CHAPTER IV

AN ANALYSIS OF THE INTENDED CURRICULUM
OR
THE SYLLABUS
NEED OF THE SYLLABUS

Importance of curriculum has already been discussed in detail. The 'syllabus' is comparatively more concrete than the curriculum. The 'syllabus' or the course-outline is spelt out in specific terms, and acts as a guide for the teacher. Preparation of curricular material is vital and important. All attempts for curricular innovations are based on a study of the existing curriculum. The syllabus - as the intended curriculum - is the educational ideal; and the operational curriculum of teachers, methodologies, textbook etc. are the reality. As the syllabus changes, the textbook follows suit. Prof. D. K. Sinha in the following words exhorted the teachers of mathematics to renew their efforts to refurbish this classical subject:

"The immediate need in our country is to introduce on a large scale a new curriculum. This requires, apart from organisational and institutional boost-up, a syllabus which, in the present context of affairs, be as detailed and specific as possible offering maximum guidance to teachers and writers of textbooks. It is obvious that such a syllabus presents not only what to teach, but how to teach the contents of it. Nevertheless, it will meet the needs of the present moment but it is not desirable for all time to come, for that might contain in it the germs that might degenerate its business to direct teachers strictly how to get at the what of the syllabus and this might even produce a kind of feeling among the teachers and the textbook writers to be alert so as to keep themselves scrupulously on the track set down by the syllabus. It may thereby deny the teacher the opportunity to use his own initiative and responsibility to make his class more interesting, more lively than what can be attained by following the so-called syllabus."
Professor Bryan Thwaites of the Southampton University (U.K.) had very forcefully advocated the need for the realignment of the course-content and the restructuring of the syllabus of mathematics at the Southampton Mathematical Conference, 1961. He said:

"In view of the great changes which have taken place during recent years in mathematics at university level, including those changes which are often considered collectively under the term 'Modern Mathematics', there is a prima facie case for a critical look at the content of the present school syllabi. Research should be instituted without delay to ascertain which parts, if any, of traditional syllabi should be omitted as of doubtful value, and what might more profitably be included. During the time that this research is taking place there is a clear need for examining the way in which the traditional content of the syllabus is taught, with a view to inspiring in children something of the modern attitude towards the structure, pattern and beauty of mathematics."

Here, Professor Thwaites clearly advocated the need for judicious scrutiny of the mathematics syllabus. He was not in favour of adhoc changes; rather he advocated rational changes based on research findings.

Eminent and sensitive pedagogues like Professor Thwaites and Professor D.K. Sinha were advocating curricular changes. But the findings of the All India Survey of Achievement in Mathematics conducted under the auspices of the National Council of Educational Research and Training, New Delhi, reported in 1970 as follows:
"As regards, the statement of mathematical content in the syllabi, they were usually arranged under topics, further divided into sub-topics. Most syllabi did not clearly define the scope of a topic. The material in the syllabi was usually arranged classwise. But not much is said about the learning activities or sequences within a class."  

Watson expressed serious concern as regards the syllabus and pointed out defects in it. According to him:

"There are serious shortcomings in the traditional school mathematics syllabus and that there has been for many years a need to bring mathematical curricula into line with modern ideas and applications."  

The world is changing faster than ever before; and so also the educational scenario. There is an urgent imperative need for curricular reform to meet the needs of a society in a flux. W. Servais and T. Varga, in this connection, had said:

"In this period of extensive educational reform the planning of school programmes in mathematics should be based on recent advances in scientific knowledge about child development in particular and about the process of human learning in general. If carried out in this basis, experiments with the construction of modern mathematics syllabuses can do much to aid the reform of mathematical education. Such experiments should cover a wide range of mathematical topics so as to contribute to an objective selection of those most appropriate to a given age group in a particular type of school, and to their distribution within syllabuses."  

The Right Honourable Sir David Eccles, the then Minister of Education of the United Kingdom wrote in 1961:
"We know that the quality of mathematics teaching could and should be improved, the curricula brought up-to-date, and above all the number of mathematicians with good qualifications increased."6

Professor Thwaites in his preface to the book "On Teaching Mathematics" pointed out the utter obsolescence of mathematics as it was taught in the United Kingdom in 1960, and stated that things had not appreciably improved since 1920's or even the Oxbridge scholarship paper situation. He referred to the imminent dangers of the 'abstract-applicable' dichotomy; and the need for curricular renewal from time to time.

The Education Commission of India (1964-66) in its Report had stated:

"At the secondary and higher secondary levels also, the mathematics syllabus which at present are divided in the traditional manner into arithmetic, geometry and algebra, trigonometry, statistics, calculus and coordinate geometry, need to be revitalized and brought up-to-date. The entire arithmetic course and also the basic operations in algebra can be completed by the end of the primary stage. There is considerable room for eliminating out-dated material from the syllabus such as simplification, factorization, the finding of H.C.F., L.C.M. etc. Trigonometry should be related to algebra and may not be treated as a separate subject. Much of the work on identities, solutions of triangles, heights and distances could be considerably cut down. The emphasis on memorizing of theorems, exercises in geometry should be given up. The approach to the teaching of geometry should be changed and an axiomatic and systematic treatment adopted.

'Set' language may be used in defining the basic terms in geometry and operations with numbers. It is only through the use of 'set' language that
a proper integration of arithmetic, algebra and geometry is possible. The use of the School Mathematics Study Group notations for line, segment, ray, and so on, which provide for more precision in language, may be adopted."

The Commission recommended for a drastic change in the mathematics syllabus. On the basis of the recommendations, there were significant changes in the mathematics syllabus in Orissa. Integration of subjects was effected. 'Set' was introduced and new notations were used.

The National Curriculum For Primary and Secondary Education laid greater stress on mathematics at the secondary stage.

"At the secondary stage, basic concepts of sets, relations, and functions should be introduced. The language of sets should be used to clarify the concepts including those learned earlier. Some part of the experimental geometry, studied at the primary stage, should be in the form of formal geometry with proofs. Arithmetic and mensuration should be included in the form of applications of algebraic method only. The treatment of algebra should be simple as required for problem solving. The treatment of trigonometry should be elementary, and enough to solve simple problems of heights and distances."8

On the basis of the National Curriculum, National Policy on Education was formulated in the year 1986. Nationwide orientation programmes of teachers were conducted since then. In Orissa, orientation programmes were held every year during summer vacations. Efforts were in the process to bring about significant changes in the curriculum. But the
recommendations of the New Education Policy had already been
effected to a very great extent in so far as mathematics
syllabus of Board of Secondary Education, Orissa was concerned.
Arithmetic was already included as an application of algebra
and mensuration as application of geometry. But trigonometry
did not find its place in compulsory mathematics. The
Secondary School Curriculum of Orissa was quite forward-
looking and was upto the expected national standards.

