and invisible asset.

Goodwill = Actual profit earned – Normal profit.
Goodwill = Certain number of times the average profit.

Ex : A and B are equal partners in a firm. Their capitals show credit balances of Rs.18000/- and Rs.12000/- respectively. A new partner C is admitted with $1/5^{th}$ share in the profits. He brings Rs.14000/- for his capital. Find the value of goodwill of the firm at the time of C's admission.

Solution : For $1/5^{th}$ of share C contributes Rs.14000/- (given).
Full capital of the new firm = $14000 \times 5 = 70{,}000/-$.
But combined total capital of the three partners = $18000 + 12000 + 14000 = 44000$.
$\therefore$ Total value of firm's goodwill = $70000 - 44000 = 26000$.

Adjustment of Capital

Ex : A, B and C have been sharing their profit and loss in the ratio of 6: 5 : 3. They admit D to a $1/8^{th}$ share. D brings Rs.16000/- for his share of capital. All the partners decide to make the balance of their capital accounts in the profit sharing ratio, calculate their capital.

Solution : Combined share of A, B and C in the new firm = $1 - \frac{1}{8} = \frac{7}{8}$.

A's new share $\frac{6}{14}$ of $\frac{7}{8} = \frac{6}{14} \times \frac{7}{8} = \frac{6}{16}$.

B's new share $= \frac{5}{14} \times \frac{7}{8} = \frac{5}{16}$.

C's new share $= \frac{3}{14} \times \frac{7}{8} = \frac{3}{16}$.

$\therefore$ New profit sharing ratio among A, B, C and D is $\frac{6}{16} : \frac{5}{16} : \frac{3}{16} : \frac{2}{16} = 6:5:3:2$.

For $1/8^{th}$ share, the new partner D brings Rs.16,000.

$\therefore$ Total capital of new firm will be $8 \times 16{,}000 = 1{,}28{,}000/-$.

$\therefore$ A's capital in new firm = $1{,}28{,}000 \times \frac{6}{16} = 48{,}000/-$.

B's capital in new firm = $1{,}28{,}000 \times \frac{5}{16} = 40{,}000/-$.

C's capital in new firm = $1{,}28{,}000 \times \frac{3}{16} = 24{,}000/-$.

D's capital in new firm = 1,28,000 × $\frac{2}{16}$ = 16,000/-.

On the Retirement or Death of a Partner

Ex : If A, B, C and D are partners sharing in the ratio of 6 : 5 : 3 : 2. D retires from the firm. Calculate the new ratio after D's retirement.

Combined share of A, B and C (after excluding D).

$$= 1 - \frac{2}{16} = \frac{14}{16}$$

A's share out of $\frac{14}{16}$ is $\frac{6}{16}$.

$\therefore$ A's share out of 1 is $\frac{\frac{6}{16}}{\frac{14}{16}} = \frac{6}{16} \times \frac{16}{14} = \frac{6}{14}$.

$|||^{ly}$ B's share is $\frac{5}{14}$.

C's share is $\frac{3}{14}$.

$\therefore$ New ratio is $\frac{6}{14} : \frac{5}{14} : \frac{3}{14}$.

Gain in ratio :

A's gain = New share – old share

$$= \frac{6}{14} - \frac{6}{16} = \frac{6}{112}.$$

$|||^{ly}$ B's gain = $\frac{5}{112}$.

C's gain = $\frac{3}{112}$.

Bills of Exchange

Definition :

A bill of exchange is an instrument, an unconditional order, signed by the maker, directing a certain person to pay a certain sum of money only to or to the order of a certain person or to the bearer of the instrument.

Discounting of the bill :

The drawer may wait for the entire period of the bill to receive its payment. If he is in the immediate need of funds, he can get the bill discounted with the bank. The drawer transfers the possession and also the ownership of the bill. The bank charges certain interest, here known as discount for the period it has advanced the amount. On due date, the bank will present the bill to the drawer and receive the payment.

Discount is always charged for a period between the date of discounting and due date.

Ex : A draws a bill on B for Rs.3,000/- on January 1, 1994 payable after 3 months. The bill is discounted by A, as he is in the immediate need of funds. Calculate the discount in the following cases :

a) The bill has been discounted at 12% on January 4.
b) The bill has been discounted at 12% on February 4.
c) The bill has been discounted at 12 % on March 4.

a) Discount $= 3000 \times \frac{12}{100} \times \frac{3}{12} = 90.$

b) Discount $= 3000 \times \frac{12}{100} \times \frac{2}{12} = 60.$

c) Discount $= 3000 \times \frac{12}{100} \times \frac{1}{12} = 30.$

Retiring a bill under rebate :

Payment of the bill is generally made after the expiry of the specified period. The drawee may make the payment of the bill even before the date of maturity of the bill. In case of receiving payment of the bill even before the due date of the bill, the drawer allows certain discount, here known as "rebate" as a customary trade practice.

Ex : Ansar accepts a bill drawn by Azar for Rs.8000/- on March 15, 1999 payable after 4 months. According to the trade practice in the industry cash rebate at 6% p.a. is allowed. Calculate the amount of rebate in the following cases.

a) Ansar makes payment on April 18, 1999.
b) Ansar makes payment on May 18, 1999.
c) Ansar makes payment on June 18, 1999.

Solution :

a) Rebate $8000 \times \frac{6}{100} \times \frac{3}{12}$ = Rs.120/-

b) Rebate $8000 \times \frac{6}{100} \times \frac{2}{12}$ = Rs.80/-

c) Rebate $8000 \times \frac{6}{100} \times \frac{1}{12}$ = Rs.40/-.

Depreciation :

Depreciation means a fall in the quality, quantity or value of an asset.

I. Factors that cause depreciation

1. Wear and tear due to actual use.
2. Efflux of time – mere passage of time will cause a fall in the value of an asset even if it is not used. Ex. A patent right acquired on lease for 10 years loses 1/10 of its value for every year, even if it is not actually used.
3. Obsolescence – a new invention or a permanent change in demand may render the asset useless.
4. Accidents – when a fixed asset is damaged by an accident, naturally it loses its value.

Except a few cases like land and paintings, all assets depreciate.

Generally, depreciation is used only in respect of fixed assets (are those that are not meant to be sold but are meant to be utilized in the firm's business). Ex. Machinery, Patents, Buildings and goodwill.

II. Need for providing depreciation

1. To assess the profit correctly. Cost of the fixed asset used up in the period should be treated as cost or expense.
2. To estimate the value of the assets possessed by the firm.
3. The amount so kept out of profits for depreciation will be made available for the replacement of the asset when its life is over.

Factors for calculating depreciation :

1. The cost of the asset
2. The estimated residual scrap value at the end of its life.
3. The estimated number of years of its life. (Not the actual but the number of years it is likely to be used by the firm). A machinery may be capable of running for 30 years, but say, due to new inventions, it will be in use only for 10 years; then the estimated life is 10 years and not 30 years).

Methods of calculating depreciations :

a) Straight line Method or Fixed Percentage on Original cost or Fixed Installment Method

$$\frac{\text{Cost} - \text{Estimated Scrap Value}}{\text{Estimated Life}}$$

Note : In the case of companies, the scrap value is assumed to be 5% of the original cost of the asset.

This method is useful when the service rendered by the asset is uniform from year to year.

Example 1: A company purchased a lathe machine in the year 1995-96 at a cost of Rs.40,000/-. At the end of its estimated life of 10 years, it is expected to give Rs.5000/- when sold as scrap. Calculate the annual depreciation value.

$$\frac{40,000 - 5,000}{10} = \frac{35,000}{10} = 3,500/- \text{ per year}$$

Example 2 : A firm purchased machinery for Rs.22,500/- on 1.1.1998 and spent for its installation Rs.2,500/-. Its life was estimated to be 4 years with a scrap value of Rs.5000/-. Calculate the amount of depreciation.

Purchase cost of the machinery	:	Rs.22,500/-
Installation charges (to be regarded as cost of the machinery)	:	Rs. 2,500/-
		Rs.25,000/-
Scrap vale of the machinery at the end of its life	:	Rs. 5,000/-
Depreciation of the machinery	:	Rs.20,000/-

Depreciation for each year is $\frac{20,000}{4}$ = Rs.5,000/-.

b) Written down value method :

In this method, the percentage of deprecation is fixed, but it applies to the value at which the asset in the beginning of the year.

Example : At the rate of 10%, what is the amount of depreciation in the third year, if the cost of the machinery in the beginning is Rs.20,000/-.

Depreciation for the 1st year $20,000 \times \frac{10}{100} = 2,000/-$.

$\therefore$ Cost of the asset in the beginning of 2nd year is 20,000 – 2,000 = 18,000/-.

Depreciation for the 2nd year $18{,}000 \times \frac{10}{100}$ = Rs.1,800/-.

$\therefore$ Cost of the asset in the beginning of 3rd year is 18,000 – 1,800 = 16,200/-.

$\therefore$ Depreciation for the 3rd year $16{,}200 \times \frac{10}{100}$ = Rs.1,620/-.

Uses : Depreciation in earlier years will be heavy, but will be light as the asset gets old. Repairs on the other hand are light in the earlier years and heavy later.

The total of the two – depreciation and repairs – will be roughly constant.

c) Sum of the Digits Method :

The amount of depreciation for each year is calculated by the formula :

$$\frac{\text{Remaining life of the asset (including the current year)}}{\text{Sum of all the digits of the life of the asset in years}} \times \text{cost of the asset}$$

Example : For an asset costing Rs.50,000/-, Life is estimated for 10 years.

What is the amount to be provided for depreciation in the first year and also in second year ?

Solution : Sum of all the digits of the life of the asset in years is

$1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 = 55.$

$\therefore$ Amount of depreciation for the first year $= \frac{10}{55} \times 50{,}000 = 9091.$

$\therefore$ Amount of depreciation for 2nd year $= \frac{9}{55} \times 50{,}000 = 8181.$

d) Depletion Method : This method is used in the case of mines, quarries, etc.

Depreciation is calculated per tonne of output.

Example : Cost of mine is Rs.20,00,000 and it is estimated that the total quantity of mineral in the mine is Rs.5,00,000 tonnes.

The depreciation per tonne of output is

$$\frac{20{,}00{,}000}{5{,}00{,}000} = \text{Rs.4.}$$

If the output for the first year is 40,000 times,
then, the depreciation is 40,000 × 4 = Rs.1,60,000/-.

If the output for 2nd year is 60,000 tonnes,
then the depreciation is 60,000 × 4 = Rs. 2,40,000/-.

e) Machine Hour Rate Method

Effective life of machine may be 20,000 hours.

Example : An asset which costs Rs.45,000/- has a useful life of 24 years and a salvage value (Trade-in-value) of Rs.3000/-. What will be the depreciation expense for the first (1st) year, the 10th year and the 24th year if the sum of year's digit method is used ?

Ans: Rs.3,360/-; Rs.2,100/-; Rs.140/-.

ANNUITY

Meaning : An annuity is a series of equal periodic payments or deposits with the interest on each one being compound interest.

TYPES OF ANNUITY (by date of payment)

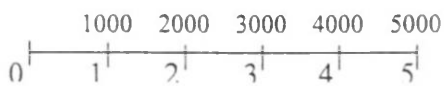
ORDINARY ANNUITY : Payments are made at the end of the payment intervals.

ANNUITY DUE : Payments are made at the beginning of the payment intervals.

DEFERRED ANNUITY : Payments are made at the end of the payment intervals but do not start until after a designated period of time.

Example for Ordinary Annuity

Find the amount of an ordinary annuity of five deposits of Rs.1000/- each made at the end of each year for 5 years, if the interest rate is 4% compounded annually.



The first deposit of Rs.1000/- is for 4 years;
The second deposit of Rs.1000/- is for 3 years;
The third deposit of Rs.1000/- is for 2 years;
The fourth deposit of Rs.1000/- is for 1 year;
and fifth receives no interest.

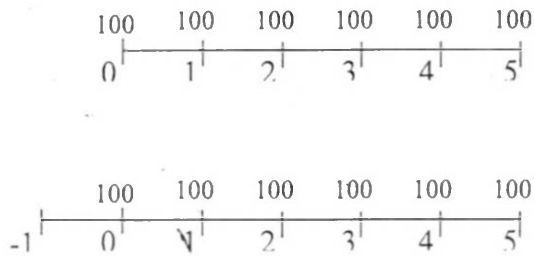
$\therefore$ $S = 1000\,(1.04)^4 + 1000\,(1.04^3 + 1000\,(1.04)^2 + 1000\,(1.04) + 1000$

$= 1000\ (1.1698586) + 1000\ (1.1248640) + 1000(1.08160) + 1000(1.04)+1000$

$= 5416.32$

Example for Annuity Due

If a payment of Rs.100 today and a like payment at the end of each year for 5 years, how much will be on deposit at the end of 6 years, if the interest rate is 5% compounded annually.



The first deposit of Rs.100/- is for 5 years.

The second deposit of Rs.100/- is for 4 years.

The third deposit of Rs.100/- is for 3 years.

The fourth deposit of Rs.100/- is for 2 years.

The fifth deposit of Rs.100/- is for 1 year.

The sixth deposit of Rs.100/- is for 0 years.

Example for Deferred Annuity

I deposited a sum of Rs.5000/- in TISCO on 1st January, for secured premium notes. The company agreed to pay me back at the rate of Rs.2000/- every year for about 5 years from the beginning of 1st January 1996.

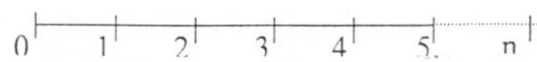
FORMULA TO FIND THE AMOUNT OF ORDINARY ANNUITY

Let P stands for the Principal;

r for interest rate per annum expressed in decimal form

n for number of years the money is left in deposit, and

A for amount or principal plus interest.



The first instalment paid at the end of 1st year will be in deposit for (n-1) years.

By using the compound interest formula this amounts to $P(1 + r)^{n-1}$.

Similarly the second instalment paid at the end of 2nd year amounts to $P(1 + r)^{n-2}$.

$$\therefore\ A = P(1+r)^{n-1} + P)1+r)^{n-2} + \ldots\ldots + P(1+r) + P$$

$$= P\ \{\ (1+r)^{n-1} + (1+r)^{n-2} + \ldots. + (1+r) + 1\ \}$$

$$= P\ \{\ 1 + (1 + r) + (1 + r)^2 + \ldots\ldots + (1 + r)^{n-2} + (1 + r)^{n-1}\ \}$$

(writing in reverse order)

$$= P\left\{\frac{1\{\ (1+r)^n - 1\ \}}{1 + r - 1}\right\} \quad = P\left\{\frac{(1 + r)^n - 1}{r}\right\}$$

(by using summation of G.P. formula)

For annuity done $A = P\left[\frac{(1+r)^{n+1} - 1}{r}\right] - P$.

PRESENT VALUE OF AN ANNUITY

The inverse of finding the amount of an annuity is finding the present value of the annuity.

Present value of an annuity is the amount of money to be deposited in the beginning so that one can withdraw a fixed amount of money at the end of each year for n-years, at which time the original investment and the interest (earned compoundly) exhausted completely.

Example : At age 21 Ram receives an inheritance of 20 equal annual payments of Rs.2000/- each, the first payment coming due at age 22. If money is worth 4% compounded annually, what is the cash inheritance at age 21 ?

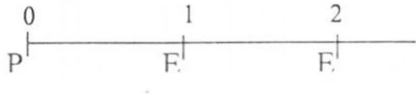
The cash inheritance is the present value of annuity.

FORMULA TO FIND THE PAYMENT VALUE OF ANNUITY

Let p is the present value, it is same as Principal,

r is the interest rate per annum expressed in decimal form,

E is the amount that can be withdrawn at the end of every year.



Consider the case for two years only.

At the end of the 1st year, the amount becomes

$$p(1 + r)$$

But ∵ E rupees is withdrawn, the principal at the beginning of the second year is $p(1 + r) - E$.

So by the end of 2nd year, this becomes $\{p(1 + r) - E\}\{1 + r\}$

But this is equal to E.

$$\therefore \{p(1 + r) - E\}\{1 + r\} = E$$

$$\text{i.e. } p(1 + r) - E = E(1 + r)^{-1}$$

$$p(1 + r) = E(1 + r)^{-1} + E$$

$$= E\{1 + r)^{-1} + 1\}$$

$$\therefore P = \{(1 + r)^{-2} + (1 + r)^{-1}\}$$

Consider the case for 3 years.

At the end of 1st year, the amount becomes $p(1 + r)$.

∵ E rupees is withdrawn, the principal becomes

$$p(1 + r) - E.$$

By the end of 2nd year this becomes

$$\{p(1 + r) - E\}\{1 + r\}$$

∵ E rupees is again withdrawn, the principal becomes

$$[\{p(1 + r) - E\}\{1 + r\}] - E$$

By the end of 3rd year, this becomes

$$[\{p(1 + r) - E\}\{1 + r\} - E][1 + r]$$

But this is equal to E.

$$\therefore [\{p(1 + r) - E\}\{1 + r\}] - E[1 + r] = E$$

$$\Rightarrow [\{p(1 + r) - E\}\{1 + r\} - E] = E(1 + r)^{-1}$$

$$\Rightarrow [\{p(1 + r) - E\}\{1 + r\}] = E(1 + r)^{-1} + E$$

$$\Rightarrow p(1+r) - E = E(1+r)^{-2} + E(1+r)^{-1}$$

$$\Rightarrow p(1+r) = E(1+r)^{-2} + E(1+r)^{-1} + E$$

$$\Rightarrow p = E\{(1+r)^{-3} + (1+r)^{-2} + (1+r)^{-1}\}$$

Similarly for n years, we can derive

$$p = E\{(1+r)^{-1} + (1+r)^{-2} + (1+r)^{-3} + \ldots\ldots + (1+r)^{-n}\}$$

The expression within the brackets is sum of n terms of a G.P. with

$$a = (1+r)^{-1} \text{ and } r = (1+r)^{-1}$$

$$\therefore \quad p = E\left\{(1+r)^{-1}\left[\frac{1-\{(1+r)^{-}\}^{n}}{1-(1+r)^{-1}}\right]\right\}$$

$$= E\left\{(1+r)^{-1}\left[\frac{1-(1+r)^{-n}}{1-\frac{1}{1+r}}\right]\right\}$$

$$= E\left\{(1+r)^{-1}\left[\frac{1-(1+r)^{-n}}{\frac{1+r-1}{1+r}}\right]\right\}$$

$$= E\left\{(1+r)^{-1}(1+r)\frac{[1-(1+r)^{-n}]}{r}\right\}$$

$$p = E\left(\frac{1-(1+r)^{-n}}{r}\right)$$

5. PROBLEM SOLVING

Dr B S P Raju

Problem 1 : In the addition given, each letter stands for a different digit. If C stands for 8, what does A, B, D,E stand for ?

```
  C D C
  A E B
B D B E
```

Solution : B = 1, since if C = 9 and A = 9 with carry 1; it becomes 9 + 9 + 1 = 19.

i.e. carry is atmost 1.

Now substituting C = 8 (given) & B = 1

```
  8 D 8
  A E 1
1 D 1 E
```

From the units column E = 9.
Substituting E = 9, we get

```
  8 D 8
  A 9 1
1 D 1 9
```

From the tens column we get D = 2.
Substituting D = 2

```
  8 2 8
  A 9 1
1 2 1 9
```

From hundreds column A must be 3.

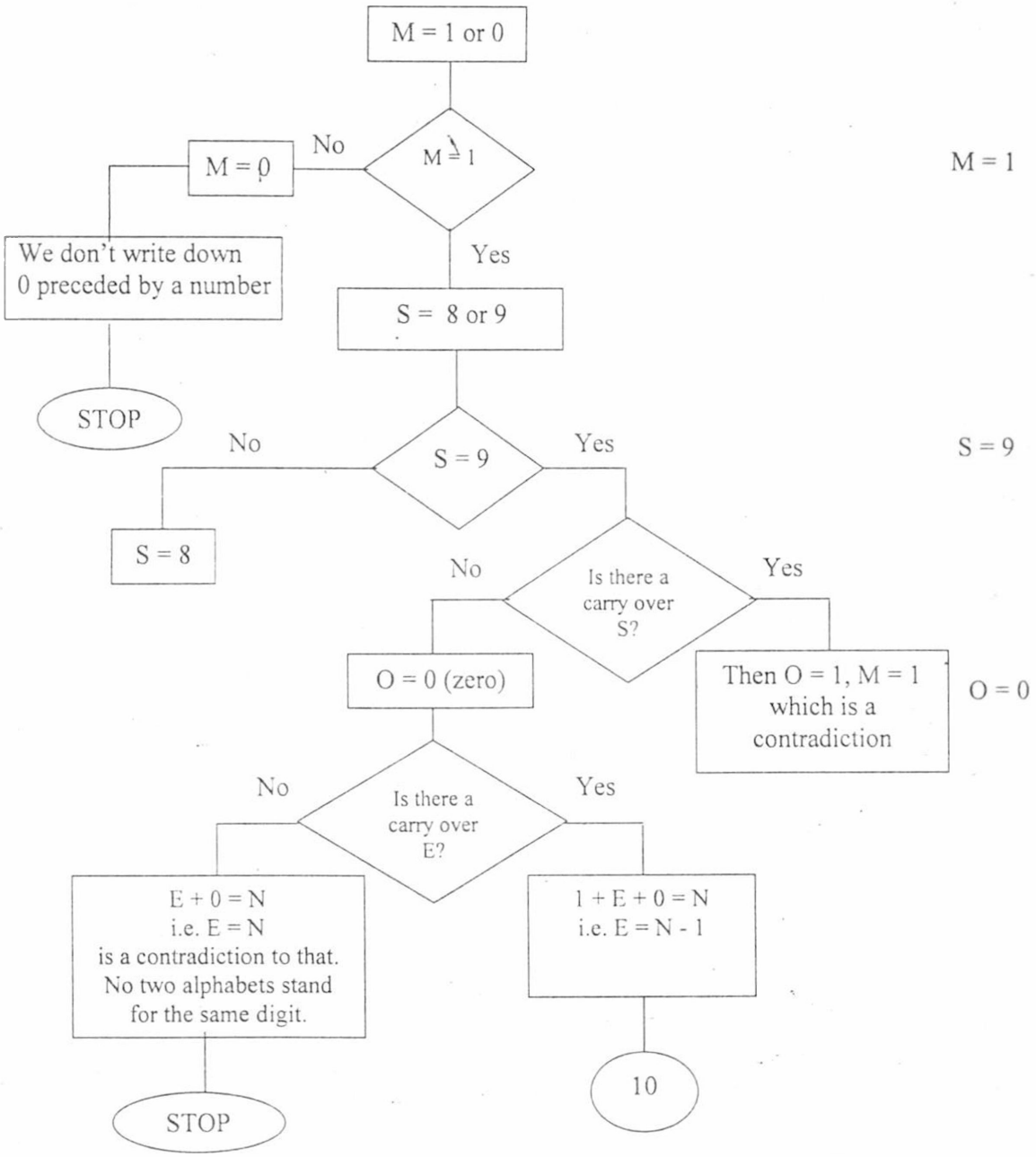
- C = 8, B = 1, E = 9, D = 2, A = 3.

