



GOA BOARD OF SECONDARY AND HIGHER SECONDARY EDUCATION

(A Corporate Statutory Body Constituted by an Act of the State Legislature)

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GBSHSE/ACAD/2012/

Date. 21/02/2012

Circular No.10

To
The Heads of all recognized
Secondary Schools
within the jurisdiction of this Board.

Sir/Madam,

Inorder to ameliorate the Mathematics teaching in schools the Board has adopted the materials prepared for the Maths Lab by the subject experts.

The new concept of Maths Lab has to be introduced in all Secondary Schools w.e.f. 2012-13.

The material adopted by this Board is enclosed herewith for reference and implementation.

Sd/-

(Bhagirath G. Shetye)
Secretary.

Encl: As above

Copy forwarded for information to:

1. All the Members of the Board
2. The Dy. Directors of Education, North/South/Central Zones Mapusa/Margao/Panaji
3. All Section Heads of this Office.
4. Guard file

MATHEMATICS LABORATORY IN SCHOOLS

It is a place where:

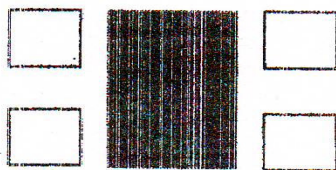
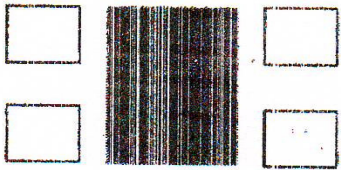
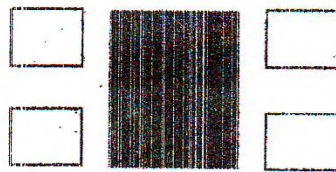
- 1) Students do experiments with numbers and geometrical shapes and try to generalize these patterns.
- 2) Students do most of their calculations with the help of scientific calculators.
- 3) Students draw graphs of large number of functions with the help of scientific or graphic calculators and try to become familiar with graphs of all the functions they usually deal with.
- 4) Students solve real life problems with real data because complex calculations are no longer a major consideration.
- 5) Students express their answers to mathematics problems in decimal numbers and not in symbols and have a good idea about their magnitudes.
- 6) Students get practice in estimating orders of magnitudes and obtaining approximate answers when exact answers are difficult to find.
- 7) Students make charts and models to illustrate mathematical ideas.
- 8) Students do almost all the work themselves, of course under the guidance of teachers, but the students are active all the time and are involved with what they are doing.
- 9) The creativity of students is allowed free play.
- 10) Students solve graphically equations involving all types of functions.
- 11) Students are free to discuss among themselves and with the teachers; in fact students and teachers form joint investigating teams.
- 12) Students find areas and volumes of both regular and irregular solids.
- 13) Students undertake projects both in mathematics and its applications.
- 14) The concepts and theorems are not given to the students; these arise naturally from their investigations.
- 15) Interfaces between algebra, geometry, probability, calculus etc are freely investigated and discussed.
- 16) Attempts are made to interpret every symbolic solution.
- 17) The process of mathematics is emphasized much more than the product of mathematics.
- 18) Students are encouraged to find alternative solutions and alternative methods of solving problems.
- 19) Students enjoy learning mathematics.

STUDENTS' WEAKNESSES IN MATHEMATICS

Students do not fair well in mathematics because:

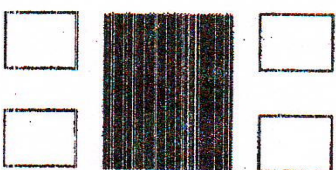
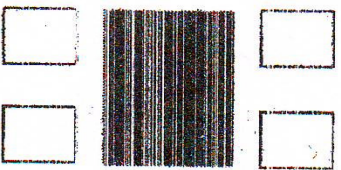
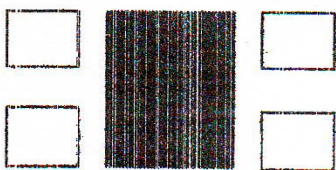
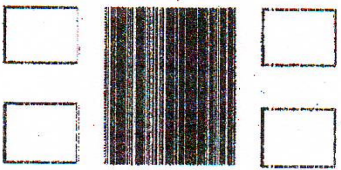
- 1) Mathematics is taught as an abstract subject.
- 2) Mathematics education is far removed from applications.
- 3) Mathematics is taught as an isolated subject.
- 4) There is too much emphasis on symbols and their manipulations and relatively little on problem solving.
- 5) Too much time is spent on routine monotonous drill type arithmetical calculations.
- 6) The goal of mathematics education appears to be passing examinations in mathematics and not understanding mathematics and its applications or developing capacity to think mathematically.
- 7) Instead of developing creativity, mathematics education encourages conformity to standard methods.
- 8) It trains students to think that there should be only one method of solving mathematics problems.
- 9) It trains students to think that there can be only one solution to a problem.
- 10) Mathematical proficiency is often confused with proficiency in making arithmetical calculations.
- 11) The process by which mathematics is created is seldom taught or emphasized.
- 12) Mathematics is presented as a purely deductive science though it is also as much an experimental science as physics or biology.
- 13) Geometric and Physical visualizations remain very weak.
- 14) Even geometric objects become just relations between symbols and are not curves or surfaces.
- 15) It convinces the students that the only law which matters is the linear law.
- 16) Students develop no idea of the order of magnitude of the results they get.
- 17) Students are passive learners.
- 18) Students do not talk mathematics, discuss mathematics or think mathematics.
- 19) Mathematics is taught as a collection of topics.
- 20) The historical development of mathematics is never emphasized.