CHANGES OF MATHEMATICS SYLLABUS BY THE BOARD OF
SECONDARY EDUCATION, ORISSA.

The Board of Secondary Education, Orissa was
established in the year 1955. Prior to that the Secondary
Education was under the Utkal University. Initially, the
same syllabus prescribed by the University was adopted by
the Board. At that time four classes were included in
the secondary stage i.e., classes VIII, IX, X and XI.

At the time of inception of the Board of Secondary
Education, Orissa, the only improvement with regard to mathemat-
cs syllabus was that the textbooks were translated from
English to Oriya. There were no nationalised textbooks.
Local authors, mostly experienced school teachers of the
subject, came forward to write books according to the syllabus.
The difference in the textbooks was only the inclusion of
new problems in the exercises.
In the year 1956, the branches of Mathematics were Arithmetic, Mensuration, Algebra and Geometry. Weightage to different branches of Mathematics was given as under,

(a) Arithmetic 25 marks
(b) Mensuration 15 marks
(c) Algebra 30 marks
(d) Geometry 30 marks

Total 100 marks

The same syllabus was in vogue up to 1973. In the year 1970, the Government of Orissa, under instructions from the Central Government, wanted to modify the syllabi. But the intention could not be materialised due to lack of sincerity and other administrative constraints.

In 1973, the syllabus of the Secondary Education of Orissa was overhauled, and naturally mathematics syllabus also underwent change. The revised syllabus was meant for the candidates appearing at the H.S.C. Examination, 1976. Therefore, the old syllabus which was in vogue since the establishment of the Board continued up to 1975. A static syllabus without any changes for two decades speaks for itself the basic conservatism of the educational system, and its lack of vision.
In the changed syllabus, weightage to different branches of Mathematics was modified.

(a) Arithmetic 20 marks
(b) Mensuration 30 marks
(c) Algebra 30 marks
(d) Geometry 20 marks

Total 100 marks

In the new syllabus some changes in Arithmetic were made by the exclusion of H.C.F., L.C.M. and Matric system and inclusion of new topics like time and distance, Approximate Calculations upto maximum of four decimals.

In Mensuration, some new topics were included in Compulsory Mathematics, viz., Circumference and Area of Circles, Approximate Value of \( \pi \), Surface and Volume of Rectangular Parallelopiped, Cylinder, Cone, ... Prism and Pathways merging of Rectangular Fields.

In algebra, two topics were excluded viz., 'Identities' and 'Ratio and Proportion'. But the topic included was 'Simple Quadratic Equation of the form \( ax^2 + bx + c = 0 \) and its roots'.

In geometry no changes either in theorem or in construction were made.
In spite of the minor changes effected in the Mathematics syllabus for the secondary classes in 1976, it continued to be the same old curriculum. Radical reforms could not be effected.

The next change in the syllabus in mathematics was effected during 1977-78. A few minor changes were effected in arithmetic without affecting algebra, geometry and mensuration portion. In arithmetic 'Taxes', 'Ratio and Proportion', 'Average' 'Simple and Compound Interest' were included.

Major structural changes in the syllabus were initiated in 1980. It was known as the New Syllabus. The secondary classes were reduced to three classes in conformity with the 10+2+3 pattern of education. The detailed syllabus has been mentioned in this chapter. From 1980 to 1988 the same syllabus was in operation.

The distribution of marks in the 1980 new syllabus was:

- Algebra
  - Its application
- Geometry
  - Two theorems (6+6)
  - Two riders (6+6)
  - One Construction
  - Its application
- Objective type and Short questions

Total - 100 marks

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<th>Subject</th>
<th>Marks</th>
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<td>Its application</td>
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<td>Geometry</td>
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<td>Two theorems (6+6)</td>
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<td>Two riders (6+6)</td>
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<td>One Construction</td>
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<td>Its application</td>
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<td>Objective type and Short questions</td>
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Another booklet was published in the year 1986 with the syllabus remaining unchanged; but a detailed description of objectives of teaching mathematics was incorporated which has already been discussed in the chapter relating to the objectives of teaching mathematics section. There was also redistribution of marks to different branches of mathematics.

"Section (A)
Algebra, Long questions - 30 marks

Section (B)
Geometry, Long questions - 30 marks

Section (C)
Short answer and Objective type questions -
  i) Algebra - 20 marks
  ii) Geometry - 20 marks

Total - 100 marks"

In 1986, changes were effected in the mathematics syllabus of Orissa by the Board of Secondary Education in its letter No. 4466 (A) (3809) (Syllabus) dated 3rd July 1986. Prior to the change, the study was conducted and, therefore, the changes were not mentioned. However, the distribution of marks remained the same. But emphasis was on sets and statistics.

The Frame of Reference:

The Secondary Schools of India are to be the most significant agencies for interpreting, promoting and
refining the democratic way of life. The schools should be the training grounds for all Indian Youth. At present India is witnessing an upward mobility in every sphere of scientific, industrial and cultural life. This trend demands a more dynamic educational programme. There is also a looming threat to our democracy both from within and without. The new broader concept of world leadership is an emerging call, for a high school programme to the development of effective citizenship. Therefore, personal-social needs of the youth should be given prominent consideration in the programme of general education. All such considerations are curricular considerations and central to the framing of the syllabus. The prosperity of a society or a nation depends squarely on the widespread application of high mathematical skills, and as such attempts should be made to develop an aptitude for mathematics among the students. It is, therefore, important to relate the teaching of mathematics to the total curriculum.

The recent changes in the country and abroad demand mathematics to be in the central position in the curriculum at all levels of study. The syllabus of mathematics ought to be reorganised so as to fulfil the mathematical requirements of the other subjects in the curriculum. The mathematics syllabus, intended for the students of a secondary school needs to be designed with
emphasis on the cultural roles of mathematics as its core and with options for higher specialised study.

MATHEMATICS SYLLABUS PRESCRIBED BY THE NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING.