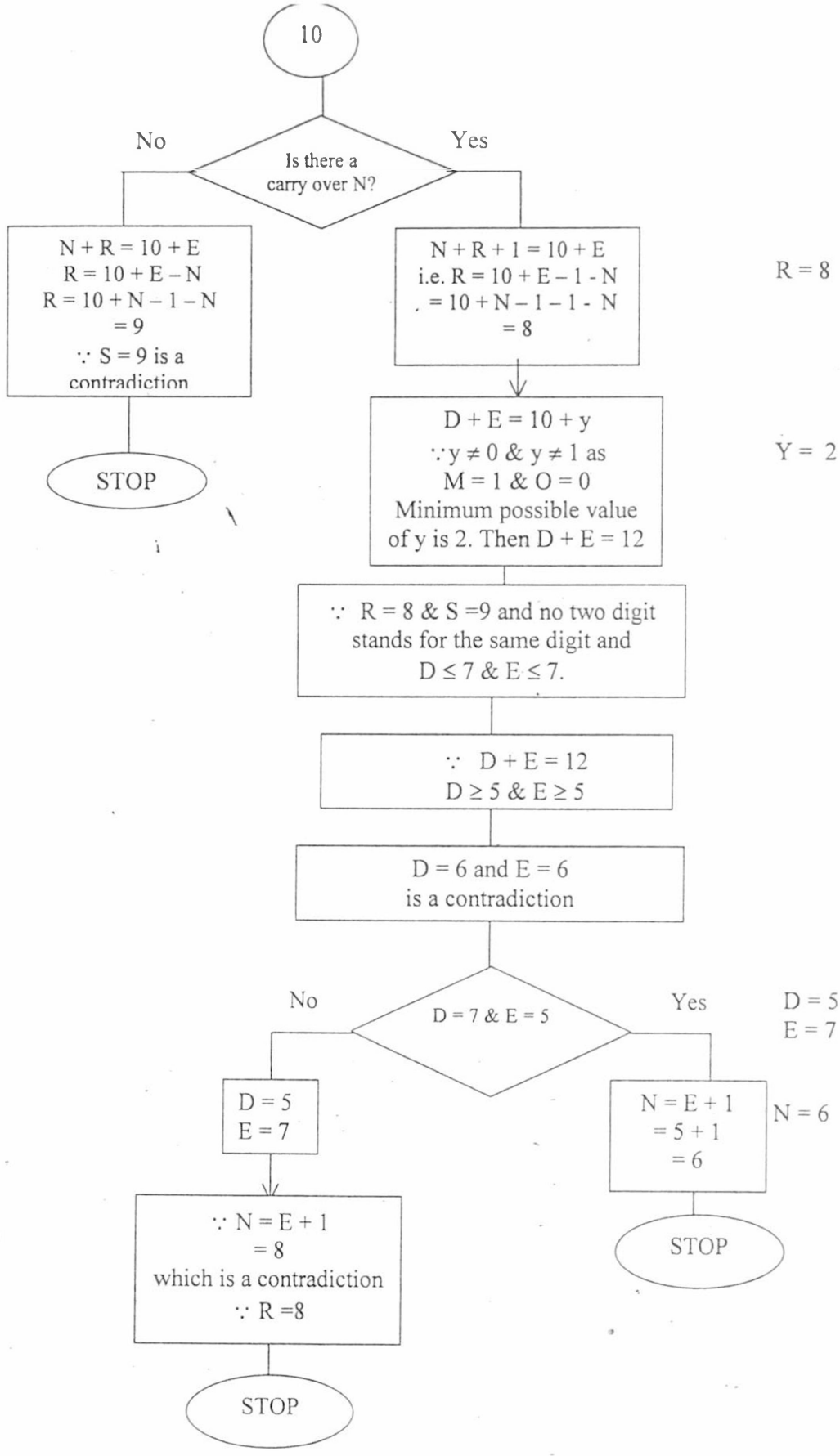
```
  8 2 8
  3 9 1
1 2 1 9
```

Problem 2 : If each of the alphabet stands for one digit from (0 to 9). No two alphabets stand for the same digit. Find the digits that stand for S, E, N, D, M, O, R, Y so that the given problem is valid.

S E N D
M O R E
M O N E Y

Proof:





$\therefore$ M = 1 Y = 2

S = 9 D = 7

O = 0 E = 5

R = 8 N = 6

S E N D	9 5 6 7
M O R E	1 0 8 5
M O N E Y	1 0 6 5 2

6. FUNDAMENTAL RESULTS ON PROBABILITY – I

Shri B C Basti

1. What are the axioms of probability function ?

2. If $A_1 < A_2$ (A_1, A_2 are events, P a probability function, then show that
   (i) $P(A_1) \leq p(A_2)$ (ii) $P(A_2 - A_1) = P(A_2) - P(A_1)$

3. For any event A show that $0 \leq P(A) \leq 1$.

4. Prove that the probability of an impossible event is zero.

5. If the probability of an event is zero then can we always say that the event is impossible ? Explain.

6. If A′ is the complement of A then show that $P(A') = 1 - P(A)$.

7. If $A_1, \ldots A_n$ are mutually exclusive events then prove that
   $$P\left(\bigcup_{i=1}^{n} A_i\right) = \sum_{i=1}^{n} P(A_i).$$

8. If A and B are any two events then show that
   $P(A \cup B) = P(A) + P(B) - P(A \cap B)$.

9. How do you generalize the above result and prove it for three events ?

10. For any two events A and B show that $P(A) = P(A \cap B) + P(A \cap B')$.

11. Generalise the above result and prove it.

12. Prove that $P(A_1 \cap A_2) \geq 1 - P(A'_1) - P(A'_2)$ where A_1 & A_2 are any two events.

7. PROBABILITY - PROBLEM SHEET I

B C Basti

1. An employer gives his illiterate servant six letters and six addressed envelopes to put the letters into them and post. Find the probability that the servant misplaces the letters.

2. An electric bulb will last 150 days or more with probability 0.7 and it will last utmost 160 hours with probability 0.8. Find the probability that the bulb will last between 150 hours and 160 hours.

3. If $\frac{1+3p}{3}$, $\frac{(1-p)}{4}$ and $\frac{(1-2p)}{2}$ are the probabilities of three mutually exclusive events, then find the interval of values of p.

4. There are 10 pairs of shoes in a cupboard from which 4 shoes are picked at random. Find the probability that atleast one pair is formed.

5. A determinant is chosen at random from the set of all determinants of order 2 with elements 0 or 1 only. Find the probability that the determinant chosen is non zero.

6. A fair coin is tossed 100 times. Find the probability of getting tails an odd number of times.

7. If A and b are mutually exclusive, then can we say that they are independent ?

8. Are independent events mutually exclusive ? Explain.

9. How do you generate the definition of conditional probability by using some standard example ?

10. If $A \subset B$ then can we say A and B are independent ?

PROBABILITY - PROBLEM SHEET – II

Shri B C Basti

1. Find the probability of a 4 turning up in two tosses of a fair die.

2. A box contains 6 red balls, 4 white balls and 5 blue balls. Three balls are drawn successively from the box. Find the probability that they are drawn in the order red, white and blue if each ball is (a) replaced (b) not replaced.

3. Box I contains 3 red and 2 blue marbles while Box II contains 2 red and 8 blue marbles. A fair coin is tossed. If the coin turns up heads a marble is chosen from Box I; if it turns up tails a marble is chosen from Box II. Find the probability that a red marble is chosen.

4. A speaks the truth 75% of the cases and B in 80% of the cases. In what percentage of cases are they likely to contradict each other in stating the same fact ?

5. Let E and F be two independent events. The probability that both E and F happen is 1/12 and the probability that neither E nor F happens is ½. Find P(E) and P(F).

6. Two events A and B are such that $P(A') = 0.3$, $P(B) = 0.4$ and $P(A \cap B') = 0.5$. Find $P(B \mid A \cup B')$.

7. Three groups A, B and C are competing for positions on the board of directors of a company. The probabilities of their winning are 0.5, 0.3 and 0.2 respectively. If group A wins the probability of introducing a new product is 0.7 and the corresponding probabilities for groups B and C are 0.6 and 0.5 respectively. Find the probability that the new product will be introduced.

8. Suppose an event A results in the mutually exclusive events $A_1,\ldots,A_n$ then show that

$$P(A) = \sum_{k=1}^{n} P(A_k)\ P(A \mid A_k)$$

Use this result to prove Bayes' theorem.

9. In a test an examinee either guesses or copies or knows the answer to a multiple choice question with four choices. The probability that he makes a guess is 1/3. The probability that he copies the answer is 1/6. The probability that the answer is correct, given that he copied is 1/8. Find the probability that he knows the answer to the question, given that he correctly answered it.

10. A man is known to speak the truth 3 out of 4 times. He throws a die and reports that it is a six. Find the probability that it is actually a six.

8. PROBLEMS FOR GIFTED CHILDREN INCLUDING L' HOSPITAL'S RULE

B C Basti

1. Explain the following statement :
   It is observed that while defining continuity at a point, we always take an open interval around that point, whereas for continuous functions on intervals, we choose closed intervals.

2. Let $f : [0,1] \to R$ be a function given by $f(x) = -1$ if x is rational
   $= 1$ if x is irrational.

   Can you explain the discontinuity of f over its domain without using the concept of limit ?

3. Let $f(x + y) = f(x) + f(y) \quad \forall \quad x,y \in R$.
   If f is continuous at $x = 0$, then f is continuous at all points of R.

4. Let $f(xy) = f(x) \cdot f(y) \quad \forall \quad x,y \in R$.
   If f(x) is continuous at $x = 1$, then show that f(x) is continuous at all $x \neq 0$.

5. If $f : [0,1] \to [0,1]$ is continuous function, then show that there exists $x \in [0,1]$ such that $f(x) = x$.

6. In the proof of Rolle's theorem, explain how you use the hypothesis that f has same value at end points.

7. State and prove Cauchy's Mean Value theorem and hence deduce Lagrange's Mean Value Theorem.

8. State L' Hospital's Rule and prove it.

9. If $f : R \to R$ is a function such that $| f(x) - f(y) | \leq | x - y |^2 \quad \forall \quad x, y \in R$ then show that f is constant.

10. If $f : R \to R$ is a function such that f is continuous at every rational point, then prove that f is continuous at every point of R.

9. CONCEPT ANALYSIS

Dr B S P Raju

Concept Name : **Equivalence Relation**

Concept Definition : Equivalence Relation in a set is a binary relation which possess (satisfies) Reflexive property, Symmetric property and Transitive property.

Essential Attributes :
Well defined set, a binary relation, Reflexive property, Symmetric property and Transitive property.

Non-Essential Attributes:
Type of set is non essential and type of relation is non essential.

Examples :

1. The relation 'equal to =' in a set R is an equivalence relation.
2. A binary relation R in the set of all triangles 'T' is an equivalence relation, where R stands for
   a) 'is congruent to'
   b) 'is similar to'
   c) 'has same area as'
   d) 'has same as perimeter as'
3. A binary relation 'is parallel to' in the set of lines in a plane is an equivalence relation.

Non-Examples :

1. A binary relation 'is a subset of' in a set of sets.
2. 'is less than' in the set of all rational numbers.
3. 'is a factor of' in the set of all natural numbers.
4. 'is perpendicular to' in the set of all lines in a plane.
5. ' >, greater than' in the set of all the integers.

Conceptual Hierarchy

1. Superordinate Concepts – Binary relation, relation
2. Subordinate Concepts – Reflexive relation, Symmetric relation, Transitive relation.
3. Coordinate Concepts – Anti-symmetric relation, inverse relation, function.

10. LESSON PLAN

Dr B S P Raju

Instructional Objectives

At the end of this lesson, a student will be able to

1. define an equivalence relation
2. state the characteristics of an equivalence relation
3. identify equivalence relation from the given relations
4. cite examples of equivalence relation
5. relate equivalence relation with other type of relations.

Teaching Point

Equivalence relation on a set is a relation on the set which satisfies Reflexive Property, Symmetric Property and Transitive Property.

Previous Knowledge

Examples Of Reflexive, Symmetric and Transitive Relations.

Expected Learning Outcomes	Sequential Learning Activities with inbuilt Evaluation		Blackboard work
	T :	***Introduction*** Good morning students (seeks the attention of the class). We have seen some properties of relation and based on these properties, we have distinguished between types of relations.	

Expected Learning Outcomes		Sequential Learning Activities with inbuilt Evaluation	Blackboard work
	T :	What are (or) Mention the properties of a relation ? ....S_1	
Recalls and lists.	**S_1 :**	Reflexive, Symmetric, Transitive, Anti-symmetric.	
	T :	Good. Mention the types of relations ? ....S_2	
	S_2 :	Reflexive, symmetric, transitive, anti-symmetric (Equivalence Relation).	
	T :	I have given you some homework to write the examples of reflexive, symmetric and transitive relations. Give me an example of reflexive relation?...S_3	
Gives an example of a reflexive relation.	**S_3 :**	"is equal to" in a set of R.	
	T :	Does this binary relation satisfy any other properties? ...S_4	
	S_4 :	Symmetric and transitive.	
	T :	Good, in the same manner check the other relations. (Gives some time to the students). What about the other binary relation ? ....S_5.	
	S_5 :	It satisfies only symmetric property.	
	T :	Repeats the same for few more binary relations.	

<table>
<tr><th>Expected Learning Outcomes</th><th colspan="2">Sequential Learning Activities with inbuilt Evaluation</th><th>Blackboard work</th></tr>
<tr><td></td><td></td><td>Development of the concept</td><td></td></tr>
<tr><td></td><td>T :</td><td>Look at the binary relations (showing to chalkboard). Are there any commonalities between the binary relations “is equal to”, “is parallel to” etc. from that of other binary relation?....S_6</td><td><table><tr><th>Binary relation</th><th>R</th><th>S</th><th>T</th></tr><tr><td>“is equal to”</td><td>✔</td><td>✔</td><td>✔</td></tr><tr><td>“is ⊥ar to”</td><td>×</td><td>✔</td><td>×</td></tr><tr><td>“is less than”</td><td>×</td><td>×</td><td>✔</td></tr><tr><td>.....</td><td>...</td><td>..</td><td>..</td></tr></table>R – Reflexive
S – Symmetric
T - Transitive

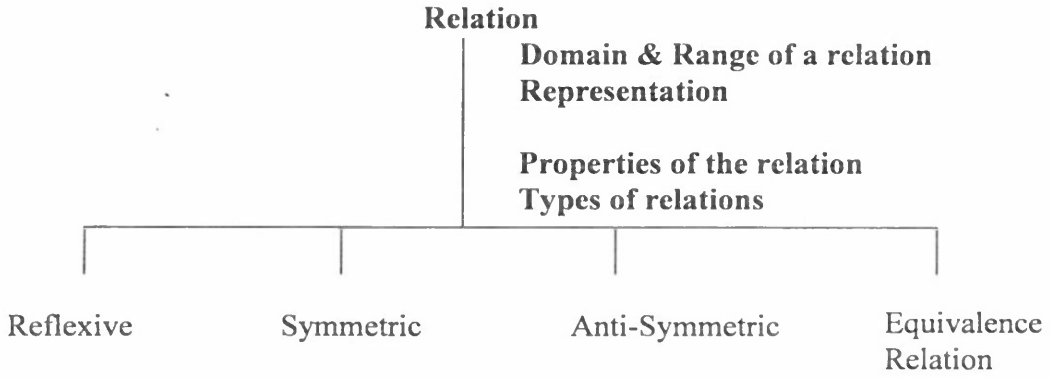
Teacher rounds of those binary relations which satisfy all the three properties.</td></tr>
<tr><td>Compares and contrasts the binary relations which satisfy all the properties from that of other binary relations.</td><td>S_6:</td><td>“is equal to”, “is parallel to”, etc. are satisfying all the three properties when compared to other binary relations.</td><td></td></tr>
<tr><td></td><td>T :</td><td>Good. The binary relations which satisfy all the three properties are called equivalence relations (writes on the board).</td><td>Equivalence Relation: Equivalence relation is a binary relation which satisfies reflexive property, symmetric property and transitive property.</td></tr>
</table>

Expected Learning Outcomes		Sequential Learning Activities with inbuilt Evaluation	Blackboard work
	T :	What is required for a binary relation to be an equivalence relation ? …S_7	
	S_7:	It should satisfy reflexive, symmetric and transitive properties.	
	T :	Good. (Gives a binary relation and asks) Is this an equivalence relation? ….S_8	1. "is less than or equal to" in a set of Real Numbers..
	S_8:	"is ≤" is not an equivalence relation.	2. "is to the left of" in a set of points on a line.
			3. "is collinear with" in a set of points in a line.
	T :	Why do you think so ? ….S_9	
Gives reason for the binary relation as the non-example of equivalence relation.	**S_9:**	It does not satisfy symmetric property.	
	T :	Good. Give me an example of an equivalence relation?…S_{10}	
	S_{10}:	"5 divides x – y" in a set of all integers.	
	T :	Why is it an equivalence relation ? …S_{11}	
Gives reasons for a binary relation to be an equivalence relation.	**S_{11}:**	Since it satisfies all the three properties.	
	T :	Right. We have seen that there are 3 conditions for a binary relation to be an equivalence relation.	1. Reflexive, 2. Symmetric and 3. Transitive properties.

Review and Evaluation

What is an equivalence relation ?
What are the characteristics of an equivalence relation ?
An equivalence relation is a kind of ---------- relation ?
What similarities and differences do you find between equivalence relation and other relations ?

Today we learnt about equivalence relation.



11. PROJECTS IN MATHEMATICS

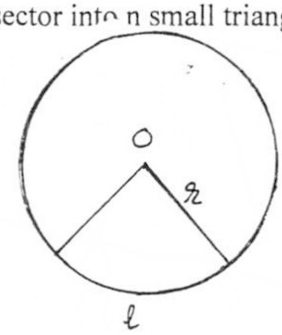
Prof N M Rao

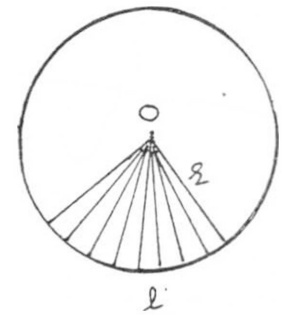
1. Area of the Circle

Objective : To find the area of the circle by using the area of small sectors.

Description :

Take a circle of radius r. Consider a sector of the circle of arc length l and divide the sector into n small triangles as shown in the figure.





The area of each triangle = $\frac{1}{2} rb$ where b = $\frac{l}{n}$.

The total area of the sector of arc length l = n (½ rb)
= ½ r (nb)
= ½ rl
since l = nb

In the same way, the area of the circle = ½ rc, where c is the circumference of the circle.

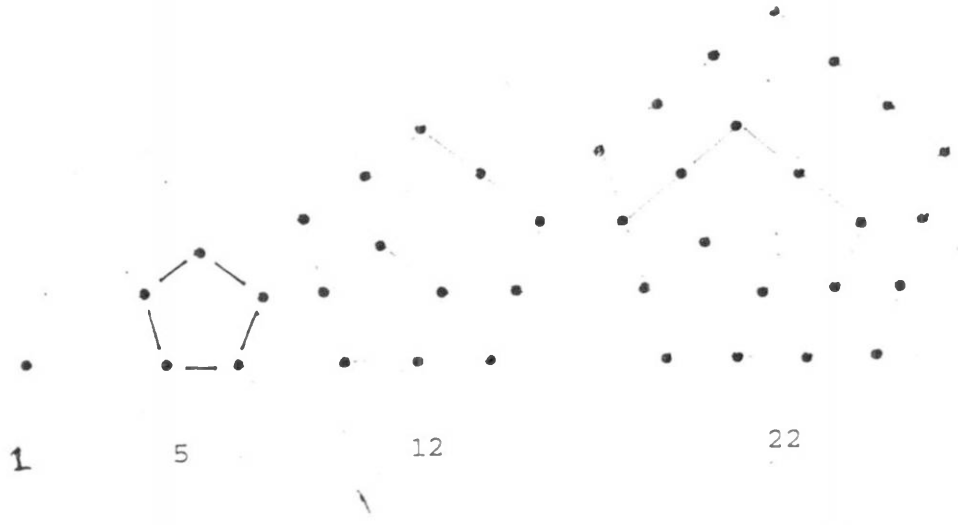
Area of the circle = ½ rc
= ½ r (2 π r)
= πr^2

2. Pentagonal Numbers

Objective : To enable the students to acquire the knowledge of pentagonal numbers.

Description:

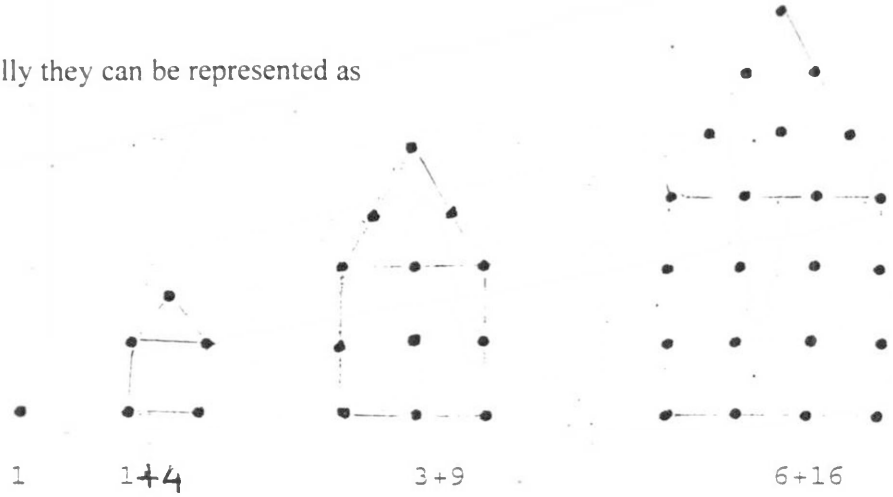
Numbers can be represented in certain patterns. One of the patterns is by representing the dots. The below shown are the pattern of pentagonal numbers.



1,5,12,22,….. are called pentagonal numbers. These pentagonal numbers are obtained by adding triangular numbers and square numbers. The pattern thus formed with these numbers are

Triangular Numbers	+	Square Numbers	=	Pentagonal Numbers
	+	1	=	1
1	+	4	=	5
3	+	9	=	12
6	+	16	=	22
10	+	25	=	?

Thus pictorially they can be represented as



The bindis can be pasted on chart paper and the patterns of the pentagonal numbers can be enjoyed by the students.

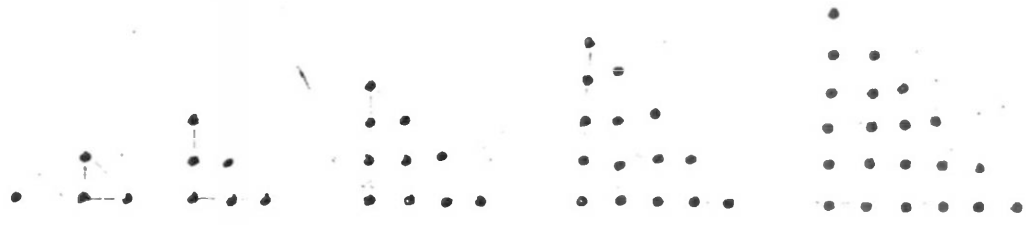
1. The students can be asked to guess the next pentagonal numberand verify it afterwards by adding the corresponding triangular and square numbers.
2. The students can also be asked to find a formula to represent the triangular, square and pentagonal numbers

3. Tetrahedral Numbers

Objective : To enable th students to acquire the knowledge of the development of fifth tetrahedral number through Pythagorean, triangular numbers.

Procedure :

The first six Pythagorean numbers are 1,3,6, 10, 15 and 21. They are represented as follows:



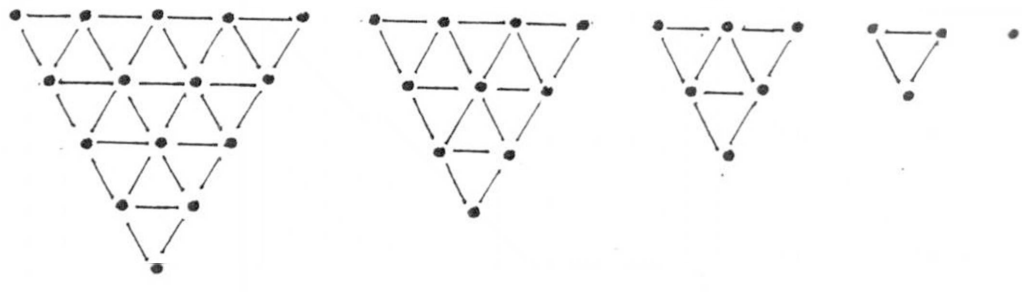
T1	T2	T3	T4	T5	T6
=1	(1+2)	(1+2+3)	(1+2+3+4)	(1+2+3+4+5)	(1+2+3+4+5+6)
=1	=3	=6	=10	=15	=21

Look at the pattern down below and the series in the fourth line :

1	1	1	1	1	1	1	1	
1	2	3	4	5	6	7	8	The Natural Numbers
1	3	6	10	15	21	28	36	The Triangular Numbers
1	4	10	20	35	56	84	120	The Tetrahedral Numbers

The tetrahedral number is built up from Pythagorean, triangular numbers as follows :

#



15 + 10 + 6 + 3 + 1

1; (1+3)=4; (1+3+6)=10; (1+3+6+10)=20; (1+3+6+10+15)=35

Taking clue from the above table, a model of the tetrahedral numbers is formed by keeping the patterns one upon the other as follows :

1. Keep one ball on the top step.
2. Below that, keep a step having three balls.
3. Next step contains 6 balls.
4. Next lower step contains 10 balls.
5. The fifth step contains 15 balls.