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MATHS LAB

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Thus the objective of a mathematics laboratory is to:

- a) Remove the weaknesses of present day mathematics education which the mathematics laboratory and the mathematics laboratory alone can do it.
- b) To develop the much needed confidence in students.
- c) To generate interest in the subject.
- d) To make the students divergent thinkers.

Having seen "WHAT" and "WHY" of a mathematics laboratory let us now discuss the "HOW" of it.

Layout of a mathematics laboratory:

The ideal mathematics laboratory will have the following sections:

- 1) Section for job discussion and planning the solution.
- 2) Section for making sketches, drawings for taking observations.
- 3) Section for reporting the results.
- 4) Section for making the working models as per job specifications.
- 5) Computer section for doing experiments of mathematics on computers.

The above sections (steps to be performed by students) need be discussed by the teacher in-charge, in the laboratory. Before the children are asked for execution, the teacher should explain the planning part as well as he/she should help them in identifying the appropriate solution in respect of choice of proper tools and their use in execution. The teacher should also explain the use of computers in finding the solution and the method of checking the accuracy of the solution already found in the laboratory.

Furnishing Mathematics Laboratory:

Sufficient furniture should be provided in the laboratory to do experiments and at the same time for displaying the working models and other means of taking observations; to carry out experiments and make a clear understanding about the use of procedural tools in engineering projects. These models are made out of discarded toys and waste articles found around us. This approach boosts the creativity, scientific development of the brain of the children, and satisfies their zeal to do something new and unique.

Raw Materials:

To enable the students to work in a mathematics laboratory, there should be a few cupboards to store raw materials, which can be issued to the students when they come to the lab for doing practical work. The list of some of the essential raw materials is as under:

- I) Circular discs: Plates of different diameters may be cut on thermo Cole sheets or may be plastic metal discs purchased from the market to determine the value of π or such other experiments.
- II) There should be square/rectangular plates cut from thermo Cole sheets, different solids like cone, cylinder for drawing different shapes and making observations for various computations.
- III) A thick card sheet, capable of folding, to prepare packing boxes, envelopes etc or other small objects.
- IV) The students will be required to use drawing sheets, graph papers, cutting tools, thread, small balls made of different materials, ready reckoners, rubric cube, calculators, **an LCD Projector & a Laptop.**

Measuring Equipment:

- 1) Measuring tapes 30m; 10m; 2m; 1m and smaller lengths, arrows (iron wire nails 20 to 30 cm long; 2.5 mm in diameter)- they act as pegs to mark points on the field ; pipe hole 1m long ; 10 mm in diameter, pointed at one end; painted with red and white strips- used for making solar observations and determination of N-S direction at a place and also finding out the angle of elevation of the Sun at any time.
- 2) Plain mirror, plum bob suspended from a hook, drawing board , mini drafter, vernier calipers , working models to verify law of parallelogram of forces, triangle of forces etc.

MATHS LAB ACTIVITIES FOR STDIX & X

1. To obtain the conditions for consistency of a system of linear equations in two variables by graphical method.
2. To verify that the given sequence is an arithmetic progression by paper cutting and pasting method.
3. To verify that the sum of first n natural numbers is $n(n+1)/2$, that is $S_n = n(n+1)/2$, by graphical method.
4. To verify the Basic Proportionality Theorem using parallel line board and triangle cut-outs.
5. To verify the Pythagoras Theorem by the method of paper folding, cutting and pasting
6. To verify that the angle subtended by an arc at the centre of a circle is twice the angle subtended by the same arc at any other point on the remaining part of the circle, using the method of paper cutting, pasting and folding.
7. To verify that the angles in the same segment of a circle are equal, using the method of paper cutting, pasting and folding.
8. To verify, using the method of paper cutting, pasting and folding that
 - a. the angle in a semicircle is a right angle,
 - b. the angle in a major segment is acute,
 - c. the angle in a minor segment is obtuse.
9. To verify, using the method of paper cutting, pasting and folding that
 - a. the sum of either pair of opposite angles of a cyclic quadrilateral is 180° .
 - b. in a cyclic quadrilateral the exterior angle is equal to the interior opposite angle.
10. To verify using the method of paper cutting, pasting and folding that the lengths of tangents drawn from an external point are equal. .
11. To verify the Alternate Segment Theorem by paper cutting, pasting and folding.
12. To make a right circular cylinder of given height and circumference of base
13. To determine the area of a given cylinder. To obtain the formula for the lateral surface area of a right circular cylinder in terms of the radius (r) of its base and height (h).
14. To give a suggestive demonstration of the formula for the volume of a right circular cylinder in terms of its height (h) and radius (r) of the base circle.
15. To make a cone of given slant length (l) and base circumference ($2\pi r$) .
16. To give a suggestive demonstration of the formula for the lateral surface area of a cone.
17. To give a suggestive demonstration of the formula for the volume of a right circular cone.
18. To give a suggestive demonstration of the formula for the surface area of a sphere in terms of its radius.
19. To give a suggestive demonstration of the formula for the volume of a sphere in terms of its radius.
20. To get familiar with the idea of probability of an event through a double colour card experiment.
21. To make a clinometer and use it to measure the height of an object.