The NCERT is the apex organisation of Government of India to advise, direct and guide in all matters relating to school education. Under its direct control there are four Regional Colleges of Education and four experimental schools. The schools are known as Demonstration Multipurpose Schools. The syllabus prescribed by the NCERT is implemented in the schools. The syllabus of the NCERT in Mathematics for Secondary Schools provides the general framework for curricular development of entire India. The NCERT syllabus has been outlined for reference:

"Class VIII
Part I
Unit I   Real numbers
1.1 Recall
1.2 Introduction
1.3 The fact that \( \sqrt{2} \) is not rational
1.4 The concept of an Irrational number
1.5 Decimal forms of some Irrational numbers.
1.5.1 The Irrational number \( \sqrt{2} \)
1.5.2 The Irrational numbers \( \sqrt{3}, \sqrt{5}, \sqrt{7} \)
1.5.3 The Irrational number \( \sqrt{k} \)
1.6 The fundamental operations on Irrational numbers.

1.6.1 Addition and multiplication

1.6.2 Subtraction and Negative Irrationals

1.6.3 Division and reciprocals

1.7 Simplification of Expressions Involving Irrational numbers.

1.8 Approximate Evaluation of Irrational Numbers.

1.9 The concept of a Real Number

1.10 The Real Number Line

Unit II Exponents and Radicals

2.1 Introduction

2.2 Numbers with Rational Numbers as Exponents.

2.3 Laws of Exponents

2.4 Simplification of Radicals

Unit III Algebraic Expressions

3.1 Recall

3.2 Polynomials with Real Coefficients: Addition and Subtraction.

3.3 Multiplication of polynomials

3.3.1 Product of two monomials

3.3.2 Product of a Polynomial and a monomial.

3.4 Division of polynomials

3.5 Rational Expressions

3.6 Addition of Rational Expressions

3.7 Subtraction of Rational Expressions
3.8 Multiplication of Rational Expressions.
3.9 Reciprocal of a Rational Expression
3.10 Division of Rational Expressions

Unit IV Special Products and Factors
4.1 Cube of a Binomial
4.1.1 Recall
4.1.2 Cube of a sum of Two Monomials
4.1.3 Cube of a Difference of Two Monomials
4.2 Some special products
4.3 Review of Factoring Techniques covered in class VII.
4.4 Factorization of a Second Degree Trinomial
4.5 Factorization of the Sum and Difference of Two Cubes.
4.6 Identities and Conditional Identities

Miscellaneous Exercise I

Unit V Linear Equation and Inequations.
5.1 The number place of the Cartesian Plane
5.2 Graphical Representation of Data
5.3 Graphs of Linear Equation in one variable.
5.4 Linear Equation in Two Variables
5.4.1 Graphs of Linear Equations in Two Variables.
5.5 Graphs of Linear Equations in one variable.
5.6 Simultaneous Linear Equation in Two variables - solution by Graphing.
Part II

Unit VI  Congruence of Triangles

6.1 Recall

6.2 No. of ways in which Two Triangles can be congruent.

6.3 Congruence of a Triangle to itself.

Unit VII  Parallel Lines and Similarity.

7.1 Recall

7.2 Ratio and proportion

7.3 Intercept on a Transversal

7.4 Relation between Intercepts made on a Transversal by Three Equidistant Parallel Lines.

7.5 Relation between the Intercepts made by Three Parallel Lines on any Transversal.

7.6 A parallel to a Side of a Triangle Cuts The Other Two Sides in the Same Ratio.

7.7 Construction

7.7.1 To Divide a Line-segment into a Given Number of Equal Segments.

7.7.2 To Divide a Line-segment into a Given Number of Segments in a Given Ratio.

7.8 Similarity

7.9 Rules for Similarity of Triangles

Unit VIII  Circles

8.1 Recall

8.2 Intersection of a circle and a Line

8.3 Tangent to a circle.
8.4 No. of Tangent to a circle from a Point.
8.5 Construction of Tangents
8.5.1 To Draw a Tangent to a Circle at a Given Point on It.
8.6 Intersection of Two Circles.
8.7 Common chord and Common Tangents
8.8 Degree measure of an Arc.
8.9 Some properties of Degree measure
8.10 The Number \( \pi \).
8.11 Remark.

Unit IX Areas.

9.1 Recall
9.2 Area of a Triangle—Hero's Formula
9.3 Area of a Quadrilateral
9.4 Area of Irregular Rectangular Figures.
9.5 Area of a Regular Polygon.
9.6 Area of a Circle
9.7 Measurement of Area by method of Counting Squares.

Unit X Volumes and Surface Areas.

10.1 Introduction
10.2 Unit of Volume
10.3 Volume of a Cuboid.
10.4 Surface Area of a Cuboid.
10.5 Volume and Surface Area of a Right Circular Cylinder.
10.6 Volume and Surface Area of a Right Circular Cone.

10.7 Volume and Surface Area of a Sphere.

Unit XI Raw Data and their Arithmetic Mean.

11.1 Introduction

11.2 Arithmetic Mean

Unit XII Frequency Distribution and Histograms.

12.1 Introduction

12.2 Use of Tally Marks.

12.3 Mean of a Frequency Distribution.

12.4 Mode of Raw Data

12.5 Grouping of data.

12.6 Graphical Representation of Frequency Distributions and Histograms.

Unit XIII Arithmetic in Daily Life.

13.1 Recall

13.2 Compound interest

Class IX

Algebra

1. Sets

1.1 Set. Members of a set, comparison of sets, Equivalent and equal sets, empty set, Finite and infinite sets.

1.2 Disjoint sets, subset of a set, Proper set of a set, Universal set.
1.3 Operation on sets. Intersection of sets, Union of sets, complement of a set with reference to a universal set. Venn Diagrams and their use to verify some basic results of operation on sets.

2. Number system.

2.1 The system of rational numbers as an ordered field. The natural numbers, whole numbers, Integers and functions as subjects, the set of rational numbers.

2.2 Representation of rational numbers as decimals and by point line.

2.3 The inadequacy of rationals for measurement of all distances in terms of a given unit of length. Gaps on the rational line. Examples of decimals which are not rational numbers. The need to extend system of rationals.

2.4 The set of real numbers, consisting of rational and irrational numbers. Gaplessness of the real line. The system of real numbers as a complete ordered field introduced intuitively.

2.5 Absolute value of a real number. Graphs of linear equation and inequations on the number line.


3.1 Ordered pairs. Cartesian product of two sets. Graph of $A \times B$ where $A$ and $B$ are non-empty subsets of $R$.

3.2 Relation from $A$ to $B$ defined as a non-empty subset of $A \times B$. Domain and range of a relation. A relation defined in a set $A$. 
3.3 A function defined as a special type of a relation. Domain and range of function.

3.4 Real function. Graph of a real function.

4. Linear equation and inequation

5. Indices and Logarithms.

Mathematics Related to Commercial Activity.