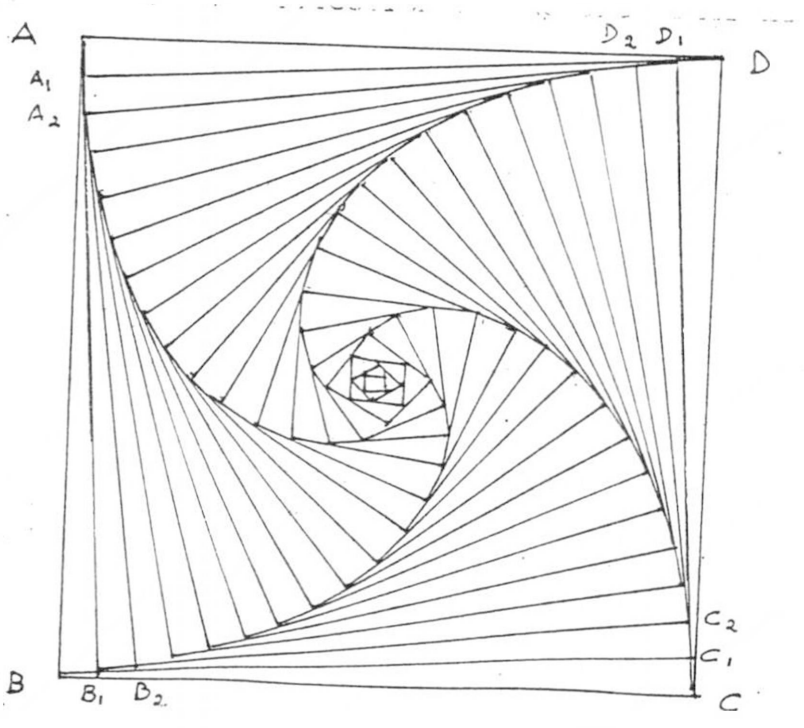
Now the complete model contains 15 + 10 + 6 + 3 + 1 = 35 balls – A tetrahedral number is built up from triangular numbers. Similarly any tetrahedral number can be built up as the sum of triangular numbers.

The students can be asked to prepare a vertical model of the above. They can also be asked to guess a formula to find tetrahedral numbers.

4. Path of Pursuits

Objective: To find the paths of four ants placed at the corners of the square, each one moving in the direction of the ant in front of it. (This path is called the path pursuits).

Take a piece of stiff card board and mark a square ABCD of side 10 cm. Mark the point A_1 on AB at ½ cm distance from A. Similarly mark B_1, C_1 and D_1 at ½ cm from B, C and D respectively. Now mark A_2 at a distance of ½ cm from A_1, on the line A_1B_1, B_2 at ½ cm from B_1 on the line B_1C_1 and so on. Continue in this way until the center of the square is reached. These envelopes are known as curves of pursuit. Since they are the paths which four ants originally placed at the corners of the square, would follow if they were always to walk in the direction of the ant in front of them.

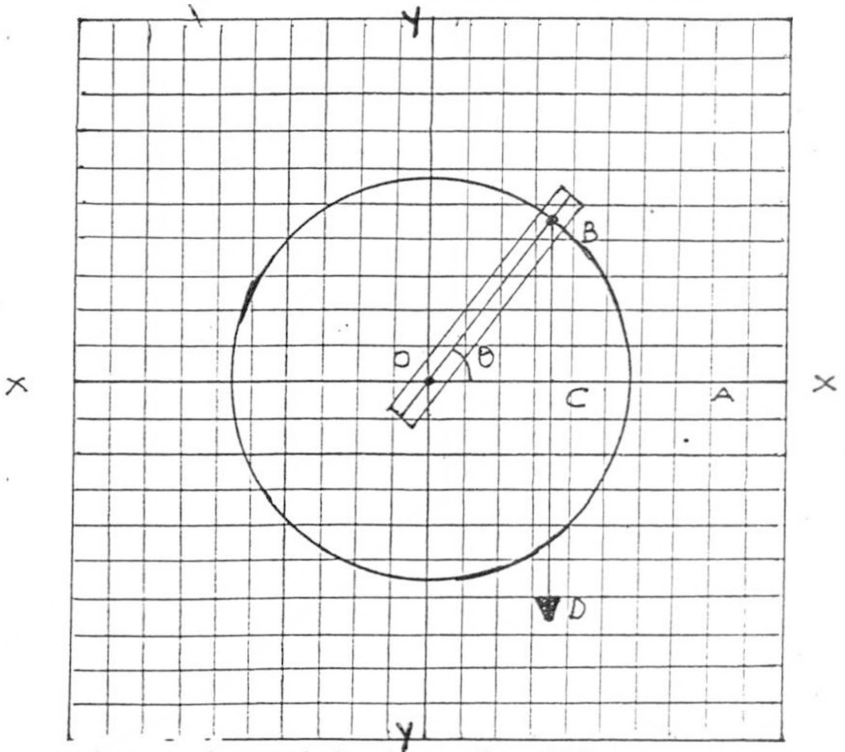


1. Can you stitch the path of pursuits on a black coloured cloth using white thread ?
2. Where is the point at which all four ants meet each other in the end ?
3. Read the chapter on envelopes and evolutes (geometry) to understand the significance of this path.

5. Building Trignometrical Tables

Objective: A simple device can be constructed by the students that will enable them to make their own table of trigonometric ratios for the sine and cosine.

Procedure :



1. On a graph paper, draw a circle with a radius of 10 cm.
2. Cut thin strip of cardboard atleast 12 cm long.
3. Draw a line down the center of the strip.
4. Attach one end of the strip to the center of the circle.
5. At the other end of the strip, 10 cm from the point where it is attached to the circle, make a small hole and attach a piece of thread.
6. At the opposite end of the string, attach a weight to serve as a plumb line.

The strip OB can be rotated around the point O so that OB makes different angles θ with x-axis. The hanging plummet BD cuts the x-axis at the point C. Count the number of spaces of length of the cord BC. Since hypotenuse is fixed at 10 cm, we can easily determine sine ratio. $\sin \theta = BC/10$. As we change the angle by moving the cardboard strip, we can observe the change in the value of $\sin \theta$. Similarly the value of $\cos \theta$ can also be read by counting the number of spaces of horizontal axis OA. $\cos \theta = OC/10$.

From this we can get the value of tan θ, cot θ, sec θ and cosec θ. There may be some error in counting the lengths of BC and OC. Therefore, students are asked to compare these values of sin θ, cos θ, etc. with the standard values given in the trigonometric tables.

6. Solids of Revolution

Objective: To show that various geometrical figures when revolved around a particular axis give various solids.

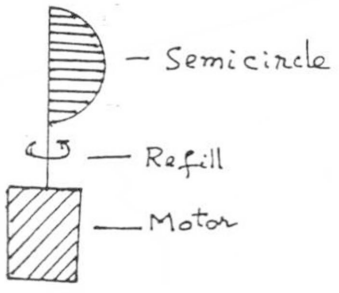
How to use this aid

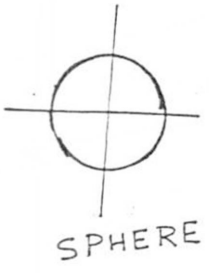
The teaching aid consists of a motor and various objects of following shapes :

a) circular
b) parabolic
c) triangular or angular
d) square or rectangular

The objects are fixed to a pen refill, that should be attached to the motor which rotates about its axis. We get the following solids of revolution.

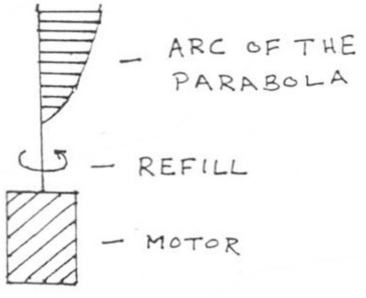
a)

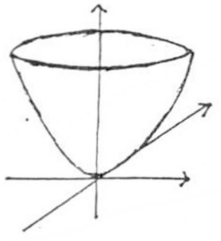




SPHERE

b)





PARABOLOID

7. Path of the Moving Chord Inside a Circle

Objective : To illustrate that, the path of the moving chord of constant length inside a circle is a circle and to find out the radius of this inner circle.

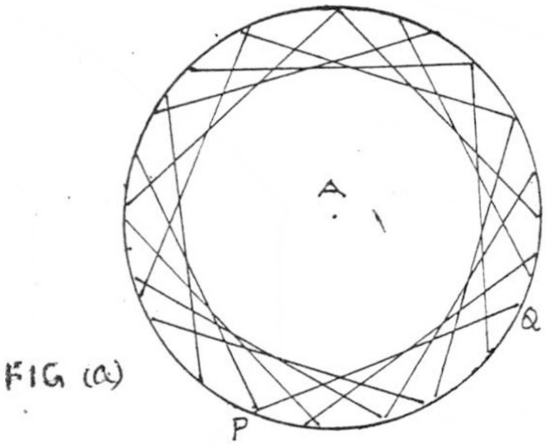


FIG (a)

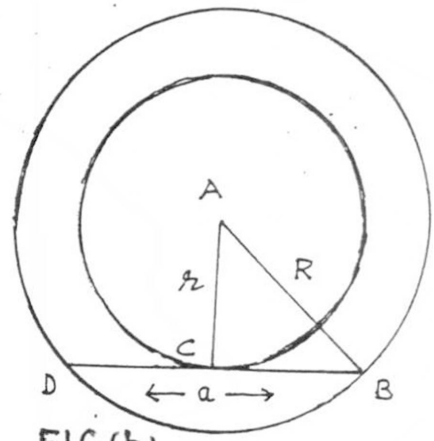


FIG (b)

PQ is a chord of constant length which moves inside the circle of a radius R, centred at the point A. What is the path of PQ ? The students can move the stick PQ inside the circle and convince themselves that the path of the moving chord PQ of constant length inside a circle in a circle. They can repeat the experiment and verify the above fact. It is also clear that the center of the new circle is also A. What is the radius of this inner circle?

To find the radius of the inner circle see Fig. (2).
In which BD = a (length of the chord)
AB = R (radius of the outer circle)
AC = r (radius of the inner circle)

By Pythagoras theorem,

$$AB^2 = AC^2 + BC^2$$

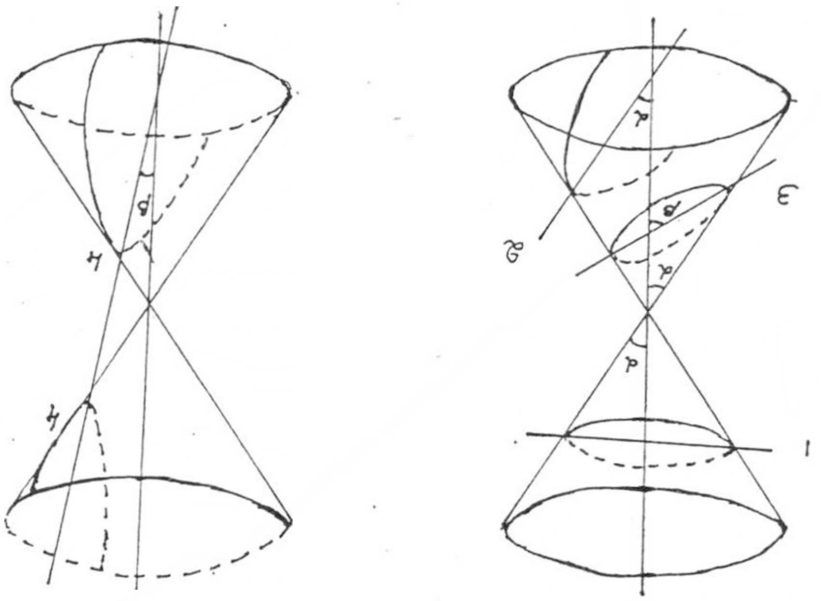
$$R^2 = r^2 + \left(\frac{a}{2}\right)^2$$

$$r = \sqrt{R^2 - \frac{a^2}{4}}$$

1. What happens if the length of the chord PQ is equal to the diameter of the bigger circle ?
2. What happens if the length of the chord PQ is equal to the radius of the bigger chord?

8. Conic Sections

Objective: To show that when a right circular cone is cut in four specific ways we get conic sections namely (1) circle, (2) parabola, (3) ellipse and (4) hyperbola.



How to use

- Hold the model and chart side by side, disjoint the right circular cone at the place marked '1' and see that the edge of the surface is a circle i.e. we get a circle by cutting the right circular cone perpendicular to its axis by a plane.
- Similarly disjoint the cone at the place marked '2' and see that the edge of the surface is a parabola, i.e. when we cut the cone parallel to one of its side we obtain parabola.
- Disjoint the cone at the place marked '3' and see that the edge of the surface is an ellipse, i.e. when we cut the cone at an inclined angle we get ellipse.

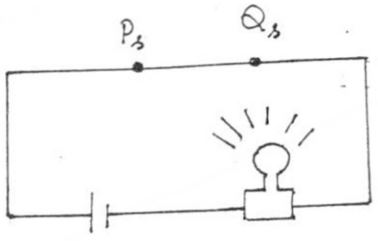
9. Logic Box

Objective: To enable the students to understand the conjunction (^) and Disjunction (v) of two statements and draw their truth tables.

P ^ Q = P and Q (Conjunction)
P v Q = P or Q (Disjunction)

How to use the Teaching Aid :

1. Connect the battery to the circuit. The circuit is now ready to operate.
2. The Ps and Qs switches, are connected in the series circuit. The circuit is given by



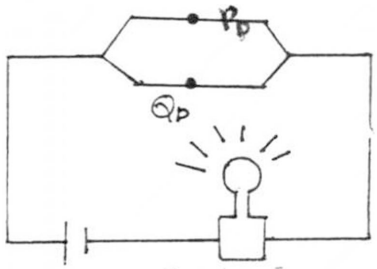
(i) When the switches Ps and Qs are both switched on the light is on (T ^ T = T).
(ii) When either of the switches are off the light is off (T ^ F = F).
(iii) When both the switches are off, the light is off (F ^ F = F).

The truth table for the given "And" circuit is :

Ps	Qs	Ps ^ Qs
T	T	T
T	F	F
F	T	F
F	F	F

This is called the *conjunction.*

3. Now see the disjunction (v) circuit.
Pp and Qp are connected in parallel circuit. The circuit is shown as



(i) When both Pp and Qp are switched on, the light is on (T v T = T).
(ii) When either Pp or Qp are switched on, the light is on (T v F = T).
(iii) When both Pp or Qp are switched off, the light is off (F v F = F).

The truth table is given by

Pp	Qp	Pp v Qp
T	T	T
T	F	T
F	T	T
T	F	F

The 'OR' circuit is off only when both Pp and Qp are off. This is called the disjunction of P, Q (Read as P or Q).

Verify whether the following statements are true or false :

1. (Conjunction) : Either 2 + 3 = 6 and 4 + 5 = 9.
2. (Disjunction) : Either 2 + 3 = 6 or 4 + 5 = 9

Justify your answer using the logic box.

10. Magic Square

Problem

Prepare a magic square by putting the given numbers between 1 and 20 in the holes of given 3 × 3 box such that sum of columns, rows and diagonals should be 21.

x_1	x_2	x_3
y_1	y_2	y_3
z_1	z_2	z_3

Solution

The least sum from 3 × 3 magic square will be 15, a multiple of 3. Let the sum be "a". To find the numbers in the magic square first subtract 15 from "a" divide by 3 and add 1.

$$\frac{a - 15}{3} + 1 = C \qquad \ldots\ldots \quad (1)$$

C will occupy the position of z_2. The number at x_3 will be c + 1. Similarly $y_2 = x_3 + 3$, $z_1 = y_2 + 3$ ($x_3 + 6$). From these four numbers we get $z_3 = a - (z_1 + z_2)$, $x_2 = a - (z_2 + y_2)$, $z_1 = a - (x_2\ x_3)$, $y_3 = a - (x_3 + z_30$.

Here the given sum is 21. From (1) $z_2 = \frac{21 - 15}{3} + 1 = 3$

$x_3 = 3 + 1 = 4$, $y_2 = 4 + 3 = 7$, $z_1 = 7 + 3 = 10$ or $4 + 6 = 10$,
$z_3 = 21 - (10 + 3) = 8$, $x_2 = 21 - (3 + 7) = 11$, $y_1 = 21 - 16 = 5$
$x_1 = 21 - (11 + 4) = 6$, $y_3 = 21 - (4 + 8) = 9$.
Therefore, a magic square of sum 21 is as follows:

6	11	4
5	7	9
10	3	8

This method can be applied for any 3 × 3 magic square.

1. Students are advised to try to form a different magic square in which the sum is 21.
2. Form a magic square of sum 15.

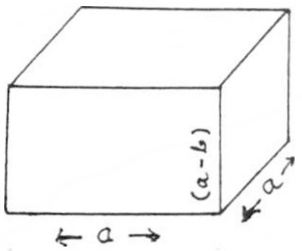
11. Model of $a^3 - b^3$

Objective : This model is to illustrate that

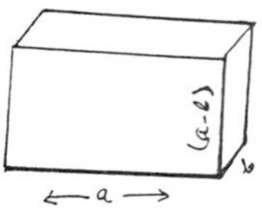
$$a^3 - b^3 = (a - b)\, a^2 + (a - b)\, ab + (a - b)\, b^2$$
$$= (a - b)(a^2 + ab + b^2)$$

Model : There are three wooden blocks of the following dimensions as shown :

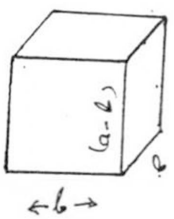
(i) $(a - b) \times a \times a$



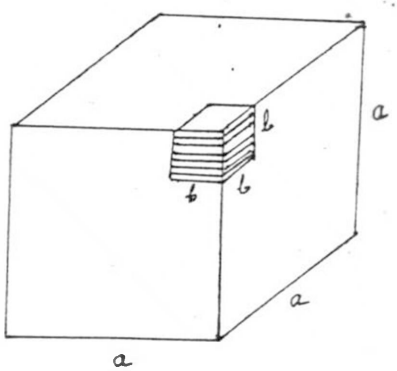
(ii) $(a - b) \times a \times b$



(iii) $(a - b) \times b \times b$



The three wooden blocks can be arranged in such a way that the complete assembly looks like $a^3 - b^3$, i.e. a small cube of volume b^3 has been removed from cube of volume a^3 units.



The students are requested to assemble the wooden blocks and convince themselves about the result :

$$
\begin{aligned}
& (a-b) \times a \times a + (a-b) \times a \times b + (a-b) \times b \times b \\
= \quad & (a-b)\, a^2 + (c-b)ab + (a-b)b^2 \\
= \quad & (a-b)\,(a^2 + ab + b^2) \\
= \quad & a^3 + a^2b + ab^2 - a^2b - ab^2 - b^3 \\
= \quad & a^3 - b^3
\end{aligned}
$$

12. Envelopes

Objective: To enable the students to understand the locus of a point and envelope of a set of lines.

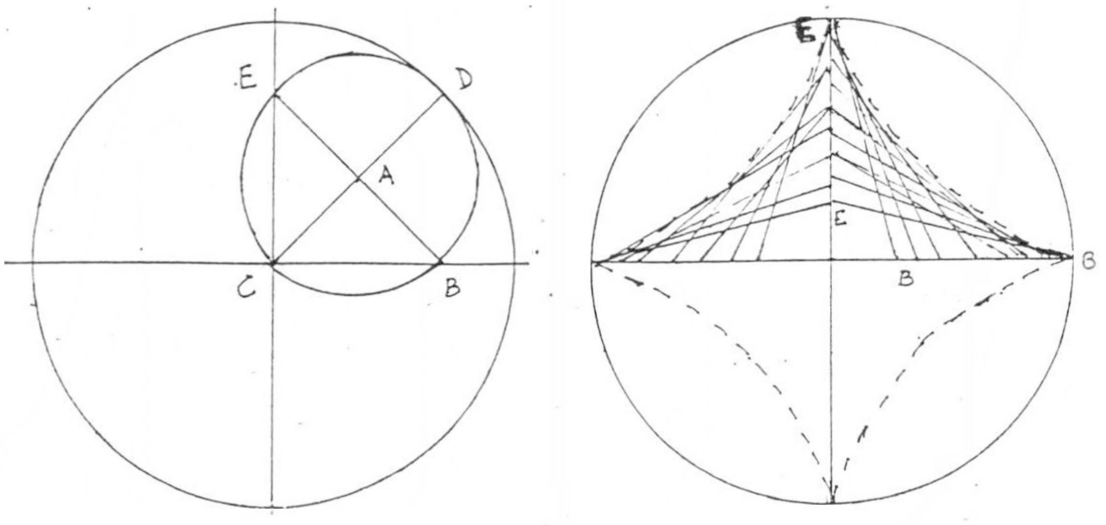
Analysis : A set of points obeying a rule is called locus and a set of lines obeying a rule is called an envelope.

Experiment :

Cut a hole whose radius is the diameter of a one rupee coin, in a piece of cardboard. Roll the coin, without slipping, round the hole. What is the locus of

(a) the center of the coin ?

(b) a point on the circumference ?



Answer :

(i) If B is any point on the coin, then the locus of B is the diameter of the hole.

(ii) If BE is the diameter of the coin, the locus of E is the perpendicular diameter of the hole.

(iii) The locus of A, the center of the coin, is a circle.

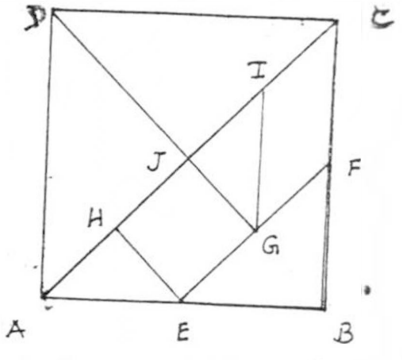
(iv) The envelope of BE is an astroid.

13. Tangrans

Objective : To form the geometrical shapes of squares, rectangles, hexagon, trapezium, etc. from the given pieces and to improve the mental ability of students.

Construction:

1. Take a square cardboard ABCD of side length 20 cms.
2. Draw the diagonal segment AC as shown in the figure.
3. The points E and F are mid points of AB and BC respectively. Draw EF.
4. G is the midpoint of EF. Draw GD.
5. Construct the line segment EH perpendicular on AC from the point E.
6. Draw a line segment GI, from the point G parallel to BC to cut the line AC at the point I.

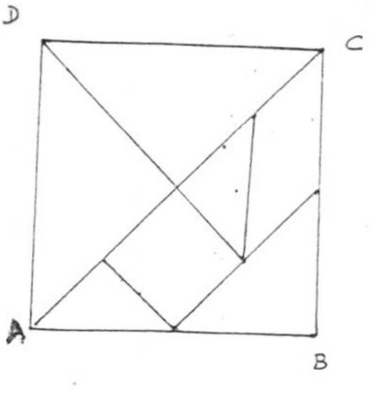


By cutting along the lines as shown in the figure, we get tan gram pieces.

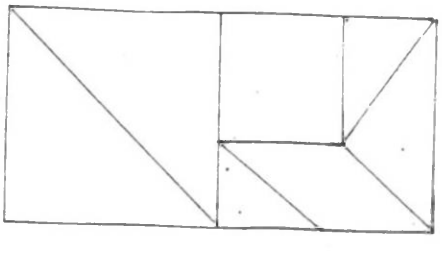
How to use

Take out all the seven tan gram pieces. Ask the learner to arrange the given pieces.

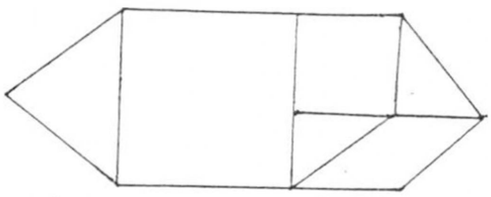
(i) to form a square



(ii) to form a rectangle

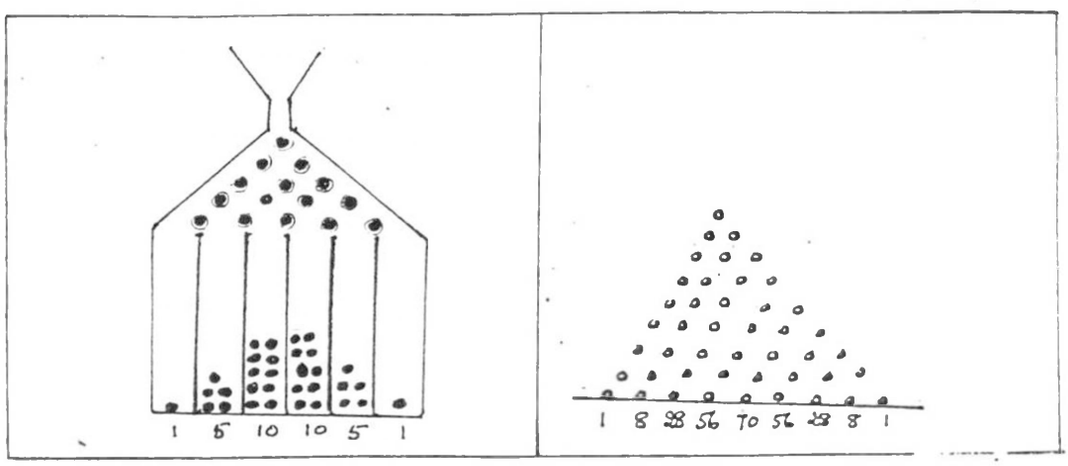


(iii) to form a hexagon



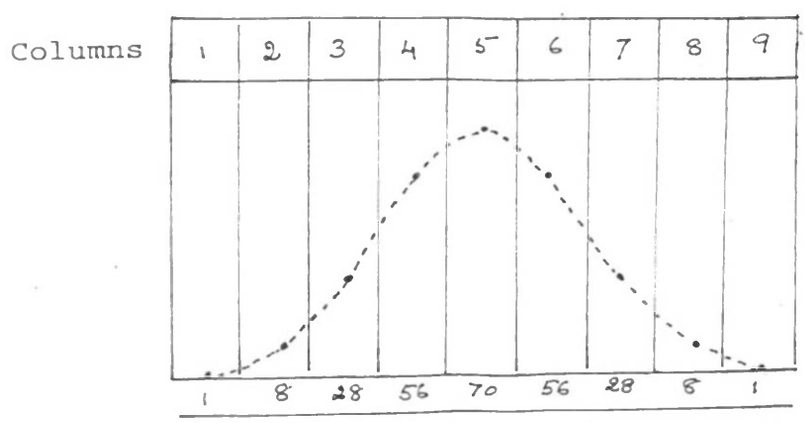
14. Probability Curve Experiment

Objective : This is a wooden model to show that the marbles flowing through a series of nails in the form of Pascal's triangle, will settle down in the shape of a Normal Probability Curve.



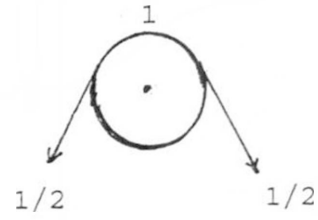
How to use it

The nails are fixed on a wooden board according to the Pascal's Triangle as shown in the figure. Above the nails, a metal box is fitted to pour the marbles uniformly. As we pour the marbles in the metal box, they come and settle in the columns in the form of normal probability curve as shown.



Principle

When we pour the marbles at the top, at the first nail, half of the marbles will flow by the left side of the nail and half the marbles will flow by the right side of the nail as shown :



The marbles coming to left nail in the second row will have two equal possibilities to go to the 3rd row, ¼ to the left and ¼ to the right. Similarly the marbles coming to the right nail in the second row will have two equal chances to go to the 3rd row, ¼ to the left of it and ¼ to the right of it. Hence in the second row, the marbles flow will be as follows : ¼ in the left, ¼ + ¼ = ½ in the center and ¼ in the right. Similarly in the third row, the marbles flow as follows : 1/8, 3/8, 3/8 and 1/8. If we continue in this way, in the eight row marbles flow as follows:

$$\frac{1}{256}, \frac{8}{256}, \frac{28}{256}, \frac{56}{256}, \frac{70}{256}, \frac{56}{256}, \frac{28}{256}, \frac{8}{256}, \frac{1}{256}$$

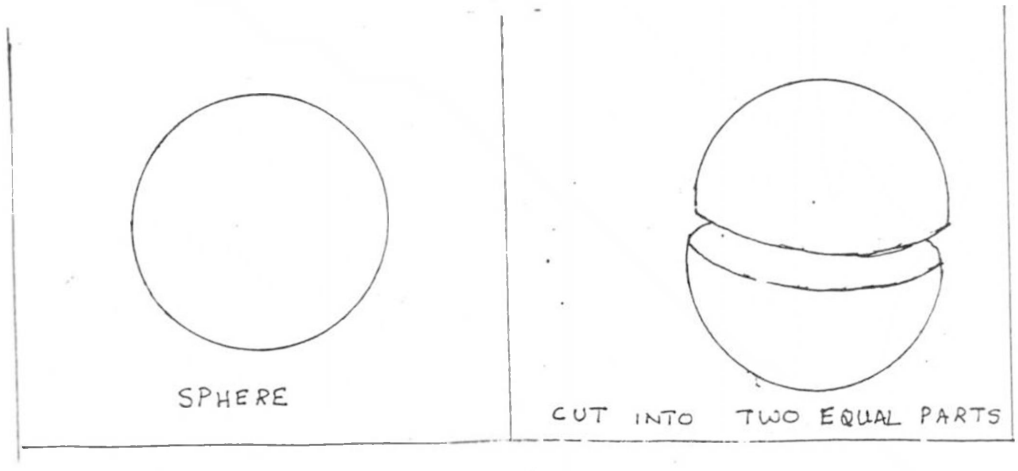
In other words, if we pour 256 marbles from the top, then in a normal case, the number of marbles setting in each column will be as shown below.

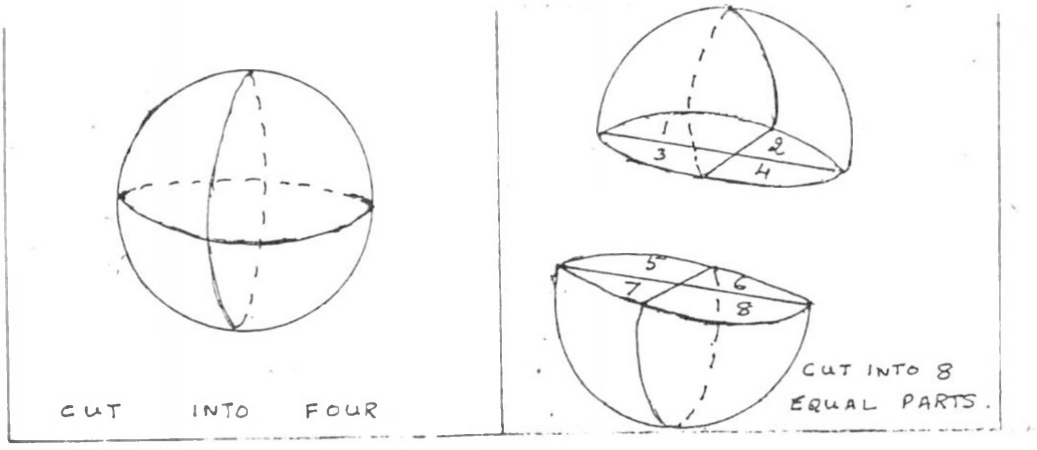
15. Relation between the volume of sphere and volume of cube, constructed from the sphere

Objective: To see the relation between the volume of the original sphere and the volume of the interior of the simple cube constructed from the sphere.

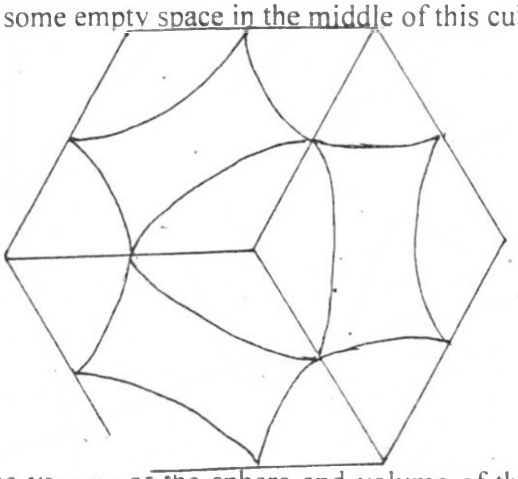
How to use:

Take a sphere of radius 'R' and cut the sphere into eight equal parts as shown below:





Join them from the reverse direction to form an object similar to a cuboid as shown below. Note that there will be some empty space in the middle of this cuboid.



The comparison is between the volume of the sphere and volume of the interior (empty space) of the constructed simple cube.

Volume of sphere = $\frac{4}{3}\pi R^3$

Volume of cube = $(2R)^3 = 8R^3$

Volume of the interior empty space of = $8R^3 - \frac{4}{3}\pi R^3$.

% of empty space in the cube = $\frac{8R^3 - (4/3)\pi R^3}{(4/3)\pi R^3} \times 100$

$= \left(\frac{6-\pi}{\pi}\right) \times 100$

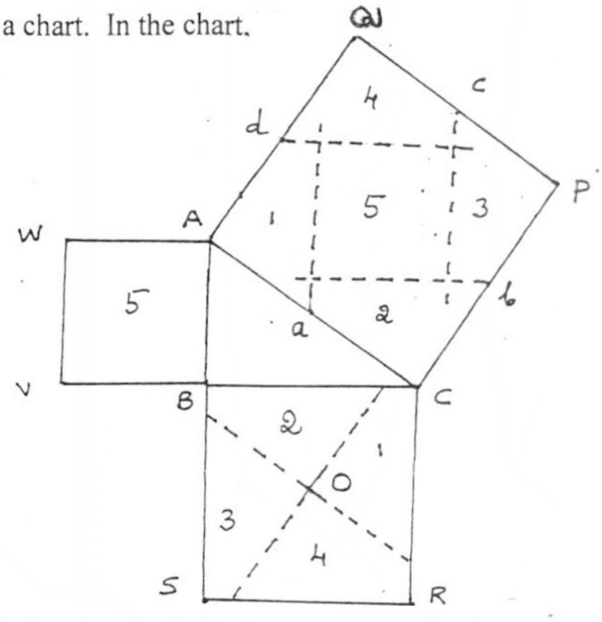
Note that this expression is independent of R.
The percent of empty space remains the same, even if the diameter of the sphere changes.

16. Pythagoras Theorem (Perigal's Dissection Method)

Objectives: To show that in a right angled triangle ABC, $AC^2 = AB^2 + BC^2$ where AC is the hypotenuse, by the Perigal's Dissection Method.

Procedure :

There is a wooden model and a chart. In the chart.



ABC is the given right angled triangle. BCRS is the square on the side BC. O is the point of intersection of the diagonals BR and CS. Draw a line parallel to AC through O. Also draw a line perpendicular to AC through O. They divide the square BCRS to four parts 1,2,3,4 as shown in the figure.

a, b, c, d are mid points of AC, CP, PQ and QA respectively. Draw lines parallel to the line AB through a and c. Draw lines perpendicular to the line AB through b and d. These four lines divide the square ACPQ into five parts 1,2,3,4 and 5 as shown.

There are five plastic cut pieces which are congruent to the shapes 1,2,3,4 and 5.

Place these plastic pieces numbered 1,2,3 and 4 on the square on BC and piece numbered 5 on the square on AB as shown in the figure.

Now place the same five pieces on the square on the hypotenuse AC. The five places exactly fit in the square on the hypotenuse (the areas are equal).

The above method justifies that

$AC^2 = AB^2 + BC^2$

Remember that it is not a proof.

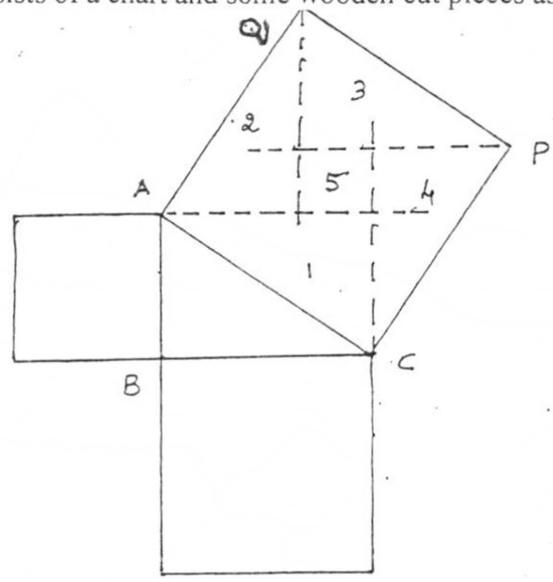
The teachers and the students are welcome to give a mathematical proof for the Perigal's method.

17. Pythagoras theorem (Bhaskaracharya's Dissection Method)

Objectives: To show that in a right angled triangle ABC, $AC^2 = AB^2 + BC^2$ where AC is the hypotenuse, by Bhaskaracharya's Dissection Method.

Procedure

This teaching aid consists of a chart and some wooden cut pieces as shown in the following figure.



ABC is a right angled triangle. ACPQ is the square on the side AC. Draw lines parallel to AB from the vertices Q and C. Also draw lines parallel to BC from the vertices P and A, and hence divide the square ACPQ into four triangles congruent to the triangle ABC and a square in the center whose side length is (BC – AB) as shown in the figure.

Now,

Area of the square ACPQ
$= 4\ (1/2 \times AB \times BC) + (BC - AB)^2$
$= 4\ (1/2 \times AB \times BC) + BC^2 + AB^2 - 2BC\ .\ AB$
$= 2\ AB.\ BC + BC^2 + AB^2 - 2AB\ .\ BC$
$= BC^2 + AB^2$

$\therefore AB^2 + BC^2 = AC^2$

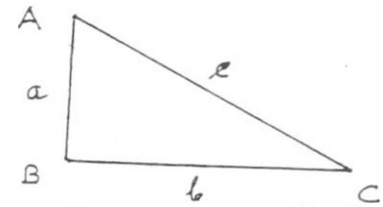
By keeping the wooden pieces in the appropriate places, the students can convince themselves that the result is true.

Now try to give a complete mathematical proof for Bhaskaracharya's method.

18. Pythagoras Theorem (Chau Pei's Dissection Method)

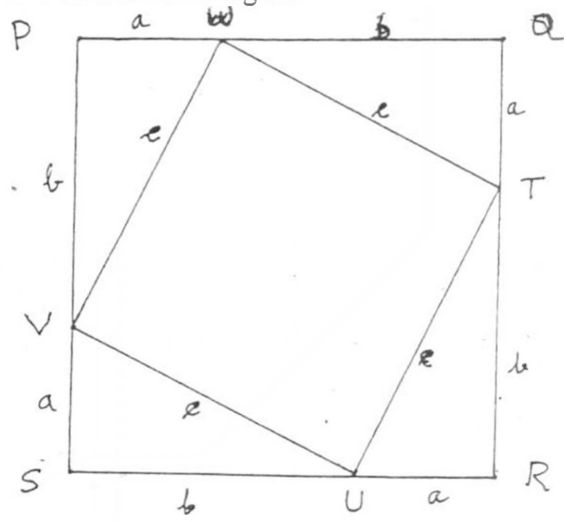
Objectives: To show that in a right angled triangle ABC, $AC^2 = AB^2 + BC^2$ where AC is the hypotenuse, by using the expansion of the expression $(a + b)^2$:

This teaching aid consists of a chart and some wooden cut pieces.



In the right angled triangle ABC, the lengths of the sides are a, b respectively while the length of the hypotenuse is c.

Take a plastic square piece PQRS of side length a + b as shown in the figure.



Then TUVW is a square whose side length is c.

Area of PQRS = $(a + b)^2$
$= a^2 + b^2 + 2ab$ (1)

Area of PQRS = Area of the square TUVW + 4 (Area of the triangle PVW)
$= c^2 + 4\ (1/2 \times a \times b)$
$= c^2 + 2ab$ (2)

From (1) and (2)

$a^2 + b^2 + 2ab = c^2 + 2ab$

$a^2 + b^2 = c^2$

$AB^2 + BC^2 = AC^2$

By keeping the plastic pieces in the appropriate places, the students can convince themselves that the result is true.

The students can also be asked to prove mathematically that the four triangles are congruent to each other. Probably this method was adopted by the Chinese Mathematician Chou Pei (AD 40). Please see the book 'History of Mathematics' by Smith.

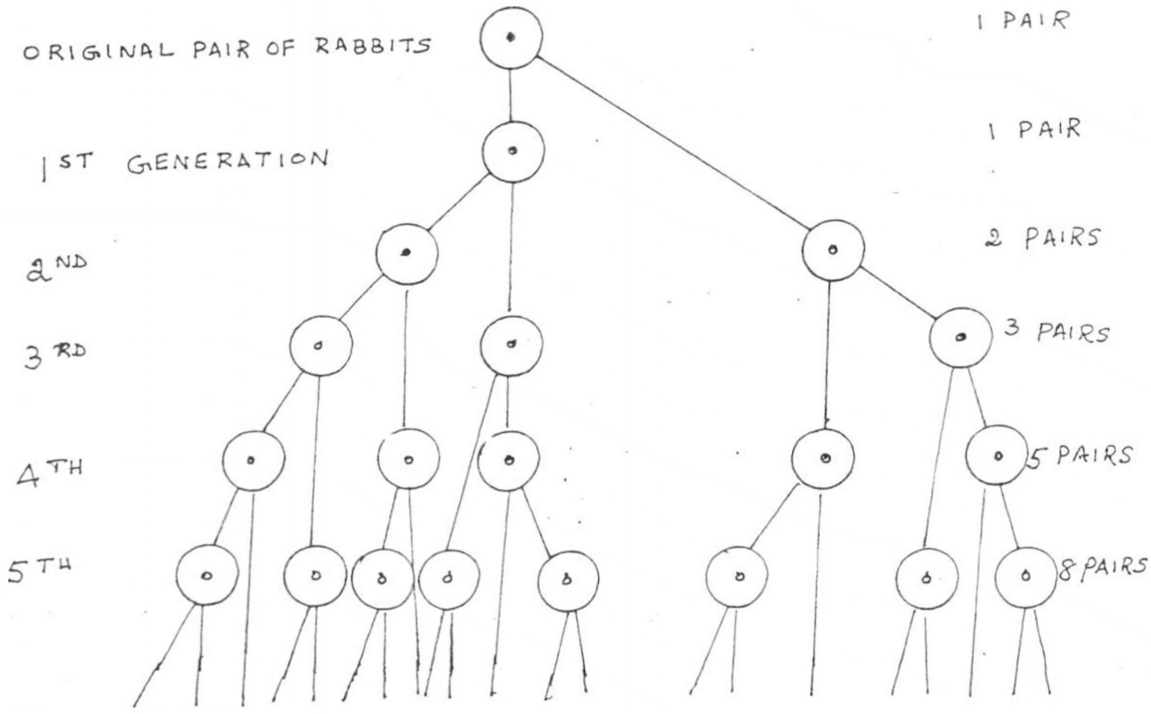
19. Fibonacci Sequence

Objective: This is a model, to show the physical meaning of the 'FIBONACCI SEQUENCE'.

The Fibonacci sequence is 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89,.....

The Problem :

The problem can be stated as follows. A man brought a pair of rabbits and bred them. The pair produced one pair of offspring after one month and a second pair of offspring after the second month. Then they stopped breeding. Each new pair also produced tow more pairs in the same way and then stopped breeding. How many new pairs of rabbits did he get each month ?



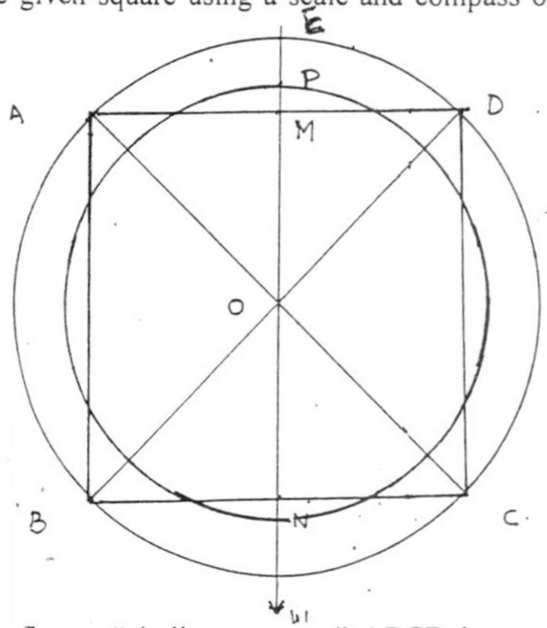
Let us write down in a line, the number of pairs in each generation of rabbits.

1. First we write the number 1 for the single pair we started with (1 new pair).
2. Next we write the number 1 for the pair they produced after a month (1 new pair).
3. The next month, both pairs produced. So the next number is 2 (2 new pairs).
4. Now the original pair stopped producing. The first generation (1 pair) produced 1 pair. The second generation (2 pairs) produced 2 pairs. So the next number we write is 1 + 2 or 3. (Total 3 new pairs).
5. Now the first generation stopped producing. The second generation (2 pairs) produced 2 pairs. The third generation (3 pairs) produced 3 pairs. So, the next number we write is 2 + 3 or 5. (Total 5 new pairs).
6. Each month, only the last two generations produced. So, we can get the next number by adding the last two numbers in the line.
7. The numbers we get in this way are called Fibonacci numbers.

Reference : Land – Language of Mathematics

20. Circling a Square

Objective: This chart can be used to explain "How to construct a circle whose area is equal to the area of the given square using a scale and compass only". (approximately equal).



How to use it

1. In the above figure, "circling a square" ABCD is a square which is to be transformed into a circle so that their areas are equal.
2. AC and BD are the diagonals of the square intersecting at O.

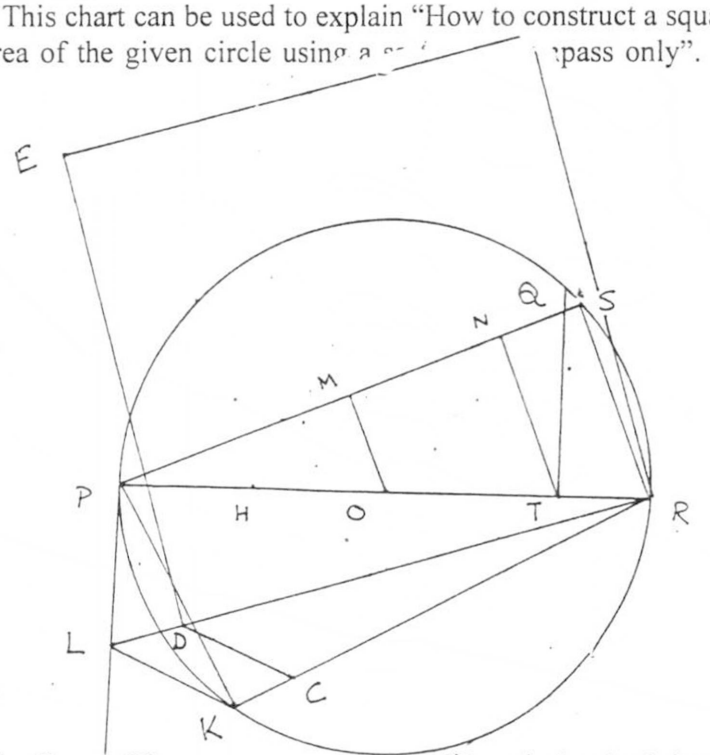
3. EW is a line passing through M, O and N, where M and N are the midpoints of AD and BC respectively.
4. With 'O' as center and OA as radius, a circle is drawn such that it intersects EW at E.
5. EM is divided such that EP = 2PM.
6. With 'O' as center and OP as radius another circle is drawn. The area of this circle is approximately equal in the area of the square ABCD.