6. Ratio and Proportion.

7. Proportional Parts and Partnership.

8. Percents and Profit and loss.

9. Simple and compound interest

10. Rate of Growth

11. Discount

Geometry

12. Lines, Angles and Triangles

13. Congruence of Triangles

14. Circles

15. Constructions
   15.1 Right bisector of a line segment
   15.2 Construction of a triangle.
   15.3 Construction of quadrilaterals.
Mensuration


16.1 Perimeter of a parallelogram rectangle.

16.2 Area - its measurement.

16.3 Perimeter and area of a circle.

16.4 Area of irregular rectilinear figures convex polygones.

17. Statistics.

17.1 Definition, Limitation of Statistics.

17.2 Collection of Primary and Secondary data.

17.3 Tabulation and classification of data.

17.4 Graphical representation of statistical data by Histogram, Frequency Polygon, Frequency Curve,

17.5 Cumulative Frequency Curve or Ogive.

Class X

1. Linear Inequation and Applications
   - Systems of inequations.
   - Linear Programming.

2. Polynomials.


4. Polynomials of degree three or four.

Mathematics related to Commercial Activity.
5. Shares and Dividends
   - Shares, Dividend and Debentures
   - Brokerage.

6. Instalment Schemes.
   - Instalment Percentage Scheme
   - Repayment of loans in instalments

7. Banking
   - Introduction
   - Savings Bank Account
   - Other forms of Deposits including Fixed and Recurring deposits.

8. Taxes.

   Geometry

9. Similarity

10. Circle

11. Loci

12. Construction of a tangent at a point on a circle.

13. Trigonometry

14. Use of Trigonometrical tables and heights and distances.

   Mensuration

15. Surface area and volume.
   - Measures of Central tendency (Location).
   - Mean (Arithmetical mean)
   - Median
   - Mode

CENTRAL BOARD OF SECONDARY EDUCATION.

The syllabus of the Central Board of Secondary Education and the National Council of Educational Research and Training are similar in nature. Therefore, the syllabus of the Central Board of Secondary Education needs no mention.

INDIAN CERTIFICATE OF SCHOOL EXAMINATION. (ICSE)

The Council for the Indian School Certificate Examination is an Anglo-Indian Organisation. A large number of schools have been established by the council throughout the country and the medium of instruction in those schools is English. The Council has framed its own syllabus keeping the needs of the entire country in its view. The details of it have been given below. The syllabus does not explain the class wise division of topics. The topics, that are to be covered in three years i.e. from class VIII to X are mentioned in the syllabus. It is the responsibility of the schools to divide the entire syllabus into different classes.
SYLLABUS

"Paper I"

1. Sets, Relations and Mappings.
   i. Sets-Notions, kinds, the cardinal numbers of a finite set; set operations, set relations, power set, laws of set operations, Numbers N, W, 1 or Z,R.
   ii. Relations - Ordered pairs, set of ordered pairs, Cartesian Product of two sets, Relation as sub-sets of Cartesian Product of sets. Graph of relations. Relations: Systematic Reflexive, Transitive and Equivalence.
   iii. Venn-diagrams - Simple applications. Universal set, one or two sub-sets.
   iv. Functions - Special relations and mappings. Types - many to-one, one-one, into, onto. (Universe of functions and composition of functions are excluded).

2. Arithmetic including Commercial Arithmetic.
   i. Pure Arithmetic - Simplification of expressions, fractions and decimals, brackets, ratios and proportion (mean proportion included but continued proportion and direct and indirect variation excluded) and squareroot. Use of rational numbers and operations on them is included. Awareness of certain irrational numbers e.g., \( \sqrt{2} \) and \( \pi \) but operations on them excluded.
ii. Unitary method and its applications - Use of the multiplying ratio problems time, work and distance speed are included (chain rule excluded).

iii. Percent and Percentage.

iv. Profit and loss Discount - (Trade and special kinds of discount excluded).

v. Simple interest compound interest - Including questions on compound interest half yearly.

vi. Shares and dividends - (Brokerage and fractional shares excluded)

3. Algebra

i. Fundamental operation in Algebra - Addition and subtraction of like and unlike terms. Multiplication of a polynomial by a monomial, binomial, or trinomial. Division of polynomial by a monomial or binomial.

ii. Expansions - (a + b); (x + a) (x + b); (a+b+c)²; (a + b)³

iii. Factors - Writing out the common factors, grouping ax² ± bx ± c:

   x² - y²; a³ ± b³.

iv. Equation of the 1st degree - Linear equations in one variable and problems on them, simultaneous linear equations in two variables and simple problems on them.
v. Matrices - 2x2, column and row, matrices from given information multiplication of 2x2 by 2x1 matrices.

4. Geometry - The proofs of theorems marked with an * (asterisk) will not be required but problems based on these may be set.

i. Angles at a point -
   * a) If two straight lines intersect, the adjacent angles are supplementary and the vertically opposite angles are equal.
   * b) If two angles having a common arm are supplementary, the other arms lie on a straight line.
   c) Constructions using roller and compass only.
   I) To construct an angle equal to a given angle.
   II) Constructions of angles of 60°, 30°, 45°, 90° and allied angles of 70°, 105° etc.
   III) Bisection of a line segment.
   IV) Bisection of an angle.
   V) Reflection in a line, finding the image by construction.
   VI) Reflection in a point.

ii. Parallel lines -
   a) If a straight line cuts two parallel straight lines, the alternative angles are equal, the corresponding angles are equal, and the internal
angles on the same side of the straight line are supplementary.

b) The reverse of (a)

c) Constructions

I) Through a given point to draw a line parallel to a given straight line.