Reference : Indian Mathematics and Astronomy by S. Balachandra Rao.

Note : The above problem, "Constructing a circle whose area is equal to the area of the given square" had remained unsolved for centuries in the history of Mathematics. The above method of construction is given by the ancient "Indian Mathematicians" in "Sulva Sutra".

21. Squaring a circle

Objective: This chart can be used to explain "How to construct a square whose area is equal to the area of the given circle using a [illegible] compass only". (Approximately equal).



How to use it :

1. In the figure, "Squaring a circle", PQRS is a circle which is to be transformed into a square, so that their areas are equal. O is the center of the circle and PR is the diameter of the circle.
2. PO is bisected at H and OR is trisected at T nearer R.
3. TQ is drawn such that TQ ⊥ PR and a chord RS is placed such that RS = TQ.
4. 'P' and 'S' are joined and OM and TN are drawn parallel to RS.
5. A chord is drawn such as PK = PM and a tangent PL is drawn to the circle at P such that PL = MN. RL, RK and KL are drawn.

6. A point 'C' is marked on RK such that RC = RH and CD is drawn such that CD is parallel to KL, meeting RL at D. Now a square is constructed on RD. Area of this square is equal to the area of the circle PQR approximately.

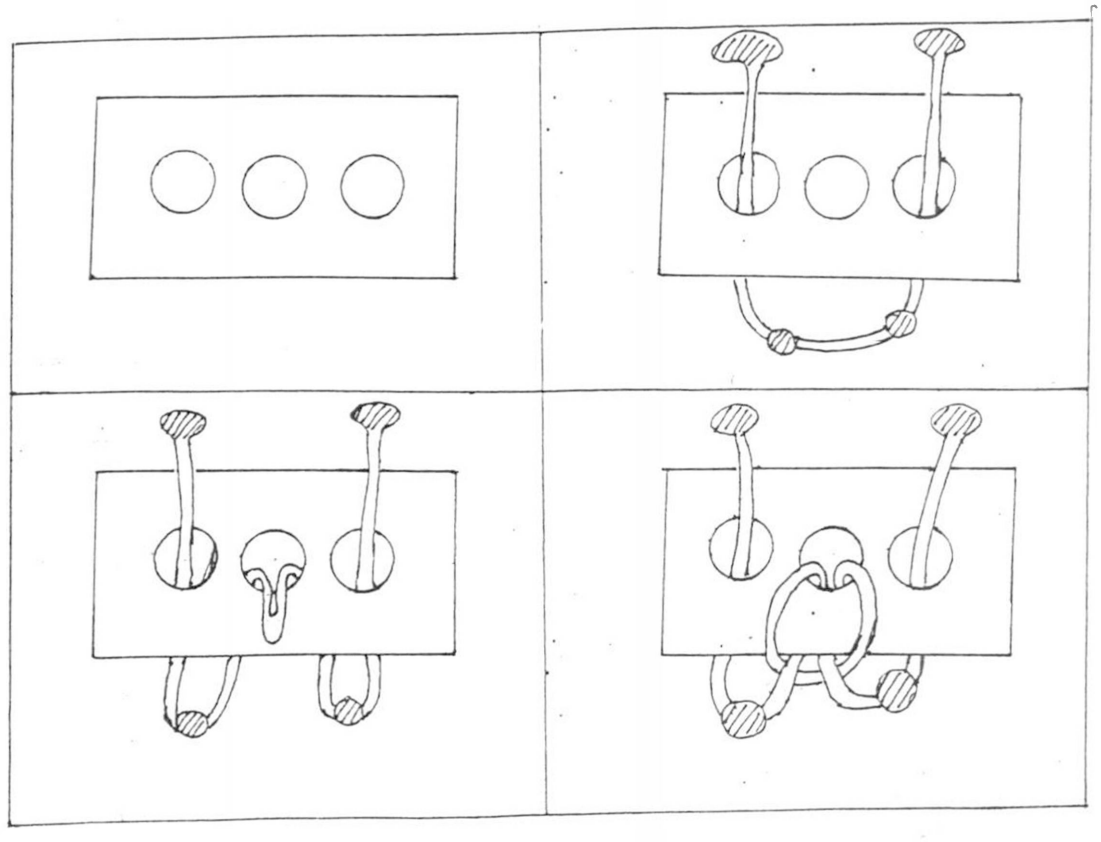
Reference: Indian Mathematics and Astronomy by S. Balachandra Rao.

Note : The above problem "Squaring a circle", i.e. to construct a square whose area is equal to the area of the given square using a scale and compass, had remained unsolved for centuries in the history of Mathematics. But ancient Indian Mathematicians solved the above problem in "Sulva Sutras". The above method of construction is given by "Srinivasa Ramanujan".

22. Buttons and Beads Puzzle

Objective: To improve the mental ability of students
Needed : Cardboard, string, two buttons and two beeds

How to prepare it :



Insert the string through the two beads and insert one end of the string, through hole A and attach a button larger than the hole. In the same direction, thread the other end of the string through hole C and attach a button as in figure 2.

How to use it

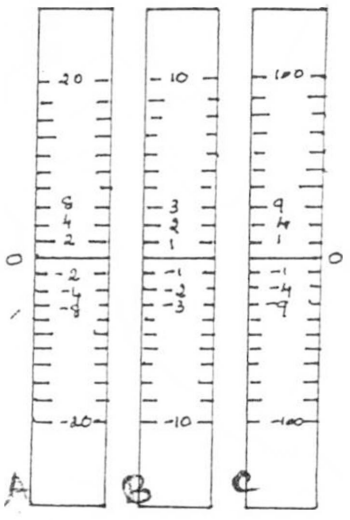
The string is looped through hole B, as in figure 3. Now to loop it back under itself as in figure 4, the loop is first threaded up in hole A and cover the button and then likewise in hole C. Now the puzzle is ready for someone to try to undo the loop and get the beads together.

23. Quadratic Equation Solver

Objective : To enable the user to solve quadratic equations.

How to use it :

The aid consists of three scales namely A, B, C of which the scale B can be moved.



Suppose we have to solve the quadratic equation $x^2 + 6x + 8 = 0$.

Step 1 : Move sliding scale B so that 0 (zero) on it coincides with 6 (six) (coefficient of x) on scale A.

Step 2: Note corresponding reading on scale C which is 9 (nine).

Step 3: Subtract 8 (eight) (constant term or equation) from 9 (nine). The result is 1 (one).

Step 4: On scale C search the position of number 1 (one). There will be 2 (two) positions on scale C where you find 1 (one).

Step 5 : Note the corresponding two readings on scale B. They are – 2 and –4. Hence, -2 and –4 are the solutions of the equation $x^2 + 6x + 8 = 0$.

Reference: Teaching of Mathematics by S K Aggarwal.

24. Four Colour Theorem

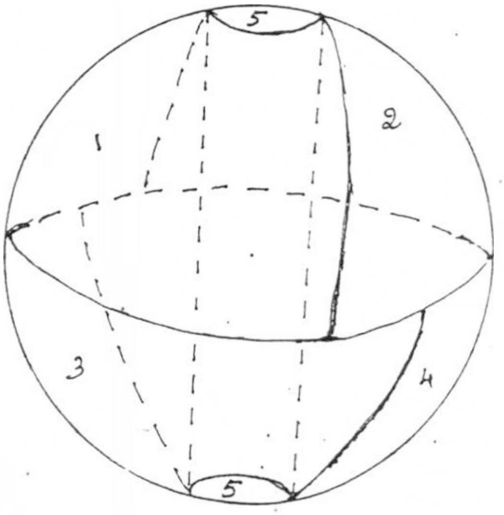
Objective : This is a model to show that the four colour theorem fails to hold in a 3-dimension object.

Analysis :

There is a celebrated theorem called 'four colour theorem' which states that four colours are sufficient to colour any map in the plane in such a way that the neighbouring states do not get the same colour.

Model

A cylindrical hole is constructed in the center of a sphere (football). A horizontal line is drawn around the sphere to make it into two semi-spheres. The horizontal line is connected to the two poles in four different places as shown in the figure. Now the sphere has five regions each having a common boundary with all the remaining four regions.



Therefore, this model requires five colours.

1. Does it disprove the four colour theorem ? (If not, why?).
2. Can you produce a map in the plane, which actually requires four colours ?

25. Euler's Formula V + F = E + 2

Objective: To show that the Euler's formula 'Vertices + Faces = Edges + 2' is satisfied by al the convex polyhedra.

Teaching Aid:

This teaching aid consists of a vertical stand in which all the five regular polyhedra (tetrahedron, hexahedron, octahedron, dodecahedron and icosahedron) made from thermacol and fixed. There are some other convex polyhedra also.

Procedure

The children will have to count the number of vertices, faces and edge of each one of these objects and make a table to find the relation between them.

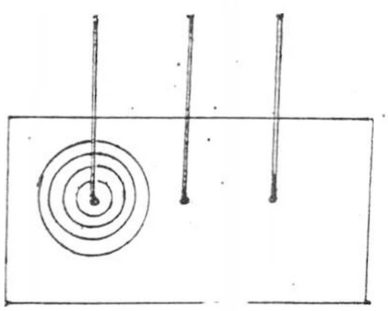
	Name	No. of Faces	No. of Edges	No. of Vertices	V + F	E + 2
1.	Tetrahedron	4	6	4	4 + 4	6 + 2
2.	Hexahedron	6	12	8	8 + 6	12 + 2
3.	Octahedron	8	-	-	-	-
4.	Dodecahedron	12	-	-	-	-
5.	Icosahedron	20	30	12	32	32

Can you produce a polyhedra which does not satisfy the Euler's formula ?

26. Tower of Hanoi

Objective : It is a puzzle called Tower of Hanoi for high school students to develop the inductive reasoning.

Puzzle :



Three vertical rods are fixed on a metallic plate. On one end of the rods, five discs of different sizes have been inserted, the largest disc being at the bottom, in the decreasing order of size.

You will have to put all the discs on any other rod, replacing one at a time and not placing a larger disc on a smaller disc. How many trials are needed to replace all the five discs ?

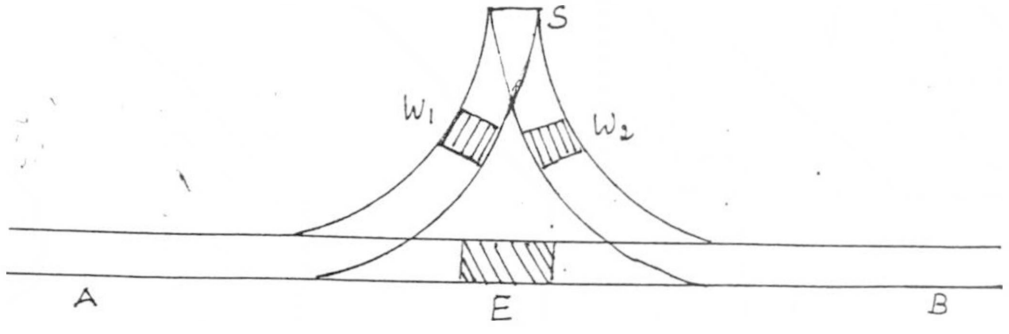
How to do

Children can try by taking two discs first. They will see that the number of trials needed are3. They can repeat this experiment by increasing the number of discs.

At last they can see that if the number of discs are n, then the number of trials required to replace them is $2^n - 1$.

27. Interchanging the Railway Wagons

Problem :



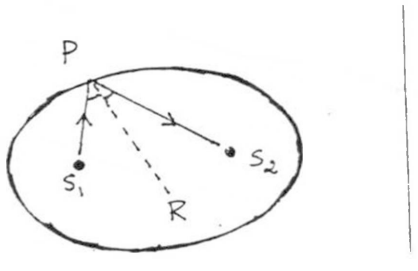
There is a railway line along AB and a slanting line S is connected to AB as shown in the figure. The length of the shunting place S will be sufficient for the wagons W_1 and W_2, but will not be sufficient for the engine E to move. Using the engine E, interchange the positions of the wagons W_1 and W_2.

The children can find the answer to this questions, themselves, by moving wagons W_1 and W_2 through the engine E to different directions. Repeated trials will help to improve their thinking and reasoning powers.

28. Elliptic Carrom Board

Objective: To enable the students to experience a geometrical property of ellipse.

Carrom Board :



An elliptic carom board is prepared, in which the two foci S_1 and S_2 are marked. Keep one carom coin each at S_1 and S_2. The coin at S_1 is pushed to hit any side of the wall of the board. After hitting the wall, the coin S_1 will hit the coin at S_2 and throw it away.

Reason

The perpendicular PR to the wall of the ellipse at any point P divides the angle S_1PS_2 equally. Hence the angle of incidence S_1PR and the angle of reflexion RPS_2 are equal.

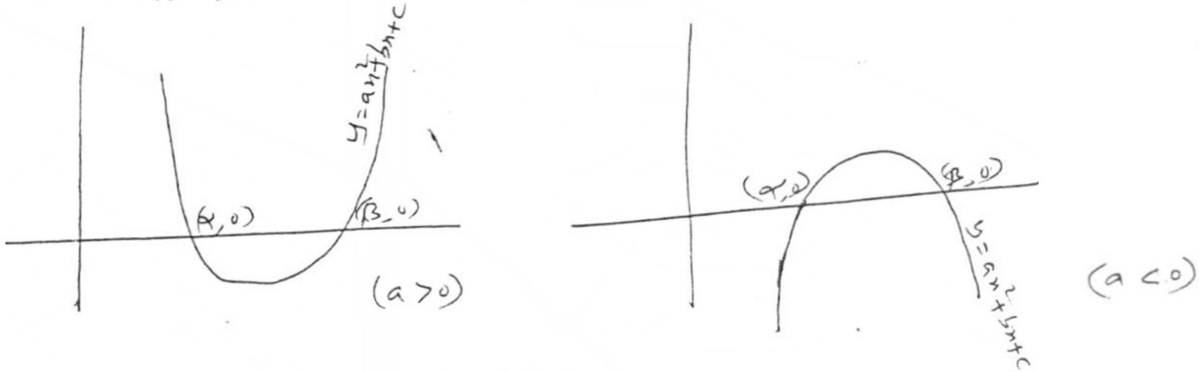
1. What happens if the point P is on the line S_1S_2 ?
2. What happens if the point P is on the perpendicular bisector of the line S_1S_2 ?

12. PROJECTS FOR CLASS XI

V V Mulgand

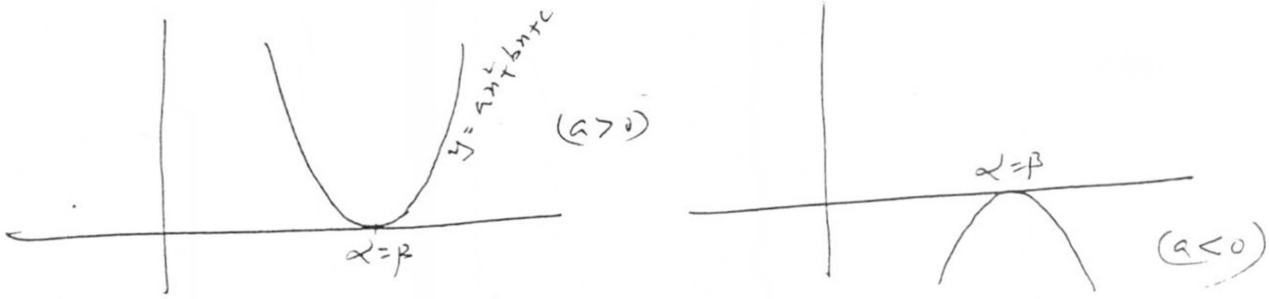
1. Topic : **Nature of roots of a Q.E by graphical method.**
Suppose $ax^2 + bx + c = 0$ is the given quadratic equation.

Case I : If $b^2 - 4ac > 0$ then the graph intersects the x-axis at two distincts, say $(\alpha, 0)$ and $(\beta, 0)$.



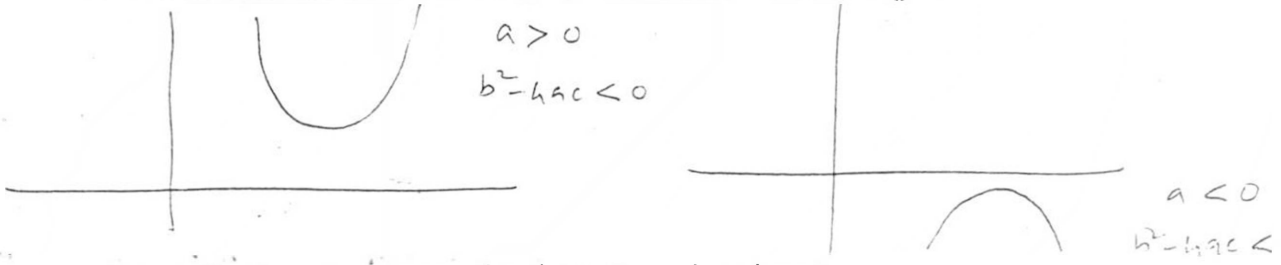
$\therefore$ The equation has two real and distinct roots.

Case II : If $b^2 - 4ac = 0$, then the graph touches the x-axis as shown below.



The equation has two real and equal roots.

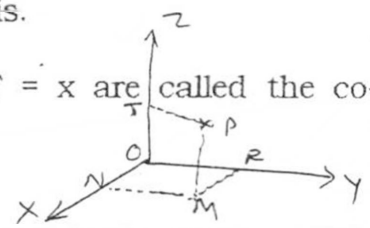
Case III : If $b^2 - 4ac < 0$, then the graph of the equation never intersects or touches x-axis. This experiment can be done by overlapping two transparencies – one with x-y coordinates and the other with the graph of the curve and moving it.



The equation has no real roots (i.e. the roots are imaginary).

2. Position of a point in space

Let P be any point in space (3-D). Through P, draw PM ⊥ XOY-plane. Draw MN ⊥ x-axis, MR ⊥ y-axis and PT ⊥ z-axis.



Then the distance ON = x, OR = y and OT = x are called the co-ordinates of the point P in the space.
∴ Coordinates of the point P = (x, y, z)

To fix a point P(x,y,z) we can use the pointer used in the stereos. This point can be moved in the space.

3. Sum of the squares of the (3) direction cosines of a line is 1

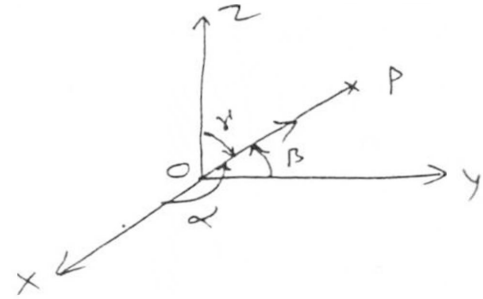
Let OP be the given line. Let α, β, γ be the angles made by this line with positive direction of X, Y, and Z axis.

Sl. No.	α	β	γ	cos α	cos β	cos γ	$\cos^2\alpha + \cos^2\beta + \cos^2\gamma$
1							
2							
3							

The last column of the above table is always 1.
Example : The d.c.'s of x-axis are 1,0,0.

∴ cos α = 1, cos β = 0, cos γ = 0.

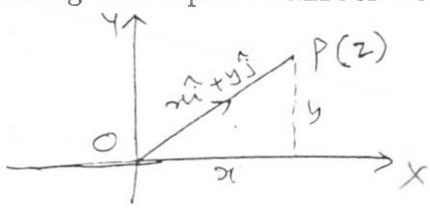
$\Rightarrow \cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$



Adopt some method to verify experimentally that $\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$.

4. Argand Diagram

Representation of a complex number, say z = x + iy in the Argand Diagram relating a complex number with corresponding vector.

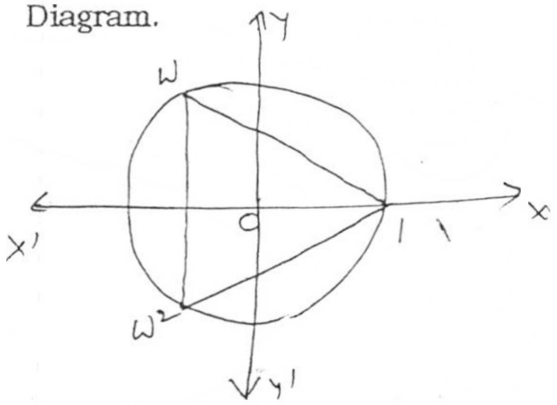


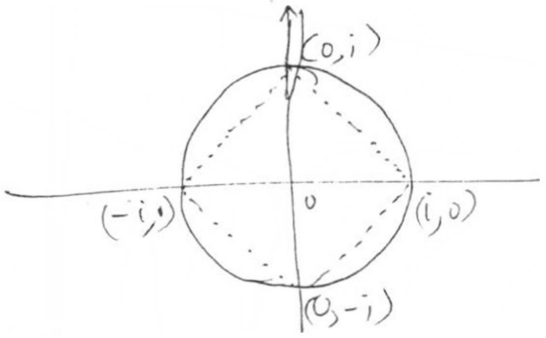
$z = x + iy$
$\overrightarrow{OP} = x\hat{i} + y\hat{j}$

$| z | = | x + iy | = \sqrt{x^2 + y^2}$.

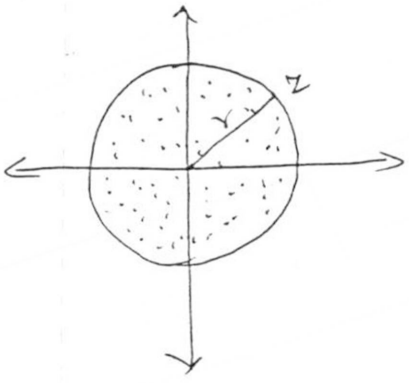
5. Geometric Representation of the sum, difference, product and quotient of complex number in the Argand Diagram.

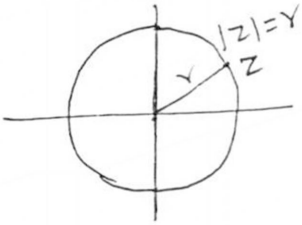
6. Representation of cube roots and fourth roots of unity on the Argand Diagram.