II) Constructions of perpendiculars to a line from a point in it and from an external point.

iii. Triangles -

a) The sum of the angles of a triangle is equal to two right angles.

b) If one side of a triangle is produced, the external angle so formed is equal to the sum of the interior opposite angles.

c) Congruency of triangles, the following four cases of congruence of triangles should be illustrated through construction and apparatus, by performing actual application of cut-out triangles together, and seeing why they must coincide

* I) two sides and the included angle.
* II) one side and any two angles.
* III) three sides
* IV) by hypotenuse and one side
d) If two sides of a triangle are equal, the angles opposite to them are equal.

e) If two angles of a triangle are equal the sides opposite to them are equal.

f) If two sides of a triangle are not equal the greater side has the greater angle opposite it and the converse.

g) Of all the straight lines, that can be drawn to a given straight line from a given point outside it, the perpendicular is the shortest.

h) Construction of triangles from given data, namely -

I) the length of three sides;
II) length of two sides and the included angle;
III) two angles and length of one side;
IV) length of the hypotenuse and one side of a right angled triangle;
V) the lengths of the three medians;
VI) the lengths of two sides and the median between them;
VII) the sum of two sides, the remaining side and the angle between;
VIII) the difference of two sides, the remaining side and the angle between;
iv. Rectangular Figures -

a) In a polygon of $n$ sides, the sum of the interior angles is equal to $(2n-4)$ right angles.

b) The opposite sides and angles of a parallelogram are equal, each diagonal bisects the parallelogram and the diagonals bisect each other.

c) If a pair of opposite sides of a quadrilateral are equal and parallel, it is a parallelogram.

d) Construction of parallelogram, rhombus, square, rectangle and regular hexagon from given data.

v. Loci -

The locus of a point which is equi-distant from two intersecting straight lines consists of a pair of straight lines which bisect between the two given lines.

vi. Symmetry -

a) Lines of symmetry of an isosceles triangle, equilateral triangle, rectangle, rhombus, square, and kite-shaped or diamond shaped quadrilateral,

Candidates may be asked to draw line of symmetry.

b) Figures having point system.

c) Construction of lines of symmetry for figures mentioned in (a).
5. **Trigonometry**

   i. **Trigonometrical ratios**
   The sine, cosine, tangent of
   \[ \theta, \quad (0 \leq \theta \leq 90^\circ) \]

   ii. **Trigonometric ratios of perpendicular angles**
   \[ 0^\circ, 30^\circ, 45^\circ, 60^\circ, 90^\circ. \]
   (Tangent of \(90^\circ\) is not defined)

   iii. **Solution of right-angled triangles.**

   iv. **Simple two-dimensional problems on heights and distances**
   Use of four figures trigonometrical tables included for (iii) and (iv)

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**Paper II**

1. **Algebra**

   i. **Framing of formulae**
   Generalisation of simple rules. The formula and change of subject of formula, substitution.

   ii. **Linear inequations**
   In one unknown. Graphical representation on the number line included.

   iii. **Quadratic equations**
   Solution by factor method only simple problems on them.

   iv. **Graphs**
   Graphs of linear equations in two variables. Graphical solution of simultaneous linear equations.
v. Indices -
Laws of indices including integral, fractional, positive, negative and zero indices, statements and simple applications only.

2. Logarithms -
Logarithm to the base 10 only. Laws of logarithms - proof of the laws will not be required. Four figure tables only to be used.

3. Coordinate Geometry -
   i. Rectangular Cartesian Co-ordinates in a plane -
   Rational values for abscissa and ordinate.
   ii. The distance formula.
   iii. The section formula -
   Internal section only (Mid-point formula).
   iv. Equation of a line -
   Slope intercept from \( y = mx + c \), Use of slope intercept from to identify perpendicularity and parallelism.
   v. Reflection in the Rotation of points only X-axis, Y-axis and origin.

4. Mensuration -
   i. Place figures -
   Perimeter and area of triangle, parallelogram, trapezium, rectangle, rhombus, and square. Area and circumference of circle, simple problems based on them.
ii. Solids -
Cuboid: Surface, volume, diagonal, Related problems.

Cylinder \{ Volume, surface (both curved and cone whole for cone and cylinder) \}

Related problems

5. Geometry -

Proof of theorems marked with an *(Asterisk) will not be required but problems based on these may be set.

i. Similarity -
As a size transformation.

ii. Similarity of triangles -
The following three similarities postulates for triangles:

* a) a pair of corresponding angles equal and the sides including them proportional;

* b) two pairs of corresponding angles are equal;

* c) three pairs of corresponding sides proportional;

I) the straight line drawn through the mid-point of one side of a triangle parallel to another bisect the third side.
II) The segments joining the mid-points of two sides of a triangle is parallel to and half of the third side.

III) A line drawn parallel to one side of a triangle divides the other two sides proportionally.

Related construction - Division of a line segment into equal parts or into parts in a given proportion.

IV) If a transversal makes equal intercepts on three or more parallel lines, then any other line cutting them will also make equal intercepts.

V) A perpendicular drawn from the vertex of the right angle of a right angled triangle divides the triangle into two triangles similar to each other and also to the original triangle.

VI) The ratio of areas of similar triangles is equal to the ratio of the squares on the corresponding sides.

iii. The Pythagoras Applications only Theorem.
iv. Area -
   a) Parallelograms on the same base and between the same parallels are equal in area.
   
   b) The area of a parallelogram is equal to that of a rectangle on the same base and of the same altitude.
   
   c) The area of a triangle is half that of a parallelogram on the same base and between the same parallels.

v. Circles -
   a) A straight line drawn from the centre of a circle to bisect a cord which is not a diameter is at right angles to the cord; conversely the perpendicular to a cord from the centre bisects the cord.
   
   b) There is one circle, and only one, which passes through three given points not in a straight line.
   
   c) Equal cords of a circle are equidistant from the centre, and the converse.
   
   d) The tangent at any point of a circle and the radius through point are perpendicular to each other.
e) If two circles touch, the point of contacts lies on the straight line through the centres.

f) The angles which an arc of a circle subtends at the centre is double that which it substends at any point on the remaining part of the circumference.

g) Angles in the same segment of a circle are equal.

h) The angle in a semicircle is a right angle.

i) The opposite angles of a quadrilateral inscribed in a circle (cyclic) are supplementary.

j) The exterior angle of a cyclic quadrilateral is equal to the interior opposite angle.

k) In equal circles, (or in the same circle).

I) if two arcs subtend equal angles at the centre, they are equal;

* II) conversely if two arcs are equal they subtend equal angles at the centre;

* III) in equal circles (or in the same circle) if two cords are equal, they cut off equal arcs;

IV) conversely, if two arcs are equal the cords of the arcs are equal.
6. Constructions -
   i. Construction of tangents to a circle, construction of tangents to two circles (direct and transverse).
   
   ii. Construction of circumscribed, inscribed circles of a triangle, circumcentre, incentre.
       
   iii. Simple cases of construction of circles satisfying specific conditions.
   
   iv. Construction of regular figures of 3, 4, 5 and 6 sides in or about a given circle.
   
   v. Construction of a circle in and about a triangle or a regular polygon upto six sides.

7. Statistics -
   
   i. Tabulation of raw data.
   
   ii. Graphical representation of data - Bar charts, Pie charts frequency polygons/curves histograms, Ogives.

   iii. Calculation of measures of central tendency - Mean from grouped and ungrouped data, Median, Mode; from ungrouped data. Median, Mode and Quartiles (from graphs also)

   (Interpolation of value of mean and mode from grouped data is excluded)
The Board of Secondary Education, Orissa holds an examination at the end of Class X in which questions are set from the courses in compulsory mathematics prescribed for Classes VIII to X. The examination is known as High School Certificate Examination. This examination "shall be so designed as to be a test of all round general education which would enable the students either to enter the working force or to take up higher level academic and vocational courses." All the high schools of the state are affiliated to this Board. A single syllabus is followed by all the schools of the State. The details of the syllabus have been given below.

SYLLABUS

"ALGEBRA AND ITS APPLICATIONS.

CLASS VIII

Set and its elements
Set of Natural Numbers
Set of Integers
Set of Rational Numbers
Set of Real Numbers
Arithmetic and algebra.

Brackets: The four simple rules;
Addition, Subtraction, Multiplication,
Division and removal of brackets.
Formulae and their applications;

\[(a + b)^2 = a^2 + 2ab + b^2\]
\[(a - b)^2 = a^2 - 2ab + b^2\]
\[a^2 + b^2 + c^2 = (a + b + c)^2 - 2(ab + bc + ca)\]
\[(a + b)(a - b) = a^2 - b^2\]
\[(x + a)(x + b) = x^2 + (a + b)x + ab\]
\[(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3\]
\[(a - b)^3 = a^3 - 3a^2b + 3ab^2 - b^3\]
\[a^3 + b^3 = (a + b)^3 - 3ab(a+b)\]
\[a^3 - b^3 = (a - b)^3 + 3ab(a-b)\]
\[(a + b)(a^2 - ab + b^2) = a^3 + b^3\]
\[(a - b)(a^2 + ab + b^2) = a^3 - b^3\]

Simple factorization and identity

Linear equations and inequations

Co-ordinates of points and plotting of areas

Application of algebra in solving arithmetical problems.

CLASS IX

Highest Common Factor by factorisation,

Lowest Common Factor by factorisation,

Fractions - reduction to lowest terms

four fundamental rules,

Laws of indices including negative and fractional indices,

Simple equations and problems involving simple equations,
Easy quadratic equations
(to be solved by factorisation),

Linear simultaneous equations involving
two or three unknowns,

(without the process of cross
multiplication) and the easy
problems involving application of
simultaneous equations involving
two unknowns.

Application of logarithm to simplify
numerical expressions.

Graph: Representation of the equation of the
form \( y = mx, \ y = mx + c, \)

Solution of linear simultaneous equations
involving two unknowns.

Collection and tabulation of data,
Histogram and Frequency Polygon.

Set, membership, methods of writing
set, empty set, universal set,

Venn Diagram, complement set
equivalent set, finite and infinite
sets, number of elements of sets,
application of sets in geometry.

CLASS X

Graphs of statistical data

\( \sqrt{2} \) is not a rational number

Factorisations:

i. \( a^3 + b^3 + c^3 - 3abc \)

ii. \( \leq a^2 (b - c) \)
iii. $\varepsilon_{ab}(a - b)$
iv. $\varepsilon_{a}(b^2 - c^2)$

Solution of quadratic equations of the form $ax^2 + bx + c = 0$, roots of the equation and their relationships, nature of roots, formation of equation with known root.

Equations inequations and their graphical representation;
graphs of quadratic expressions

$(y = ax^2 + bx + c)$.

GEOMETRY AND ITS APPLICATION:
CLASS VIII

(A) Plane geometry and geometry of one, two and three dimensions.

1. Two different lines intersect at most in one point.

ii. If two straight lines intersect, the vertically opposite angles are equal.

iii. If one side of a triangle is produced, the measure of the exterior angle so formed is greater than the measure of either of the interior opposite angles.
iv. Parallel straight lines.
If a straight line cutting two other straight lines makes the measures of alternate angles equal, then the two lines are parallel.

v. If a straight line intersects two parallel straight lines, it makes the measure of alternate equal to one another.

vi. If a transversal intersects two parallel straight lines then
a) the measure of two corresponding angles are equal,

b) the sum of the measures of the two interior angles on the same side of the transversal is two right angles.

vii. Straight lines which are parallel to the same straight line are parallel to one another.

viii. The measures of three angles of a triangle are together equal to two right angles.

ix. The measures of the interior angles of a convex polygon, together with four right angles are equal to twice as many right angles as the number of sides of it.

x. If two triangles have the measures of two angles equal to the measures of two angles of the other each to each
and the length of any side of the first equal to the length of the corresponding side of the other than the triangles are congruent.

xi. If two sides of a triangle are equal in length the measure of the angles opposite to these sides are also equal.

xii. If the measures of two angles of a triangle are equal, the sides opposite to these angles are also equal in length.

xiii. If two triangles have the three sides of one equal in length to the three sides of the other, each to each, then the triangles are equal in all respects.

xiv. If in two right angled triangles the lengths of the hypotenuse and one side of one respectively equal to the lengths of the hypotenuse and one side of the other, the two triangles are equal in all respects.

(a) Area of triangles
Area of rectangles and rhombus
Area of trapezium
Area of quadrilaterals

Construction of Equilateral, right angled isosceles triangles and quadrilaterals.
CLASS - IX

i. If two sides of a triangle are unequal the greater side has the greater angle opposite to it, and the converse.

ii. The sum of any two sides of a triangle is greater than the third side.

iii. Of all straight lines that can be drawn to a given straight line from a given point outside it, the perpendicular is the shortest.

iv. If two opposite sides of a quadrilateral are equal and parallel than its other two sides are also equal and parallel.

v. The opposite sides and angles of a parallelogram are equal and each diagonal bisects the parallelogram.

vi. If three or more parallel straight lines make equal intercepts on any transversal, then they make equal intercepts on any other transversal.

vii. Parallelograms standing on the same base and between the same parallels are equal in area.

viii. The area of a triangle is half the area of the rectangle on the same base and having the same altitude.

ix. Triangles on the same base and between the same parallels are equal in area.

x. Triangles standing on equal bases and between the same parallels are equal in area.
xi. Equal triangles on the same base and on the same side of it are between the same parallels.

xii. Converse of Pythagoras theorem (to be assumed).

APPLICATION:

(a) Surface and volume of a cuboid.

(b) Idea of projection. Relation between the sides and projection in acute angled and obtuse angled triangles Appolonius' theorem.

(c) Solution of right angled triangles with use of \( \sin \theta, \cos \theta, \tan \theta, \cosec \theta, \sec \theta, \) and \( \cot \theta \) (\( \theta \leq 90^\circ \))

CONSTRUCTION.