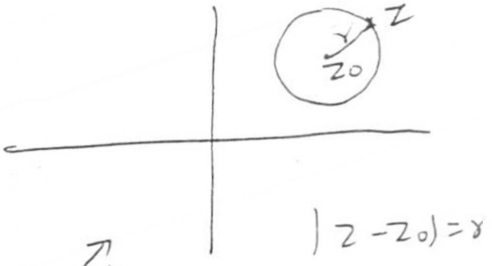


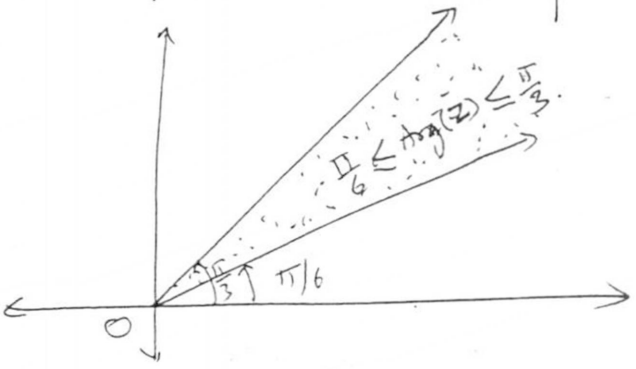


8. Sets of points represented by complex numbers in Argand Diagram which obey some geometric conditions.







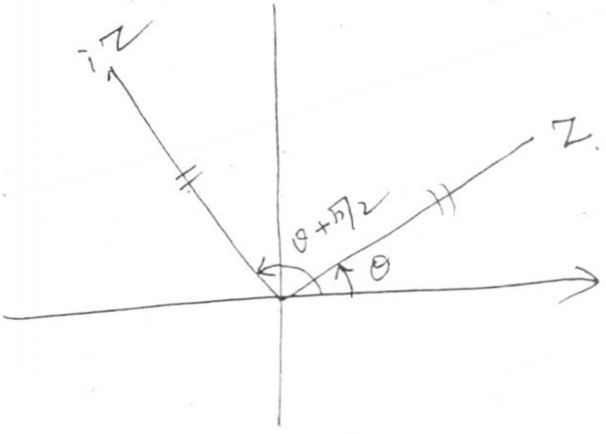


8. Multiplication of a complex Z by i.

$Z = r (\cos \theta + I \sin \theta)$

$i = \cos (\pi/2) + I \sin \pi/2)$

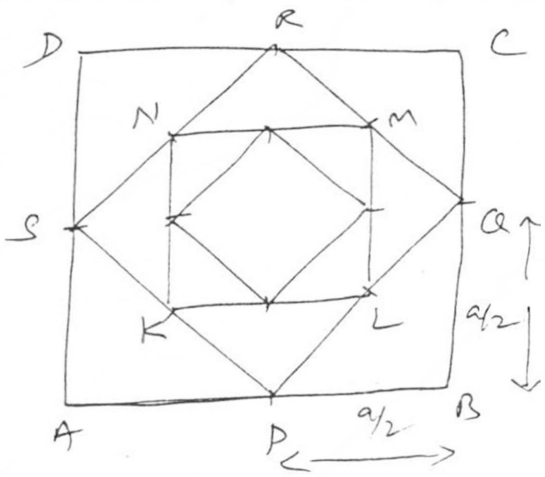
$iZ = r [\cos (\theta + \pi/2) + i \sin (\theta + \pi/2)]$



iz is obtained by rotating z through an angle of $\pi/2$ in the positive direction.

Sum to infinity of a Geometric Series

Let ABCD be a square of side 'a' units. P, Q, R and S are the middle-points of the sides AB, BC, CD and DA.



By Pythagoras theorem,

$$PQ = \sqrt{\left(\frac{a}{2}\right)^2 + \left(\frac{a}{2}\right)^2} = \frac{a}{\sqrt{2}}$$

$\therefore$ Area of square PQRS $= \left(\frac{a}{\sqrt{2}}\right)^2 = \frac{a^2}{2}$

K, L, M, N are mid points of the sides PQ, QR, RS and SP of the square PQRS.

Now, $KL = \sqrt{\left(\frac{a}{2\sqrt{2}}\right)^2 + \left(\frac{a}{2\sqrt{2}}\right)^2} = \sqrt{2 \cdot \frac{a^2}{4.2}}$

$$= \frac{a^2}{4}$$

$\therefore$ Area of square KLMN $= \frac{a^2}{4}$.

$\therefore$ (Area of the square ABCD) + (Area of PQRS) (Area of the square KLMN) +.....

$$= a^2 + \frac{a^2}{2} + \frac{a^2}{4} + \frac{a^2}{8} + ...$$

$$= a^2 \left[1 + \frac{1}{2} + \frac{1}{2^2} + \frac{1}{2^3} + ...\right] = a^2 \cdot \frac{1}{1 - \frac{1}{2}}$$

$= 2a^2$ sq. mts.

Sets

1. Explaining through numerical examples and Venn diagrams, the different operations on sets, properties of sets, and Cartesian product of sets (put rubber bands).

2. Diagrammatic representations of all types of functions (using rubber bands).

3. Verification of De-Morgan's law using Venn diagrams.

4. Verification of the results

   $n(A \cup B) = n(A) + n(B) - n(A \cap B)$ and
   $n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cup B) - n(B \cup C) - n(A \cup C) + n(A \cap B \cap C)$
   by drawing Venn diagrams and actual counting.

5. Partition of sets, taking mod n and pictorial representation.

6. Different possibilities of 2 or 3 sets as subsets of U.

CONIC SECTIONS

I. Model showing different conic sections

Form a double cone using wax, wood, plaster of Paris, cardboard, etc.

i) Cutting it horizontally, we get a circle.
ii) Cutting it by a plane ||ly to the generator, we get a parabola.
iii) Cutting it by a plane which is somewhat inclined and cutting only one plane, we get an ellipse. If the cutting plane..... both the planes, then the conic section is a hyperbola.

II. Charts showing the four standard forms of a parabola, marking its vertex, focus, directrix, axis, Latus Rectum, etc.

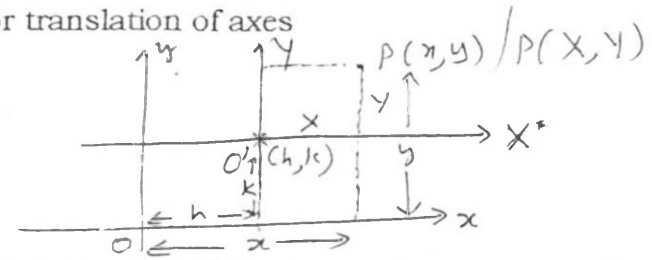
III. Drawing different parabolas on the same graph for separate cases when $a < 1$ and $a > 1$.

IV. Charts showing the standard forms of an ellipse and a hyperbola, marking their vertices, foci, directrices, axes, etc.

V. Construction of an ellipse (by fixing two nails and a loose twine).

CO-ORDINATE GEOMETRY

I. Diagram showing the shifting of origin or translation of axes

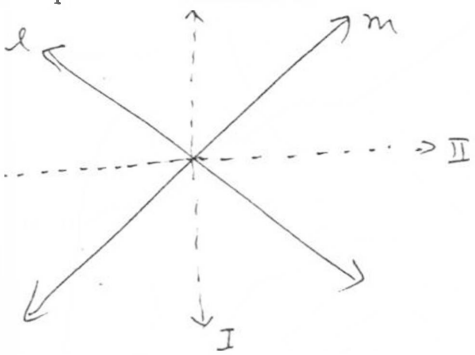


Let O be the origin and let O′ be the co-ordinates of the new origin w.r.t. the old axes. Let p(x,y) be the co-ordinates of any point w.r.t. the old axes and let p(X,Y) be the co-ordinates of the same point w.r.t. the new axes.

Then $x = X + h$ and

$Y = Y + k$

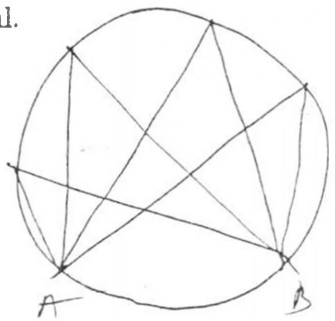
II. Diagram showing the pair of bisectors between two lines.



I and II gives the pairs of bisectors between the lines l and m.

III. Angle inscribed in the same arc of a circle are equal.

Draw chords on a cardboard or a thermocoal.

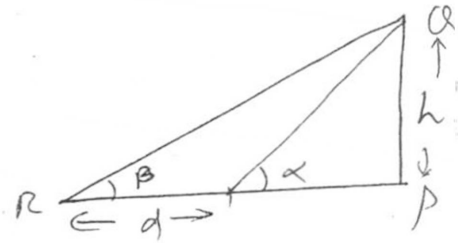


TRIGONOMETRY

1. (i) Preparation of clinometers and finding the height of the flag staff.

   (ii) Finding the height of the flag staff by using the formula

$$h = \frac{d \tan \beta \tan \alpha}{\tan \alpha - \tan \beta}$$



   where the quantities are represented in the diagram.

2. Solution of Triangles :
   Construction of triangle (given S,A, S) to get other angles and sides using appropriate formula.
   (i) ASA (ii) SSS

3. Drawing the graphs of sin x and cos x in $-2\pi \leq x \leq 2\pi$ in two transparent sheets, superposing and studying the common points.

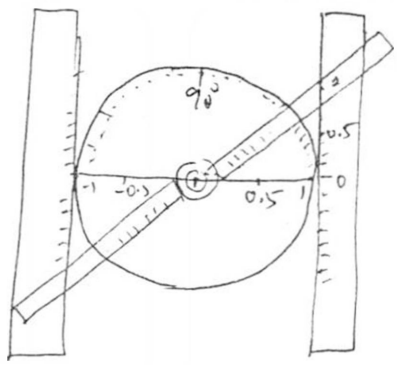
Example :

sin x and $\sin^{-1} x$	sin x, sin 2x and sin x/2
-sin x and $-\sin^{-1}x$	sin $(\pi/4 + x)$, sin $(x - \pi/4)$

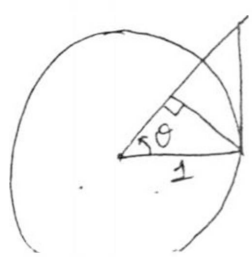
4. Draw graphs of
   (i) $\sin^2 x$ and $\cos^2 x$ and find the value of $\sin^2 x + \cos^2 x$ at each unit on x-axis.
   (ii) $\sec^2 x - \tan^2 x$

5. Graphs of periodic functions which are not trigonometric functions.

6. Model to find values of trigonometric functions for different angles.



7. $\sin^2 \theta + \cos^2 \theta = 1$
   $1 + \tan^2 \theta = \sec^2 \theta$
   $1 + \cot^2 \theta = \operatorname{cosec}^2 \theta$



(Permutations and Combinations, Mathematical Logic, Statistics)

1. Construction of Pascal's triangle using binomial coefficients for the expansion upto $(a + 6)^{10}$ and find the coefficient for further any value of n.

2. Take 20 points on a plane, calculate the number of lines and triangles can be drawn such that (i) no three points will be collinear, (ii) at least five points are collinear. Verify by drawing the figure.

3. Prepare a pie chart for the result analysis of class XII Board Exam of your Vidyalaya subjectwise of this year. Use proper material.

4. Collect the information of heights and weights of each of the students of your class and study the variation in the standard deviation and variance.

5. Consider a statement p denotes a true statement and q denotes a false statement. Construct truth tables to represent "conjunction" and "disjunction". Also draw the corresponding circuit diagram.

Binomial Coefficients

n = 0	C(0,0)
n = 1	C(1,0) C(1,1)
n = 2	C(2,0) C(2,1) C(2,2)
n = 3	C(3,0) C(3,1) C(3,2) C(3,3)
n = 4	C(4,0) C(4,1) C(4,2) C(4,3) C(4,4)
n = 5	C(5,0) C(5,1) C(5,2) C(5,3) C(5,4) C(5,5)
n = 6	C(6,0) C(6,1) C(6,2) C(6,3) C(6,4) C(6,5) C(6,6)
n = 7	C(7,0) C(7,1) C(7,2) C(7,3) C(7,4) C(7,5) C(7,6) C(7,7)

6. Applying the principle of permutation and combination to many interesting classroom and school situations and finding the mind-boggling number of possibilities :

   Eg. 1. If any student of the class can occupy any seat, no. of ways possible.
   2. If girls and boys change seats among themselves, no. of ways possible.
   3. If the rooms in the school are interchanged for different classes, no. of ways possible.
   4. No. of ways of selecting leader and deputy leader for the class.

13. APPLICATION OF TRUTH TABLES

Dr B S P Raju

It is a story of a man out for a walk who finds himself approaching an unsigned T-junction situated in the middle of a remote village.

Now all the inhabitants of this village have a curious habit : any inhabitant either invariably tells the truth or invariably tells a lie. The traveler wants to know which way to turn at the T-junction in order to reach a given destination (say a temple), but he was allowed to ask only one question and to only one of the village's inhabitants, who may reply either "yes" or "no". the man must solve the problem. Is there a question he can ask in order to be certain that the answer given will reveal to him the correct route, and, if so, what is the suitable question ?

We can tackle this by setting a truth table.

Where

a represents the villager questioned is a truth teller.

b represents the traveller should turn left to reach his destination.

If turning left is correct, a truth teller says Yes and a liar says No.

Let a = 1, the villager giving reply is a truth teller.

a = 0, the villager giving reply is not a truth teller i.e. a liar.

b = 1, the traveller should turn to left.

b = 0, the traveller should turn not to left i.e. turn to right.

The problem will be solved if a question is asked to which either a truth teller or a liar will answer in one particular way.

Say 'yes' if turning left is correct and 'No' if turning right is not correct.

Thus irrespective of the truth value of 'a', we must get a is zero 'yes' if the truth value of 'b' is one, and 'no' if the truth value of 'b' is zero.

The situation is represented by

a	b	Answer
1	1	Yes
1	0	No
0	1	Yes
0	0	No

If 'a' is zero means the villager giving a reply is a liar and so the last two entries of the answer will be changing.

a	b	Answer
1	1	Yes
1	0	No
0	1	No
0	0	Yes

This is a biconditional.

$a \Rightarrow b$ and $b \Rightarrow a$ i.e. $a \Leftrightarrow b$

a	b	$a \Leftrightarrow b$
T	T	T
T	F	F
F	T	F
F	F	T

So the question is

"Are you a truth teller if and only if I should turn to left to get my destination?".

i.e. If you are a truth teller then I should turn towards left

and

If I should turn to left then you are a truth teller.

In a simplified way

Are the two statements –

You are a truth teller and I should turn left

either both are true or false ?

Analysis of the answer

a) If the traveller should turn left, then

   i) For a truth teller, a truth teller and turning left both are true and so will answer yes.

   ii) For a liar, one statement is false so both the statements together are false. But since he is a liar, he will answer yes.

b) If the traveller should turn right, then

   i) For a truth teller, one statement is false, so both the statements together are false. Since he is a truth teller, he will answer 'no'.

   ii) For a liar, both the statements are false, he should answer 'yes'. But since he is a liar, he will answer 'no'.

   So if the answer to his question is 'yes', the traveller should turn to the left and, if the answer is 'no, he should turn to the right.

Another Answer :

"If I were to ask you, if I should turn left, would you say 'yes'".

[Source : Further Pure Mathematics : Chapter – 2 by L.Bustock & Others).

14. EXCERPTS FROM A STUDY OF THE ORGANIZATION AND CLARITY OF A MATHEMATICS LESSON

(by Dr Hativa, National School of Education,
Tel Aviv University, Israel)

V V Mulgund, PGT(M)
K V Malleswaram, Bangalore

- *"A well-organized and clear presentation is one which is easy to follow, understand and remember".*

- *'easy to follow'* involves structuring, stimulating students' interest and good oral presentation.

- *'good oral presentation'* involves enthusiasm, clear speech, fluency, avoidance of oh, eh, umm, false starts of a sentence, halts, redundant repeated words and vague sentences.

- *'aids to remember'* include highlighting and review of main points of the lesson, use of markers, algorithms.

Good teachers do the following : They

1. name the main topic of the lesson
2. provide motivation for the topic and for sub topics as well
3. excel in their oral presentation, clear, lively and fluent speech
4. provide review of material for learning sub-topics
5. sort content and problems into categories
6. break down explanations into components
7. present the lesson in good sequence
8. rationalize what they are doing and why
9. repeat and elaborate on important points of the lesson and
10. provide algorithms for procedures.

A low rated mathematics teacher does the following :

He/She

1. uses vague terms
2. starts sentences but does not complete them
3. uses hesitating expressions
4. skips intermediate steps
5. states facts that students do not yet have the basis to perceive or understand
6. makes errors in computations and proofs and
7. provides wrong or inaccurate statements.

15. MATHEMATICS CLUB

R U Patil, Principal
K V Borjhar, Guwahati – 17

An organization which caters for mathematical thinking, mathematical attitude, development and developing interest in Mathematics which will supplement the work of a classroom and puts the syllabus on a practical bias may be named as 'MATHEMATICS CLUB'.

Learning by doing and learning by living are two cardinal principles of teaching Mathematics and Science. It is the natural urge in children to make things, to break things, to handle things. Mathematics Club provides opportunities for them through its activities.

I. Main Objectives

1. To break monotony of the classroom teaching.
2. To provide opportunity for self expression, self experience and exploration.
3. To provide opportunity by learning by doing.
4. To explore the innate talents and to nurture them further.
5. To widen the outlook of the students and to enable them to apply their knowledge of Mathematics in certain life situations.
6. To transfer the curricular content into activities and to provide opportunities to students to multi-channel learning.
7. To foster values like co-ordination, co-operation, team spirit, leadership, problem solving, etc.
8. To enable students to learn certain skills which are useful to their day to day life.
9. To establish a healthy rapport between Vidyalayas and Society.
10. To get the club affiliated to various organizations and to benefit students thereby.

II. Factors Governing the Success

The success of the working of a club depends upon the teacher, accommodation, necessary equipments, proper guidance. It mainly depends on the enthusiasm, resourcefulness, and ingenuity of Mathematics teachers. He is the pivot of the activities. But at the same time we cannot overlook the difficulties of the teacher. The teachers should be provided adequate facilities and the time spent on the organization of the club should be included in their normal teaching load as far as possible. This however does not mean that they should wait for the said facilities and compensation. Willing and intelligent teachers will make the whole programme a success even in the face of difficulties. Adequate space is indispensable. If a room cannot be spared it is fine. Two or three cupboards initially will serve the purpose by placing them in Physics laboratory to staff room, equipments can be accumulated by purchasing and by collecting students work in the form of projects, exhibits, etc.

III. Organisation of the Club

It should have a constitution and every member should strictly abide by it. Principal can be a patron and P.G.T. Maths, the Incharge of the Club. A treasurer and a Secretary among Mathematics teachers will assist the Incharge teacher. All Mathematics teachers and interested students will be members. Students representatives may be in the executive body which includes office bearers and selected staff.

Executive body directs on the following :

(i) The name of the club and its aims.
(ii) Conditions and procedure of becoming a member.
(iii) Membership fee if required.
(iv) Dates and time for meeting.
(v) Types of activities to be undertaken.

IV. Activities of the Club

1. Holding discussion, meetings, debates, paper reading contests, etc.
2. Arranging guest lectures on various topics and general.
3. Arranging excursions, visits to Mathematics Department of renowned colleagues, universities, post offices, banks, shops, share markets, etc.
4. Holding Mathematics exhibitions regularly.
5. Running a Mathematical Laboratory.
6. Preparing Mathematics kits, aids for classroom teaching.
7. Preparing Mathematical games.
8. Conducting Mathematics quizzes for different levels like XI-XII, IX-X, VI-VIII students, etc.
9. Running departmental library by collecting old Maths books from the students who pass out and from library.
10. Running mock post office, bank, shop, etc.
11. Screening video recording of TV programmes like Mathemagic, UGC programme, etc.
12. Preparing Mathematics dictionary, magazines, including sketches of mathematicians along with life history.

16. ACTION RESEARCH

Dr. C.G.VENKATESH MURTHY

Action Research is a *Problem-solving approach.* Action Research helps a practitioner *to perceive, understand* and *assess* the situation, and it further facilitates a *systematic analysis* and working out plausible reasons for the *unsatisfactory condition.* With this, different *alternative solutions* can be tried out and finally an intervention can be worked out with which the *problem can be solved satisfactorily.*

Salient Features

1) Small Scale intervention:
Small scale intervention of the intact group.

2) Contextual nature: Unique to a given situation.

3) Reflective Practice: Facilitates critical reflection of practice.

4) Enhancement of the efficiency:
Enhance the efficiency of the practice of the professional.

5) Practitioner's privilege: Single Practitioner. Collaborative too.

Steps in Conducting Action Research

1. Developing a focus
   a) What is happening in the present situation?
   b) What is causing dissatisfaction?
   c) What can I do about it?
   d) How can I do it?

2. Analyzing the problem

3. Stating the probable causes.

4. Development of propositions

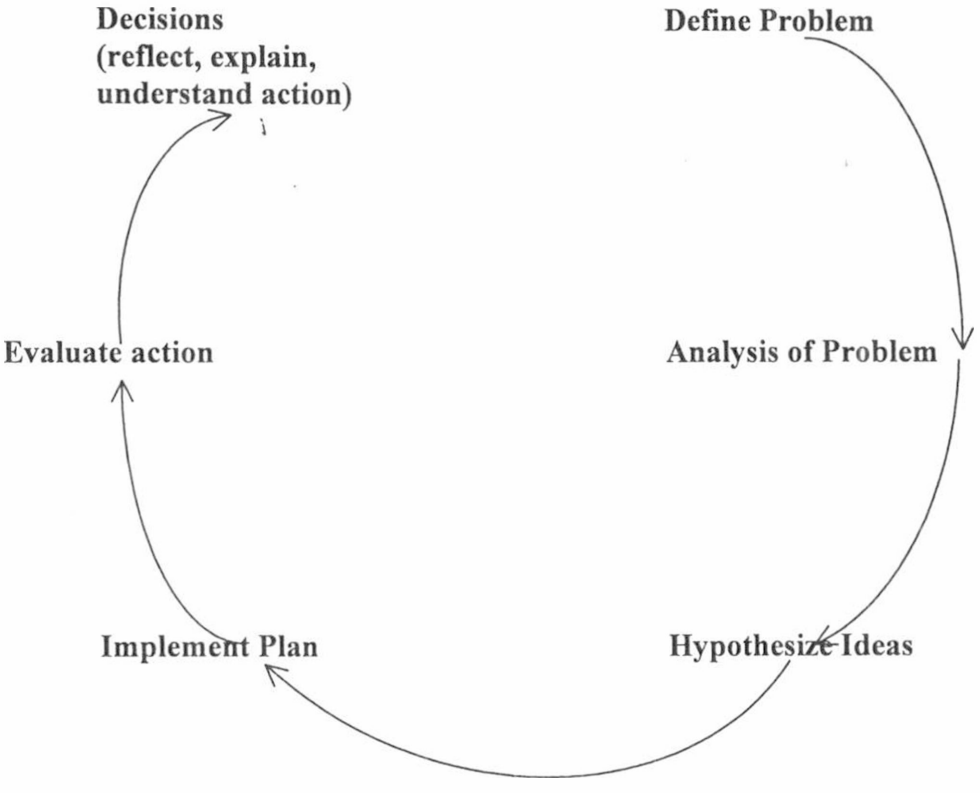
5. Developing Action Research Design & Execution.

6. Decisions

7. Sharing of results.

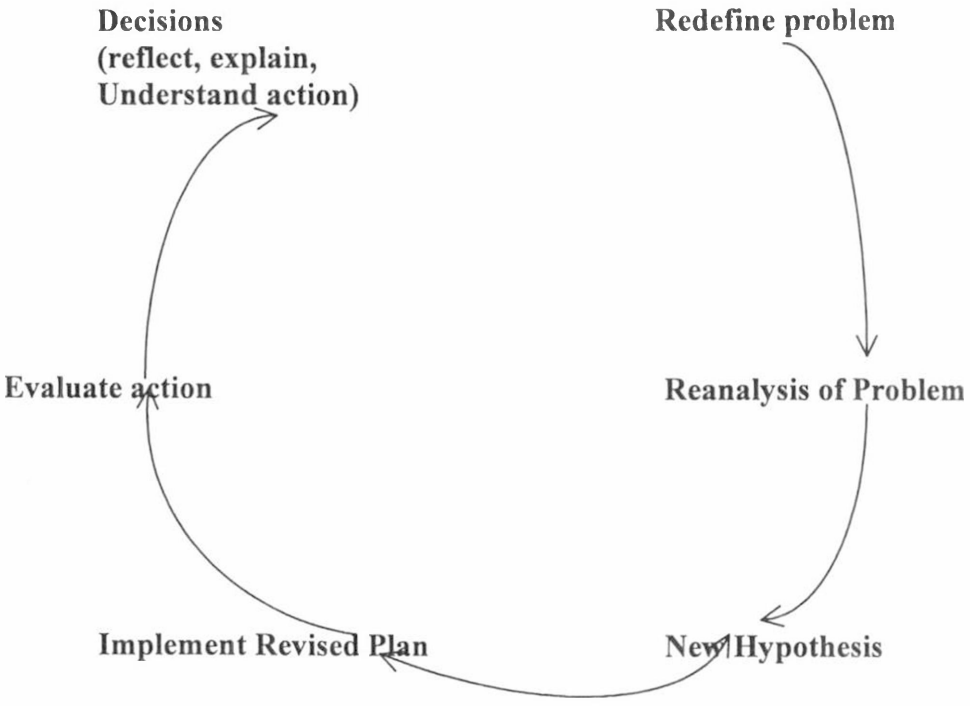
ACTION SPIRAL 1

Problem situation



Action Spiral 2

Problem Situation



Sl. No.	Criteria	Basic Research	Action Research
1.	Objectives	Developing and testing educational theory and derive generalizations	Finding solution to problems in a specific context. Deriving generalization is not the objective.
2	Selection of a problem	A wide range of methods is used to select a problem.	Practitioners identify problem, which is an unsatisfactory condition in one's profession
3	Research Question(s)	Mostly 'what' is studied, and 'How' is also studied when processes are to be studied.	'What' is studied to understand 'How' of a situation in order to make it better
4	Hypotheses	Highly specific and varied kinds of hypotheses are developed and tested.	Only Action Hypotheses are developed and tested.
5	Need for Review of related literature	An exhaustive and thorough review is required.	No such review is required .
6	Subjects/Units observation	Generally, Samples are studied.	Intact groups are studied.
	Research Designs	Includes most complex research designs too.	Simple research designs are used. They are simple intervention studies.
8	Analysis of data	Includes sophisticated analysis too.	Simple analysis is all that is required.
9	Conclusions	Facilitate generalizations	No generalizations are made, but address local specific problems only.
10	Training	Intensive training in research methodology is required	Simple orientation is adequate.