(Using ruler and compasses).

(a) Construction of triangles with the following data:

I) Perimeter and two base angles.
II) Base, one base angle, sum of two sides.
III) Base, one base angle, difference of two sides.

(b) Construction of a triangle given two sides and any angle. Discussion of the ambiguous case.

(c) Construction of a quadrilateral with sufficient data.
i. A straight line drawn from the centre of a circle to bisect a chord which is not a diameter is at right angles to the chord, and the converse.

ii. One and only one circle can pass through three given points not in a straight line (To be assumed).

iii. Equal chords of a circle are equidistant from the centre and the converse.

iv. Of any two chords of a circle, which is nearer to the centre is greater than one more remote and the converse.

v. In the same circle or in equal circles, equal arcs subtend equal angles at the centre. (To be given as an axium)

vi. In equal circles (or in the same circle) arcs which are cut off by equal chords are equal, the minor arc being equal to the minor arc and the major to the major.

vii. In equal circles (or in the same circle) chords which cut off equal arcs are equal.

viii. The angle which an arc of a circle subtends at its centre is double the angle which it subtends at any point on the remaining part of the circle.

ix. Angles in the same segment of a circle are equal.

x. The angle in the semicircle is a right angle.
xi. The opposite angles of a quadrilateral inscribed in a circle are supplementary and its converse.

xii. The perpendicular bisector of sides, the internal bisectors of the angles, the median and the perpendiculars drawn from the vertices to the opposite sides of a triangle are concurrent (to be assumed).

APPLICATIONS:

i. Length of an arc of a circle

ii. Area of a circle

iii. Area of a sector and problems.

Surface and volume of a right circular cylinder, right prism, right circular cone, sphere.

Constructions (Using ruler and compasses only)

a) Reduction of a triangle to-
   I) a rectangle
   II) a parallelogram
   III) an isosceles triangle and
   IV) a right angled triangle of equal area.

b) Reduction of a quadrilateral to a triangle of equal area.

c) Construction of squares equal to twice and thrice the area of a given square.
Comparative Analysis of the Syllabi:

The syllabi of the Central Board of Secondary Education and the National Council of Educational Research and Training were one and the same. Therefore, one of the two syllabi was taken into consideration for comparison with the syllabi of Indian Certificate of School Examination, and Board of Secondary Education, Orissa. The syllabi of classes VIII, IX and X were taken into consideration in all the cases. The analysis revealed that:

1. The syllabi of NCERT and BSE, Orissa were class wise; but the syllabus of ICSE was paperwise.

2. a) In compulsory mathematics, a student with the syllabus of BSE, Orissa had to appear with one paper carrying 100 marks at the High School Certificate Examination whereas in the ICSE syllabi a student had to appear in two papers carrying 100 marks in each paper. But in the CBSE syllabi a candidate had to appear in one paper with 100 marks only on the subjects taught in the class X. Therefore, a greater weightage was accorded to mathematics in the ICSE syllabus.
b) In the BSE, Orissa syllabus, there was provision for optional subject in mathematics (which is not there under NCERT and ICSE) with a paper carrying 100 marks. A student with mathematics as his optional subject had to appear in two papers with 100 marks each. The underlying philosophy of such an arrangement in the syllabus of the BSE(O) is that minimum mathematical knowledge is a prerequisite, for one and all; and the compulsory mathematics syllabus has been designed accordingly. The optional mathematics is for those of the candidates who have a special aptitude for this subject and desire to have advanced knowledge in this area. Psychologically, the Orissa scheme is better than that of the ICSE and the CBSE or the NCERT.

3. Broadly speaking the NCERT and the ICSE syllabi were almost identical except that,

a) The ICSE syllabus was rich with an extra branch i.e., coordinate geometry consisting of cartesian coordinates, distance and section formulae, slope-intercept in the form of equation of a straight line.

b) In the ICSE syllabus, the branch 'Algebra' was rich with an extra topic "Matrix".
c) In the NCERT or the CBSE syllabus the branch 'Commercial Mathematics' was having an extra topic 'Banking and Taxes'.

4. a) The Orissa syllabus for each class had been divided into two major sections viz., 'Algebra and its applications' and 'Geometry and its applications' with two specific textbooks for each class containing the contents in conformity with the syllabus.

The first section contained Algebra and statistics and the second section contained Geometry, Trigonometry and Mensuration. Trigonometry and Mensuration were treated as applications of geometry.

b) Branches like "Commercial Mathematics" and "Co-ordinate Geometry" had not been included in the BSE, Orissa syllabus.

c) Only the "Mensuration" portion, treated as application of geometry, was comparable to the other two syllabi.

d) All other branches of the BSE, Orissa syllabus were found deficient in some respect or the other;

Algebra and its applications:

Set operations, relations, functions number system and exponentials were not included.
in the BSE, Orissa syllabus. In statistics, measures of central tendency was deficient.

**Geometry and its applications:**

In geometry section, 'loci' was not included and in trigonometry 'Heights and Distances' was not included.

e) In case the syllabus of 'Optional Mathematics' prescribed by the Board of Secondary Education, Orissa was taken into consideration, all the above mentioned deficiencies of the BSE, Orissa compulsory mathematics syllabus would have been made up and even in some cases it would have been richer in content than the other two syllabi individually or the both taken together.

**SYLLABUS**

Teachers' opinions were collected as to the adequacy of the mathematics curriculum prescribed by the Board of Secondary Education, Orissa. Out of 220 teachers, 134 expressed satisfaction, 56 teachers dissatisfaction and only 35 teachers indifference. From the analysis of the syllabi it was seen that the BSE, Orissa syllabus was adequate
to the needs of the students, and compared well with the curricula of the NCERT and the ICSE.

**Preparation of Syllabus:**

Teachers' opinions were sought for the preparation of mathematics curriculum. 114 out of 220 teachers were in favour of preparing the curriculum for their own school; but almost an equal number, i.e., 111 teachers did not favour such a proposition.

According to the New Education Policy (1986), it is targeted that a minimum standard of knowledge in each subject is to be acquired by the pupils throughout the country. In case the curriculum is prepared by each school for its own, it was feared, the ideal of the minimum learning continuum may not be achieved. Therefore, the preparation of curriculum by the Board of Secondary Education, Orissa was justified.