A. BRIDGE COURSE IN MATHEMATICS FOR CLASS VI

To reinforce the knowledge acquired in the primary classes, to increase the speed of solving problems and to strengthen their mathematical concepts, the following syllabus is suggested for the bridge course to be conducted on students entry into class VI.

Sl. No.	Content/Topic	No. of Periods
I.	**NUMBERS AND NUMERALS**	
	1. To read and write in both Indian and International system from 1 to billion.	2
	2. Spellings while writing the numbers 1 to 20, 30, 40, ...100, 1000 in words	1
	3. Difference between place value and face value of digits.	1
	4. Reinforcing the term natural number for counting number.	1
	5. Successor, Predecessor, consecutive numbers, odd and even numbers; prime and composite numbers, twin primes.	1
	6. Ordering of numbers and use of symbols > and <.	1
	7. Operations on numbers	2
	8. Operations on fractional numbers	2
	9. Operations on decimals	2
II.	**FACTORS AND MULTIPLES**	
	1. Factors and prime factorization	1
	2. L.C.M. and find L.C.M. by division method.	1
III.	**PERCENTAGES AND THEIR APPLICATIONS**	
	1. Profit, Loss, SP, CP, Profit Percentage, Loss Percentage	1
	2. Simple Interest	1
IV.	**METRIC MEASURES**	1
V.	**BASIC GEOMETRICAL CONCEPTS**	
	1. Concept of point and collinear points	1
	2. Concept of line segment and its measure	1
	3. Angle, types of angles and measure of an angle	1
	4. Triangle and circle	1
VI.	**PERIMETER AND AREA**	
	1. Unit for measuring length, area	1
	2. Perimeter and area of a square and a rectangle	1

B. BRIDGE COURSE IN MATHEMATICS FOR CLASS IX

Topics covered in classes VI, VII and VIII are basis for classes IX and X. Hence reinforcement of the concepts of these topics becomes very much essential to proceed with the topics of classes IX and X. The following syllabus is suggested for the bridge course to be conducted on students' entry into class IX.

Sl. No.	Content/Topic	No. of Periods
I.	**NUMBER SYSTEM**	
	1. Types of numbers and their inter relations, scientific form.	1
	2. Difference between rational and irrational; real number system.	1
	3. Operations and properties including exponential.	2
	4. Squares; square roots and cubes	1
II.	**POLYNOMIALS**	
	1. Types of polynomials, degree of a polynomial.	1
	2. Algebraic expressions and identities.	2
	3. Factorisation of algebraic expressions.	1
	4. Operations in algebraic expressions.	1
III.	**SIMPLE EQUATIONS**	
	1. Equations in one variable, writing equations in verbal form.	1
	2. Root or solution of an equation.	1
	3. Effect on roots of an equation by adding a number on both sides or by multiplying both sides of the equation by a number.	1
	4. Solving equations and verbal problems including verification.	2
IV.	**LINES AND ANGLES**	
	1. Intersecting; parallel; perpendicular, concurrent lines.	1
	2. Adjacent angles, linear pair, vertically opposite angles, alternate, corresponding, interior angles.	1
V.	**TRIANGLES**	
	1. Types and parts of triangles, medians, altitudes, etc.	1
	2. Triangle inequality.	1
	3. Construction of triangles of the type SSS, SAS, ASA, RHS	1
	4. Division of line segment	1
	5. Congruence properties	1
VI.	**QUADRILATERALS**	
	1. Types of quadrilaterals	1
	2. Construction of important quadrilaterals (specially rhombus)	1
VII.	**AREAS AND VOLUMES**	
	1. Measurement of area and units of area	1
	2. Areas of quadrilaterals and circles	2
	3. Volumes	2
	4. Surface Area	2

C. BRIDGE COURSE IN MATHEMATICS FOR CLASS XI

Mathematics studied in class XI is useful for higher studies. If the basics are clear, the students will be able to cope up with the subject in class XI. Hence it is advisable to reinforce the following before the students start with the Mathematics subject in class XI.

Sl. No.	Content/Topic	No. of periods
1.	Sets, Venn Diagrams, Elementary Properties, Sets of Numbers and proportions	3
2.	Factorial, Permutation and Combination, Application to solve simple problems	6
3.	Trigonometry, extension of θ upto 2π, identities and graphs	6
4.	Logarithms	6
5.	Basic Operations including short cut method for arithmetical computation to get a quick result	6
6.	Differentiation and Integration (simple formulas to apply in physics)	8
7.	Concept of Infinity and zero to be introduced	1
	Total	**36**

D. PROGRAMME SCHEDULE

Date/Day	9.30 am to 11.00 am	11.30 am to 1.00 pm	2.00 pm to 3.15 pm	3.30 pm to 5.00 pm	5.00 pm to 6.00 pm
1.6.2002 Saturday	Inauguration & Exploratory – BSPR	Pre-test BSPR	BSU	NMR	Library Work
2.6.2002 Sunday	GR	NMR	BSU	BSPR	Library Work
3.6.2002 Monday	GR	BCB	BSPR	Demonstration Lesson – NMR	Library work
4.6.2002 Tuesday	BSU	NBB	BSPR	Demonstration Lesson – BSPR	Library Work
5.6.2002 Wednesday	BCB	NMR	NBB	Demonstration Lesson-BCB	Library Work
6.6.2002 Thursday	BCB	NMR	NNP	Demonstration Lesson – BSU	Library Work
7.6.2002 Friday	BSPR	CGVM	BSU	Demonstration Lesson –NMR	Library Work
8.6.2002 Saturday	BSU	BSU	NMR	Demonstration Lesson-BSU	Library Work
9.6.2002 Sunday	← ASSIGNMENT →				
	BSPR	BSU	NMR	BCB	
10.6.2002 Monday	BSU	BCB	NBB	Demonstration Lesson-BSPR	Library Work
11.6.2002 Tuesday	NMR	NBB	NNP	Demonstration Lesson-BSU	Library Work
12.6.2002 Wednesday	BSU	NBB	BSPR	Demonstration Lesson-NMR	Library Work
13.6.2002 Thursday	BCB	NBB	NMR	BSU	Library Work
14.6.2002 Friday	NMR	Guest Lecture	KD	Demonstration lesson-BSPR	Library Work
15.6.2002 Saturday	BSU	Guest Lecture	NBB	BSPR	Library Work
16.6.2002 Sunday	← ASSIGNMENT →				
	BSPR	NMR	BCB	BSU	
17.6.2002 Monday	NMR	BCB	KD	Demonstration Lesson- NMR	Library Work
18.6.2002 Tuesday	GR	BCB	BSPR	NMR	Library Work
19.6.2002 Wednesday	GR	ASNR	BSU	BSU	Library Work
20.6.2002 Thursday	BCB	NBB	BSPR	BCB	Library Work
21.6.2002 Friday	BCB	NMR	Post Test BSPR	← Valedictory → BSPR	

			No. of Sessions
GR	*Dr G Ravindra*	1. Nature of Mathematics 2. Linear Programming	4
KD	*Dr K Dorasami*	1. Structural approach to teaching of Mathematics 2. Evaluation in Mathematics	2
NMR	*Dr N M Rao*	1. Statics and Application. 2. projects in Mathematics	17
BSU	*Dr B S Upadhyaya*	1. Vectors & their Applications in 3-D Geometry 2. Use of Computers in teaching Mathematics	17
BCB	*Mr B C Basti*	1. Probability 2. Strategies and Techniques for Teaching of slow learners and gifted children in Mathematics	13
BSPR	*Dr B S P Raju*	1. Commecial Mathematics, 2. Boolean Algebra – Logic – Proofs in Mathematics 3. Concept learning in Mathematics at +2 level.	17
NBB	*Dr N B Badrinarayana (Retired)*	1. Dynamics	8
NNP	*Dr N N Prahallada*	1. Value Education	2
CGVM	*Dr. C G Venkatesh Murthy*	1. Action Research	1
ASNR	*Dr A S N Rao Sindhe*	1. Some Aspects of learning	1
GTN	*Guest Lectures*		
	1. Shri G.T. Narayana Rao		1
	2. Dr V Jagannath		1
			84

All the Lecture Sessions will be followed by Discussion and Group Work.

Venue : Room No. 16
Tea Break **: 11.00 – 11.30 am**
Lunch **: 1.00 – 2.00 pm**
Tea Break **: 3.15 – 3.30 p.m.**

E. TOPICS FOR DEMONSTRATION LESSONS

	Topic	Name of the Teacher	Date
1.	Limit of a function	*S Behuria*	3.6.2002
2.	Relations and Functions	*L K Bera*	3.6.2002
3.	Maxima and Minima	*Sam Lawrence*	4.6.2002
4.	Problems in Probability	*Esther*	4.6.2002
5.	Differentiation of Implicit functions	*Bala Subramanian*	5.6.2002
6.	Logarithmic Differentiation	*S Khan*	5.6.2002
7.	Second and Higher Order Derivatives	*Dr Singh*	6.6.2002
8.	Rolle's Theorem	*P C Panda*	6.6.2002
9.	Continuous functions	*Sukumar Brajabasi*	7.6.2002
10.	Quadratic Equations	*M C Varma*	7.6.2002
11.	Integration as a Limit of a sum	*Dr M K Sharma*	8.6.2002
12.	Product Rule and Quotient Rule of Differentiation	*Sudhakar Singh*	8.6.2002
13.	Tangents and Normals	*D K Sahoo*	10.6.2002
14.	Circles – Equations	*S Prasad*	10.6.2002
15.	Construction : To devide a given line in the given ratio 3 : 2	*C Prasad*	11.6.2002
16.	Improper Integrals	*Mulgund*	11.6.2002
17.	Equation of a line in 3D Geometry – Vector form	*Balambal*	12.6.2002
18.	Equation of a plane in 3D	*K M Chinnamma*	12.6.2002
19.	Conic Section	*Sophia*	14.6.2002
20.	Equation of a circle	*Ravi Kumar R*	14.6.2002
21.	Introduction to Differential Equations	*Vatsala G R*	17.6.2002

F. TEST ON CONTENT CATEGORIES

Each statement given below describes a content category in Mathematics. All that you have to do is to identify the concept in the list. If a statement describes a concept, write 'concept' in the blank provided against the statement. Otherwise write "not a concept". Write 'undecided' if you cannot categorise a statement.

---------- 1. Matrix multiplication is not commutative in general.

---------- 2. A square matrix is a matrix, in which the number of rows is equal to the number of columns.

---------- 3. A function is a relation in which no two distinct ordered pairs have the same first coordinate.

---------- 4. For every real number c,
$\lim_{x \to a} c\, f(x) = c \lim_{x \to a} f(x)$

---------- 5. If f and g are differentiable functions, then their product fg is also differentiable and $(fg)' = fg' + f'g$.

---------- 6. It is good to remember quotient rule for differentiation in the following form.

Derivative of a quotient =
$$\frac{\text{(denominator) (derivative of the denominator) - (numerator) (derivative of denominator)}}{(\text{denominator})^2}$$

---------- 7. The distance s in metres described by a particle in t seconds is given by
$s = ae^t + \frac{b}{e^t}$

---------- 8. There is only one triangle (apart from the triangles congruent to it) with prescribed lengths for sides a,b,c with $a < b + c$.

---------- 9. Two events E and F on the sample space S of a random experiment are independent if
$P(E \text{ and } F) = P(E) \bullet P(F)$.

---------- 10. The bivariate raw data is usually presented in the form of a table called "the bivariate frequency table".

G. PRETEST

1. Sum of the two forces is 18 and their resultant perpendicular to the lesser of the forces is 12. Then the magnitudes of the two forces are

   a) 12, 18 b) 5, 13
   c) 6, 12 d) 9, 9

2. Moment of the Force 15 Newtons acting along the positive direction of x-axis about the point A(2,3) is equal to

   a) $15 \times 2 + 15 \times 3$ units b) $15 + 5$ units
   c) 15×2 units d) 15×3 units

3. Let A be an event such that $P(A) = P(\bar{A})$ ($\bar{A}$ is complement of A), then

   a) A is certain event b) A is null event
   c) $P(A) = \frac{1}{2}$ d) $A = \bar{A}$

4. If A and B are two events such that $P(A \cup B) = P(A \cap B)$ then

   a) $A \cup B = A \cap B$ b) $P(A \cap B) = \frac{1}{2}[P(A) + P(B)]$
   c) $P(A \cup B) = 2 \cdot P(A) \cdot P(B)$ d) None of these

5. The vector equation of a straight line is $\bar{r} = 5\bar{i} - 2\bar{j} + 4\bar{k}) + \lambda(2\bar{i} - \bar{j} + 3\bar{k})$, then its Cartesian equation is given by

   a) $\frac{x-5}{2} = \frac{y+2}{1} = \frac{z-4}{3}$

   b) $\frac{x-5}{2} = \frac{y-2}{-1} = \frac{z+4}{3}$

   c) $\frac{x-5}{2} = \frac{y-2}{-1} = \frac{z-4}{3}$

   d) None of the above

6. The number of elements in the power set of the null set is

   a) 1 b) 0 c) 2 d) Not defined

7. $A = \{1,2,3\}$, $B = \varphi$. The number of elements in $A \times B$ is

   a) 3 b) 6 c) 0 d) 1

8. Solution of $\frac{dy}{dx} = 2^{y-x}$ is

a) $2^x + 2^y = 2^c$ b) $2^{-x} - 2^{-y} = 2^c$
c) $2^x - 2^y = 2^c$ d) None of these

9. If $\bar{a} = (1,2,3)$, $\bar{b} = (2, -1, 5)$, $\bar{c} = (3,2,1)$ then $\bar{a} . (\bar{b} \times \bar{c})$ is

a) 37 b) -37 c) 34 d) –34

10. Straight line method of calculation of depreciation is given by

a) $\frac{Estimated\ Scrap\ Value - Cost}{Cost}$

b) $\frac{Cost - Estimated\ Scrap\ Value}{Cost}$

c) $\frac{Cost - Estimated\ Scrap\ Value}{Estimated\ Scrap\ Value}$

d) None of the above

Short Answer Type

1. Prove that there is no largest prime number.
2. Use Fundamental Theorem of Arithmetic to show that N × N is a countable set where N is the set of all natural numbers.
3. Illustrate an impossible event by taking a random experiment.
4. Along the sides of a regular hexagon, taken in order, forces a,b,c,d,e,f are applied. Show that if they are equivalent to a couple, then d + e = a + b and a + f = c + d. Also find the Moment of the couple.
5. forces equal to 5,3,4 and 6 Newtons act along CB, BA, DA and DB of a square ABCD (respectively) of side length 2 meters. Find the algebraic sum of the Moments about C.
6. Maximize x + 2y under the constraints $2x + 3y \leq 6$, $x + 4y \leq 4$, $x, y \geq 0$ graphically.

H. POST–TEST

1. If $P(A \cap B) = 0$, then A and B are

   a) independent events
   b) any two events A and B
   c) mutually exclusive events
   d) atleast one of A or B is null event

2. If A be an event such that $P(A) = P(\overline{A})$ ($\overline{A}$ is complement of A), then

   a) A is certain event
   b) A is null event
   c) P(A)= ½
   d) $A = \overline{A}$.

3. Straight Line Method of calculation of depreciation is given by

   a) $\dfrac{\text{Cost} - \text{Estimated scrap value}}{\text{Cost}}$

   b) $\dfrac{\text{Cost} - \text{Estimated scrap value}}{\text{Estimated scrap value}}$

   c) $\dfrac{\text{Cost} - \text{Estimated scrap value}}{\text{Estimated life}}$

   d) None of the above

4. Amount of instalment to be credited to Sinking Fund is given by

   a) $E(1 + r)^n$
   b) $\dfrac{Ar}{(1 + r)^n - 1}$
   c) $\dfrac{A.(1 + r^n) - 1}{1 - r}$
   d) None of these

5. Is the statement, For every real number c,
   $\lim_{x \to a} cf(x) = c \lim_{x \to a} f(x)$ is a

   a) concept
   b) generalization
   c) fact
   d) skill

6. In the expression $x = \dfrac{A + B}{C - D}$, the letters x, A, B, C and D are always positive. Which of the following operations will be sure to decrease the value of x ?

   a) keep A and C constant and decrease B and D.
   b) keep A and C constant and increase B and decrease D.
   c) keep C and D constant and increase A and decrease B.
   d) keep A and B constant and increase C and D.

7. A force of 9 kg weight is inclined at an angle of 15° to the horizontal. Then its resolved part along the vertical direction is equal to

a) $9 \cos 15^\circ$ b) $9 \sin 15^\circ$

c) 9 d) None of the above

8. If three forces acting upon a rigid body can be represented in magnitude and direction by the three sides of a triangle taken in order, then

a) the system is in equilibrium.

b) the system is sliding.

c) the system is a couple

d) none of the above

9. The line of shortest distance between two skew lines is perpendicular to

a) one of the two lines

b) none of the two lines

c) both the lines

d) none of these

10. If $\bar{a}$ and $\bar{b}$ are unit vectors inclined at an angle θ, $|\bar{a} - \bar{b}| =$

a) $2 \sin \frac{\theta}{2}$ b) $2 \cos \frac{\theta}{2}$

c) $\sin \theta$ d) $\cos \theta$

III. Give a counter example to show that the definition given below is not correct.

"Singular matrix is a matrix whose transpose is equal to the given matrix".

IV. Show that $(A \Rightarrow B) \Rightarrow A$ logically implies A.

III. 1. The forces a, b, c, d, e, f are applied along the sides of a regular hexagon, taken in order. If the system is equivalent to a couple, find the moment of this couple.

OR

2. A small ring of weight w can slide on a smooth vertical circle and is attached to the highest point by means of a string which is equal to the radius of the circle. Find the Tension in the string and the reaction on the ring in equilibrium position.

IV. Solve the following system of inequations graphically.

$x + y \geq 2;$

$y \geq 3;$

$x \geq 1.$

V. A body of mass 2 kg is falling vertically under gravity at the rate of 50 m/s. What is the uniform force acting vertically upwards that will stop it in 2 seconds ?

I. LIST OF PARTICIPANTS

	Name of the Participant	Official Address	Residential Address	Telephone No.
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J. LIST OF RESOURCE PERSONS

1. Prof G Ravindra, Principal, RIE, Mysore
2. Prof K Dorasami, Dean of Instruction, RIE, Mysore
3. Prof N M Rao, Section Head, Mathematics Section, RIE, Mysore
4. Dr B S P Raju, Reader in Mathematics, RIE, Mysore
5. Dr B S Upadhyaya, Reader in Mathematics, RIE, Mysore
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Use of Language Laboratory for English Language Classroom transactions in Puducherry

A Training Package for Teachers
at the Secondary and Higher Secondary Level

Programme Coordinator & Editor

Dr Nidhi Tiwari
DESSH

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December 2009

Use of Language Laboratory for English Language Classroom transactions in Puducherry

A Report

HIGHLIGHTS

- Assessment of audio-visual materials and CALL materials led to the realization that it was too specific to Western Culture, the Indian version was limited to textbooks only and was based on behaviourist approach.

- A need to procure Communicative CALL which is based on Constructivist approach and later adapt it to Indian situations was deeply felt.

- If possible, production of interactive audio-visual materials to suit Indian needs was also considered and recommended.

REPORT

About the Programme

A training programme to train Key Resource Persons in the use of Language Laboratory for English language classroom transactions at secondary and higher secondary levels in Puducherry was proposed in January 2009. The duration of the programme was 8 months, i.e. commencement from May 2009 and target date of completion being December 2009. It had four activities.

Need and Justification

Technology plays a vital role in education. In language teaching, the use of language software in Computer Laboratories and audio-cassettes in language laboratories enhances the competence of teachers and facilitates classroom transactions. It makes the classroom learner friendly as audio-visual materials instantly attract the attention of learners and provide scope for interactive sessions. Hence, the need for this programme for training key resource persons at the secondary and higher secondary levels in the use of language laboratories for language classroom transactions is justified.

Objectives:

- To familiarize the teachers with language laboratories where they get an opportunity to listen to audio cassettes in phonetics and also get practice in using it.
- To train teachers to handle language software in Computer Laboratories which could later be used by them in classroom transactions.
- To enable them to make their presentations using Power Point and Multi Media.

Methodology : Questionnaire and Workshop Mode

Activity 1 :

A tool was prepared by the Coordinator to identify the needs of the learners in July 2009. After this, 4 sets of the questionnaire were sent to the Directorate of

School Education, Puducherry in August 2009. Most of these questionnaires were filled by the English teachers at secondary and higher secondary levels and posted to RIE, Mysore. After closely examining the responses of these questionnaires, the Coordinator prepared an Approach Paper which introduced the concept of language laboratory and its importance in teaching/ learning situations in English classrooms in schools of Puducherry. It spelt out the objectives, focused upon the questionnaire and the responses of the teachers, laid the plans for the review of the existing training package which contained the needs to develop the skills and framework of the module.

Though purchase of books and ELT Software was proposed in Activity II, yet keeping in mind the requirement of Review Workshop under Activity II, this was advanced.

Activity II:

The Review Workshop was held from October 9-13, 2009 at RIE, Mysore. Seven resource persons assembled for this workshop. The resource persons went through the Approach Paper and reviewed the training package which had been prepared to train the KRPs at secondary level from Tamil Nadu. It was decided to add modules on Web-Based Learning, Teaching Short Story and Drama in the Lab. The Supplement on Appreciation of Poetry was to be expanded and converted from Supplement to a module. Some modifications and additions were suggested in the modules on Reading, Listening, Speaking Skills and Grammar.

After the new modules were written and changes were incorporated in the existing modules, the new training package was prepared. This time a CD was prepared on poetry.

We took a decision to involve the KRPs in PowerPoint presentations during the training so as to address their field requirement. It would also give them hands-on experience in ICT labs.

The draft training package with a CD on poetry was ready a week before the training programme.

Activity III:

A five-day training workshop was held in RIE, Mysore from November 30 – December 4, 2009. About 30 KRPs from Puducherry, both TGTs and PGTs attended this training programme. After a formal inauguration by Prof.G.T.Bhandage, where the KRPs were made aware of the need of language labs, they were taken to the Skillsphone Language lab where most of the sessions were held. All the modules were transacted by the resource persons in the language lab. Plenty of VCDs were shown that supported each module. There were lot of discussions on the effectiveness of these ELT softwares in the context of English classroom situations in Puducherry

The KRPs were also taken to NIIT interactive digital lab. where they could understand the dimensions of group work, pair work and learning at the pace of an individual (an impossibility in a normal classroom) in a digital lab. Every day had a practical session on preparing their Power Point presentations in the ICT lab.

For this, on the first day the Co-ordinator divided the KRPs into six groups. Each group had to work on a language component which was

i) Vocabulary

ii) Grammar

iii) Poetry

iv) Reading Comprehension

v) Conversation

vi) Listening Skills

It was verified that each group had at least one person who was computer literate. Some tips of PowerPoint presentations were given before they were taken to ICT lab for practical work. In the ICT lab, the resource persons and technical staff moved around and assisted each group. These sessions turned out to be most fruitful. As several KRPs had gathered ideas from the ELT softwares they had seen earlier, they were quite excited to come up with their own presentations. In fact, this hands-on experience generated lot of interest and confidence.

The Valedictory function was held in the evening session of the last day i.e. December 4, 2009 in the Intel Lab. The groups showed their presentations to the august gathering that comprised of Prof.B.S.Raghavendra, Dr.Beulah Jayseeli, Dr.Aruna P. Devi and Dr.K.B.Shaji. The Programme Coordinator provided the details of the 5-day training programme. The KRPs provided the feedback which indicated that they found the training very beneficial and expressed their happiness and gratitude. In his Valedictory address, Prof.Raghavendra stated that a new beginning had been made and motivated the KRPs to carry the torch further.

As the training package was in the draft stage, only the CDs were given to the KRPs with a promise to send the training package later.

Activity IV :

The training package is ready and copies are being sent to the KRPs as December 2009 is coming to a close.

FEEDBACK OF THE PARTICIPANTS

Training Programme on the Use of Language Laboratory for English Language Classroom Transactions in Puducherry

Feedback of the First Day by Group 1

Registration of 30 participants who came from the Union Territory of Puducherry to participate in the 5-day programme on the use of Language Laboratory for English Language Classroom Transactions in Puducherry started at 9 a.m. on 30.11.2009.

Dr.Nidhi Tiwari, Programme Coordinator welcomed all the participants. Then the participants introduced themselves to the Principal, RIE, Mysore and other staff.

The Principal, RIE, Mysore in his address stated that Language Laboratories are for Language Learning. We, teachers, should go for the use of technology for teaching of English language. The students should be given continuous exposure to language. Software materials are useful. We, teachers should move away from traditional way in language teaching. There are various aspects in setting up language laboratories. Teachers should know the use of language laboratories and be capable of imparting training to other teachers in using language laboratories. They should know how to make it functional and this 5-day training may be useful.

Mr.C.Praveen talked about "Understanding Language Laboratories". At first he explained what language laboratory refers to. He said that there is also digital laboratories. He showed audio visual materials of CIEFL, Hyderabad, ETNL, BBC, etc. He advised that two sessions/ periods in a week may be allotted for language laboratories. He also stated that film clips may be used for language teaching in the language laboratories.

Dr.K.Nataraja Pillai gave a lecture on "Listening Skills". In his lecture, he explained the objectives of listening. He also explained what to listen when we listen.

He gave details regarding audio-visual equipments that are useful to develop listening skill among learners. He gave list of activities which will enhance listening skill of learners.

In the afternoon Mr.C.Praveen gave a lecture on "Building Vocabulary". He showed the video recording of the ways of building vocabulary he prepared during the 5-day workshop organized for the teachers of Tamil Nadu. He said that the materials that are available in Internet may be utilized for building vocabulary among learners. He gave a list of website addresses for the usage in language laboratories for building vocabulary.

Dr.Nidhi Tiwari divided the 30 participants into six groups. These six groups should prepare PowerPoint presentation for the topics as given below.

I group	Conversation
II group	Story Telling
III group	Poetry
IV group	Listening
V group	Grammar
VI group	Vocabulary

Dr.Nidhi Tiwari asked the first group to prepare a report on the activities of 30th November 2009.

The Inaugural Address of the Principal, Regional Institute of Education, Mysore is useful for the teachers. His address kindled the teachers to have language laboratories in the UT of Puducherry.

The talk of Mr.C.Praveen enlightened the teachers to understand the language laboratories. His speech helped the teachers how to build vocabulary in the minds of students. When vocabulary is built the learners can be able to use the language in their day to day life confidently.

The lecture of Dr.K.Nataraja Pillai made the teachers know how to develop listening skills by using language laboratories. When the learners begin listening, it will pave the way for speaking. Hence, the first day programme is effective and useful.

Members of the First Group
V.Balabascarane
V.Jayabalan
A.Baskar
T.Kannappan
M.Damodaran

Feedback of Second Day of (1.12.09) of the Training Programme

The second day of the training programme commenced with the report reading by Sr. Lecturer Mr. Balabhaskaran of Pondicherry. The expectations of the RPs to incorporate participants' views and suggestions in the report were taken with prime concern.

Report reading session was followed by the slot of teaching of Short Story through Language Lab. by Dr.Shaji. Though we had some impediment due to technical default, the session gained momentum with the film strip of Ben Hur. What else could bring in the Roman setting so precisely to the classroom but for this piece? We were exposed to a new technique of narrating a short story with accompaniment of musical symphonies especially to convey the emotions of pathos. By this session, it was made clear that Aristotelian grandeur cannot be expected out of short stories. Moreover, many myths despite being overt or covert will have a deep rooted reality which could be exploited for short stories. Unperishable themes like love and death shall never turn stale with which ample number of stories be woven to enhance the listening and reading skill of the learners.

Dr.Nidhi Tiwari's session on presentation skills was itself the best example for how a good presentation could be. The objectives of presentation and the guiding factors to create the same was explained in a nutshell through her PowerPoint. A demo play of the presentation followed by an interesting listening activity in which all the participants were engrossed. This particular activity brought out the salient features of creating worksheets for Language Labs.

In post-lunch session on Appreciation of Poetry, handled by Mr.C.Praveen was the show of the day. His genuine labour behind exploring parallel text and poetry was evident from the meticulous preparation based on the prescribed textbooks of Puducherry state. His collection of materials related to the text will definitely pave way for extended reading among students. It would also make them more receptive to art and culture in due course of time. His inclination towards the subject served as a

source of inspiration to all of us to make the language lab. as the best place of language learning.

This session was followed by that of Dr.Nataraj Pillai on the importance of reading skill and enhancing the same through language lab. After briefing on the types of reading and on the components of reading, he introduced us to the softwares on reading along with comprehension exercise and vocabulary building games. The importance of increasing the eye span and the need to reduce the regression were also emphasized. With this, the day's proceeding came to an end.

Group Members – II group

Ms.Soorya Kumari
Mr.Amalaprakash
Dr.M.Das
Mr.Thampi Rajan

Report on the Third Day's Proceedings

This is the report of the Third group comprising the members

1. Mr.N.D.Perunthagai
2. Mr.P.S.Kannadasan
3. Mr.Ramanan
4. Mr.Natramizhselvan and
5. Mrs.Beena

This report is on the proceedings of the third day of this training programme (2.12.2009).

In the first part of the morning session, Mr.Nadeemulla Sherief and Dr.Harinath were introduced to the participants by Dr.Shaji.

Both the resource persons, Mr.Nadeem and Dr.Harinath explained to us the basic tenets of preparing a viable PowerPoint presentation.

Their lecture and demonstration (lecdem) on the sub-topics such as 'one slide for one concept', 'outline', 'slide structure', etc. threw much light on the ways and means of preparing a PPT.

Their categorization of do's and don'ts provided us with an indepth knowledge of preparing an effective PPT. Though this training programme is not meant for Computer Education, Mr.Nadeem, on our request, came forward to help us by explaining to us the technical aspect of working on a computer for the production of a PPT.

In the second part of the morning session Dr.Shanthi gave her lecture on 'Developing Skills through a Language Lab'. Her versatility over the English language and Literature was seen by her presentation of the subject matter. In her opening speech she quoted Aristotle that a language is learnt logically and psychologically. Similarly, she concluded her lecdem with a quote from Othello.

Othello asks Desdemone, "Where is the hand kerchief?" For this Desdemone says, "I wish I had not seen it".

This was quoted by Dr.Shanti to elucidate the point of 'modifying ideas' and 'developing the skill of asking questions with restrictions'.

The reasons for the non-development of communication skills were enumerated by her with her valuable suggestions, then and there, for overcoming the impediments.

Further, she pointed out that the structure of the sentence should first be introduced. She reiterated that grammar, vocabulary and pronunciation should also be given importance for developing the speaking skill.

She mentioned the various possibilities of using the Language Lab. for the development of this skill.

At one point she went on to explain how questions with restriction can be asked. For elucidating this point, she took our State Co-ordinator Dr.M.Doss for the role play of a famous personality. Dr.Doss enthused all of us with his quick wittedness and with his power of imitating the hackneyed English of the personality.

Dr.Shanti then added that this kind of simulations can be recorded and used in the lab. effectively.

In the afternoon session of this day, Dr.Nidhi Tiwari with her erudition and with her spontaneous flow of the language delivered her lecture on "Integrating Skills in a Language Lab".

She gave us a detailed explanation on the sub-topics such as Kinds of Language Lab, Advantages of Integrating Skills, steps in integrating skills, etc.

She made a mention of the usefulness of Audio-Visual materials and then she played a CD on 'Model Innovative English Classroom'.

The day's proceedings came to a close with the discussion on the methodologies adopted by the teacher on the movie.

Fourth Day Proceedings

The fourth day started with the Feedback session as usual. Then Ms.Sangeetha took the class on Web based Learning. She explained with the help of a PowerPoint Presentation about 'CBT' and 'WBT'. Madam highlighted the advantages as well as the limitations of Web-Based Learning. Also she explained how far computer based training would go without Internet connection. In the case of 'WBL', we can directly contact anyone around the world. Thus the world has shrunk into a global village. WBT is a vehicle for delivering training to an individual at a time anywhere in the world. We felt very much the difference between the CBT and WBT.

	WBT		CBT
1.	It is online.	1.	It is offline.
2.	Self-learning at any time.	2.	It is instruction based learning.

Madam discussed the comparison between the physical and virtual classroom. Various competitions like elocution can be held on line.

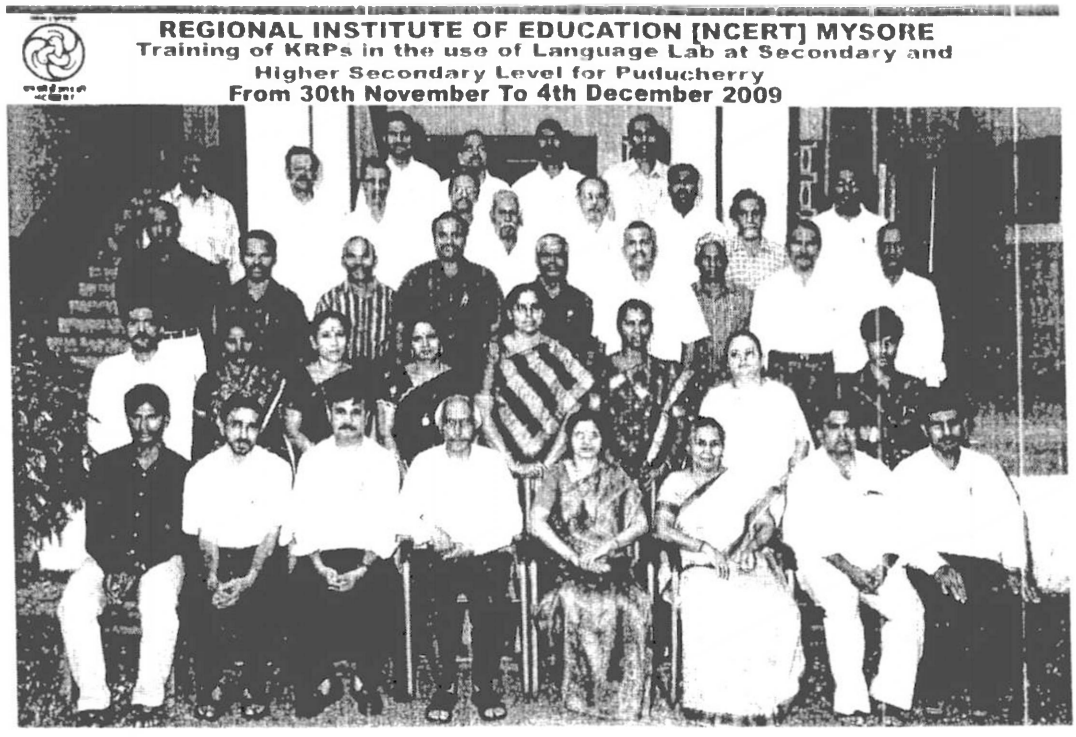
After tea break, the groups were engaged in preparing PowerPoint presentation. With the help of Internet, Mr.Imran and Mr.Nadeem guided in preparing PPT. After lunch break, we all gathered for the session on handling pronunciation by Dr.Beulah Jayseeli. She insisted the importance of pronunciation right from primary level onwards. She gave examples such as cucumber, derogative. She said how to teach English and correct it in the classroom situation. She also said that English is stress time language, whereas Tamil is considered to be syllable time language. Further, Madam showed video-clips regarding right and wrong pronunciation.

Finally, she concluded saying that teacher is the most indispensable in teaching pronunciation and not the Language Lab.

The last session the groups were continued to finish their PowerPoint presentation. The day came to an end with 'photo' session happily.

Group Members:

Mr.R.Ragunatham
Mr.Muthukrishnan
Mrs.Rehana
Mr.Suhumaran
Mr.Antony



Annexure

LIST OF RESOURCE PERSONS

1. Dr V R Prabodhachandran Nayar
'Prasadam', Plancherry Lane
Vallikkadavu PO
Trivandrum

2. Dr. K.V.V.L. NARASIMHA RAO
Principal (Retd.), S.R.L.C.
Central Institute of Indian Languages
(Res.) M-43, I Phase (HUDCO)-KHB
Udayaravi Road, Kuvempunagar
M Y S O R E - 570 023.

3. Dr Beulah Jeyaseeli
Principal
Bishop Appaswamy College of Teacher Education
Coimbatore

4. Dr. N.Nadaraja Pillai,
Reader
Central Institute of Indian languages
Mysore

5. Dr Nidhi Tiwari
Reader in English
Regional Institute of Education
Mysore 570 006

6. Dr.R.Shanthi
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PG and Research Department of English,
A.V.V.M Sri Pushpam College,
Poondi, Thanjavur.

7. Mr.C. Praveen
Lecturer,
Govt. College of Teacher Education
Trivandrum

8. Dr P Aruna Devi
Sr. Lecturer in English
Institute of Distance Education
Madras University, Chennai

9. Dr Gayathri Devi Dutt
Former Director
Regional Institute of English
Jnanabharathi Campus
Bangalore

10. Dr Karunakaran B Shaji
Lecturer in English
RIE, Mysore

11. Mrs. Sangeetha Belur
Soft Skills Trainer
Frankfinn, Mysore

TRAINING OF KEY RESOURCE PERSONS IN THE USE OF TECHNOLOGY INCLUDING LANGUAGE LABORATORY FOR LANGUAGE CLASSROOM TRANSACTION IN PUDUCHERRY

Kindly fill up the following questionnaire to enable us to design the training material to suit your special needs :

1. Name of the Participant :
2. Educational Qualification :
3. Name of School :
4. Address of School :
5. Years of experience in teaching English :
6. Special Training acquired in the teaching of English :
7. Methodology used in the Teaching of English (whether translation, teacher dominated, teacher initiated, participatory, etc.)

I. Briefly answer the following questions.

1. Are you familiar with Language Laboratory? If yes, would you kindly mention how it was used for language teaching?
2. Have you done a course in Phonetics?
3. Do your students struggle with pronunciation?
4. Is it possible for the students to consult a dictionary for purpose of pronunciation?
5. Have you used recorded material for listening comprehension in the classroom?
6. According to you what is the role of audio material in the language teaching?
7. Has it been possible for you to use any ELT software in the language classroom?
8. Do you think that exposure to audio-visual materials will prove useful in language teaching?

9. Are the students able to make presentations in the classroom? What kind of presentations do they make?

10. Are you able to make PowerPoint presentations?

11. What modern technology are you employing to develop vocabulary of your students?

12. In your opinion, will the communication skills of your students be enhanced if they are provided access to video CDs on group discussions?

13. Have you engaged your students in conducting interviews? If yes, how did you proceed about it? Have you displayed any video of interviews?

14. Does the skill of public speaking find a place in your language classroom? In what manner have you involved the learners in focusing on public speaking?

15. What is the importance of integrating the skills? Can multi-media be used to meet the requirement for developing integration of skills?

16. Would you like to specify any needs as regards language teaching using a language laboratory?

Training of Key Resource Persons in the Use of Language Laboratory for Language Classroom transactions in Puducherry

Introduction

Language teaching has seen major paradigm shifts ever since technology facilitated learning. Language laboratories have been part of this exciting teaching learning process over three decades in higher education. However, even now most learners at the school level are unaware of the existence of language laboratories. Those who are aware happen to be the teachers who have not been able to put it to proper use due to lack of access to it.

Earlier language laboratories meant teaching of Phonetics using audio-cassettes and tape-recorders in a soundproof room with booths and headphones. But the emphasis on communicative language teaching has expanded the nature and functioning of language laboratories. The focus in a language classroom is on skills development for purpose of communication. On the other hand, technology has spread its wings and with computers and multi-media dominating the scenario, language laboratories have become multifunctional. The use of language softwares along with several audio-visual materials enlarges the scope of language laboratories and plays a vital role in enhancing the competence of teachers and also facilitates classroom transactions. The classroom becomes learner friendly as technology instantly attracts the attention of learners and provides scope for interactive sessions.

This programme fulfills the need to provide the training to key resource persons at the secondary level in the use of language laboratories for language classroom transactions in Puducherry.

Objectives

1. To familiarize the teachers with language laboratories where they get an opportunity to listen to audio CDs in Phonetics and know about Pronunciation in use.

2. To train teachers to handle language softwares in the Language Laboratories for purpose of skills development.

Background of Learners

In the light of the objectives stated above, a questionnaire was developed to identify the needs of this training programme. This questionnaire was sent to several secondary schools in Puducherry. The response was good from the respective schools. Almost all English teachers expressed the need to use technology in the language classroom. The interest to know more about language laboratories was evident from their responses.

Questionnaire

The questionnaire focused on major aspects associated with language laboratories. The questions were like :

1. Are you familiar with Language Laboratory? If yes, would you kindly mention how it was used for language teaching?
2. Have you done a course in Phonetics?
3. Do your students struggle with pronunciation?
4. Is it possible for the students to consult a dictionary for purpose of pronunciation?
5. Have you used recorded material for listening comprehension in the classroom?
6. According to you what is the role of audio material in the language teaching?
7. Has it been possible for you to use any ELT software in the language classroom?
8. Do you think that exposure to audio-visual materials will prove useful in language teaching?
9. Are the students able to make presentations in the classroom? What kind of presentations do they make?
10. Are you able to make PowerPoint presentations?

11. What modern technology are you employing to develop vocabulary of your students?

12. In your opinion, will the communication skills of your students be enhanced if they are provided access to video CDs on group discussions?

13. Have you engaged your students in conducting interviews? If yes, how did you proceed about it? Have you displayed any video of interviews?

14. Does the skill of public speaking find a place in your language classroom? In what manner have you involved the learners in focusing on public speaking?

15. What is the importance of integrating the skills? Can multi-media be used to meet the requirement for developing integration of skills?

16. Would you like to specify any needs as regards language teaching using a language laboratory?

The replies of the respondents provide an insight into the working conditions and field realities. It also indicates their needs. The responses can be enlisted thus :

- Most teachers indicated that they were not familiar with language laboratories.
- Many teachers felt that language laboratories would prove useful in teaching pronunciation.
- Some teachers had done courses in Phonetics and had used audio-cassettes to teach pronunciation.
- Several teachers indicated that they had not used any technology in the language classroom and felt that if they had access to language softwares, they would like to use them.
- All teachers unanimously accepted that language laboratories would certainly facilitate language learning and make the classroom interaction interesting.
- The needs specified by the teachers were – using multimedia for presentations, audio and video CDs for pronunciation and to develop LSRW and communication skills. Ear phones, tape recorders and overhead projectors were also specified.

Planning for the Training Package

The administration of the tool and the feedback generated from the responses enables planning for the training package.

The areas identified for enhancing language skills can be arranged in this manner when modules have to be written.

GENERAL INTRODUCTION

Understanding Language Laboratory

PART A – BASIC SKILLS

1 Listening Skills
2 Speaking Skills
3 Reading Skills
4 Handling Pronunciation
5. Building Vocabulary
6. Grammar in Use

PART B – HIGHER ORDER SKILLS

7 Public Speaking
8 Presentation Skills
9 Appreciation of Poetry
10 Teaching Short Story
11 Drama in the Lab.

PART C – TOWARDS AN INTEGRATED APPROACH

12 Integrating the Skills

PART D – E-LEARNING

13 Web-Based Learning

Epilogue

Framework of Module

A tentative framework for writing the modules could be as follows :

i) Objectives
ii) Theoretical Background
iii) Audio-Visual Materials
iv) Activities

v) Evaluation

vi) Summarizing

vii) References

Conclusion

Language laboratories have a major role to perform in language teaching learning process and will soon find a place in educational institutions. Keeping in mind the fast pace of technology, it becomes a prime concern to train our school teachers in the use and efficient handling of the audio-visual materials in the language laboratories. The language laboratories provide a congenial space to orient students towards an active application of their aural-oral skills through creative activities. These range from basic interactive situation as an informal introduction to formal presentation. Personality development is an important aspect here. Thus, language laboratories are vibrant to the needs of a heterogeneous student community with varied socio-economic background and impart interactive communication skills. This training programme is designed to develop suitable materials to equip the teachers to handle the language laboratories and make the language classrooms learner friendly and effective in developing the basic and higher order skills in language use in society for a variety of purposes.

*****

List of Participants

1. R.Ragunathan
   TGT
   T.P.G.G.H.S.S.
   Ariankuppam
   Puducherry

2. K.Ramanan
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   Sinnatha Govt. Girls Hr. Sec. School
   Muthialpet, Puducherry

3. M.Pazhanivel
   TGT, Govt. Middle School
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4. N.D. Perunthagai
   Lecturer In English
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5. Dr.M.Doss
   Lecturer, State Training Centre
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Training Programme on Use of Language Laboratory for English Language Classroom Transactions in Puducherry

Programme Schedule

30th November – 4th December 2009

Day / Date	9.00 – 9.45	9.45-11.15	11.30-1.00	2.00-3.30	3.45-5.15
Monday 30.11.2009	Registration	Inauguration	Understanding Language Lab. **Mr.C.Praveen**	Listening Skills **Dr.N.Pillai**	Building Vocabulary **Mr.C.Praveen**
Tuesday 1.12.2009	Feedback Session	Teaching short Story **Dr.K.Shaji**	Presentation Skills **Dr.Nidhi Tiwari**	Appreciation of Poetry **Mr.C.Praveen**	Reading Skills **Dr.N.Pillai**
Wednesday 2.12.2009	Feedback Session	Speaking Skills **Dr.Shanti**	Drama in the Lab. **Dr.Gayatri Devi**	Preparing PowerPoint Presentation **Dr.Harinath**	Integrating the Skills **Dr.Nidhi Tiwari**
Thursday 3.12.2009	Feedback Session	Web-Based Learning **Ms.Sangeetha Belur**	Web-Based Learning **Ms.Sangeetha Belur**	Handling Pronunciation **Dr.Beulah Jeyaseeli**	Grammar in Use **Dr.P.Aruna**
Friday 4.12.2009	Feedback Session	Public Speaking **Dr.Beulah Jeyaseeli**	Group Work **Dr.Nidhi Dr.Harinath Dr.Shaji Mr.Imran Mr.Nadeem**	Presentation by KRPs **Dr.Nidhi Dr.Harinath Dr.Shaji Mr.Imran Mr.Nadeem**	Valedictory

11.15 to 11.30 am & 3.30 – 3.45 pm : Tea Break; 1.00 – 2.00 pm : Lunch Break

Nidhi Tiwari
Programme Coordinator