Most of the teachers lacked the expertise requisite for preparing the area-specific curriculum that would conform to modern national and international requirements and satisfy the local needs. Naturally, most of the teachers were shying away from this onerous task.
However, a number of mathematics teachers opined that the mathematics curriculum should be prepared by the schools independently. In case it was to be prepared by the school, then who was the right person to prepare it? In this connection a question was asked to the teachers and their opinions have been presented in the table 4.1

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Headmaster and the mathematics teacher.</td>
<td>95</td>
</tr>
<tr>
<td>2. Only the mathematics teacher</td>
<td>77</td>
</tr>
<tr>
<td>3. Headmaster, mathematics teacher and the student representatives.</td>
<td>30</td>
</tr>
<tr>
<td>4. Only the Headmaster/Headmistress</td>
<td>12</td>
</tr>
<tr>
<td>5. Headmaster, mathematics teacher, student representative, and the parents.</td>
<td>6</td>
</tr>
</tbody>
</table>

\[ N = 220 \]

(Vide Question No. 3 in the 'Miscellaneous' section of the Teachers' Questionnaire)

Majority of teachers opined that the school mathematics curriculum ought to be prepared by the headmaster.
and the mathematics teachers jointly. The intended mathematics curriculum or the syllabus is prepared by the B.S.E., Orissa. The other curricular aspects in the teaching of mathematics are usually taken care of by the headmaster and the mathematics teachers. The mathematics teachers by themselves cannot act independently. Preparation of time-table, allotment of classes, distribution of subjects, allotment of activities in mathematics etc. cannot be done by ignoring the headmaster. Therefore, the opinions of the majority of teachers seem to be justified. The bureaucratic authority of the headmaster is an important factor and could not be ignored. So, majority of the teachers desired the presence of the Headmaster, (even if he is totally ignorant of the subject) to obtain his administrative approval. This pre-empts the carefully constructed curriculum from being sabotaged through administrative apathy or antagonism. Only 77 out of 220 teachers, felt that curriculum development should be the exclusive concern of the mathematics teachers only. A microscopic minority of 12 teachers wanted to leave this entire business in the hands of the Headmasters. This opinion did not find favour with most of the teachers.

The mathematics teachers were, by and large, allergic to associate the students and the parents in curriculum development. Students were viewed as immature individuals and the parents as ignorant. The teachers did not desire to enter into a dialogue with the consumers of the curriculum (students) or the financiers and the ultimate controllers (Parents).
The conservative, traditional approach is clearly evident from the foregoing analysis.

**Mathematics Syllabus Committee**

The Board of Secondary Education, Orissa had constituted a committee consisting of ten members to prepare the mathematics curriculum. In the questionnaire, the views of the teachers were sought to select persons from different categories to form the committee. Of course, the categories were already provided in the questionnaire. The teachers were asked to select the category of their choice. Their opinions were tabulated by adding the numbers in each category.

**Table - 4.2**

**Suggested Composition of the Syllabus Committee**

<table>
<thead>
<tr>
<th>Categories</th>
<th>Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Secondary School Mathematics Teachers.</td>
<td>4</td>
</tr>
<tr>
<td>2. University teachers (Professors, Readers and Lecturers)</td>
<td>3</td>
</tr>
<tr>
<td>3. Training College Mathematics specialists.</td>
<td>2</td>
</tr>
<tr>
<td>4. Primary School Mathematics Teachers.</td>
<td>1</td>
</tr>
<tr>
<td>5. School Student Representatives</td>
<td>x</td>
</tr>
<tr>
<td>6. Guardians</td>
<td>x</td>
</tr>
<tr>
<td>7. Any Other Category</td>
<td>x</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>10</td>
</tr>
</tbody>
</table>

(Vide Question No. 4 in the 'Miscellaneous' section of the Teachers' Questionnaire)
Table 4.2 reflects the attitude of the mathematics teachers as regards the desirable composition of the syllabus committee.

The school teachers are the practitioners and are fully conversant with the class-room realities. They only deserved a 40% representation. The University and College Professors, Readers and Lecturers are viewed as intellectuals who are well-versed in higher mathematics and the frontiers of this subject. As top specialists, it was considered that they should get 30% representation in the syllabus committee. The Method Masters of the Colleges of Education (Training Colleges) are expected to be aware of the pedagogical developments and the intricacies of curriculum development. They were accorded 20% representation. The students of the primary school enter the secondary schools; and as such a representative from the primary education sector was considered to be essential. However, as already stated the mathematics teacher did not relish the idea of associating either the students or the parents with this technical task of curriculum construction.

Merits and Demerits of Mathematics Syllabus:

The mathematics syllabus prescribed by the Board of Secondary Education, Orissa may not be considered as a unique one, devoid of defects and demerits. The teachers actualise the intention of the curriculum through effective
implementation of the syllabus. They are keenly aware of the merits and demerits of the curriculum.

Most of the teachers refrained from responding to question, (No.9), that tried to elicit their value judgement, about the curriculum. This may be due to a lurking fear of the administrators who do not take kindly to criticisms.

So, most of the teachers avoided answering the questions to be on the safe side. However, a few teachers did respond and their responses have been listed below:

**MERIT**

1. Most of the topics were included keeping in view the objectives of teaching mathematics;

2. the syllabus was suited to the students of average standard;

3. topics were graded systematically and also in order of difficulty;

4. topics included helped students to study the laws of nature;
5. prepared the students for higher study;
6. helped students to solve their present problems;
7. helped students to face competitions in life;
8. syllabus was so prepared that it could be completed in time;
9. fundamental ideas were discussed clearly;
10. the syllabus was at par with the other good syllabi of India.

**DEMERITS**

1. Arithmetic should be included as a separate branch preferably commercial arithmetic.
2. It was a difficult syllabus.
3. Greater emphasis had been laid on deductions of Geometry.
4. Syllabus should be updated and should conform to the syllabus of the NCERT.

The merits smack of some sycophancy.
The demerits, though few, highlight the drawbacks and limitations of the curriculum.
Importance of Topics:

In the questionnaire, a detailed list of topics included in the mathematics textbooks of Orissa, for the classes VIII, IX and X for the year 1986, was presented to the teachers for their opinions with instructions to record their opinion on a five point scale from 'very important' to 'should not be included' on each topic. None of the topics invited an agreeable opinion. Almost all the teachers were confined within three opinions viz. very important, important and moderately important. Their opinions have been presented in table 4.3.

TABLE 4.3
IMPORTANCE OF TOPICS ACCORDING TO TEACHERS

<table>
<thead>
<tr>
<th>Class</th>
<th>Different branches and Topics.</th>
<th>Very important</th>
<th>Important</th>
<th>Moderately important</th>
<th>Unimportant</th>
<th>Should not be included</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIII</td>
<td>ALGEBRA AND ITS APPLICATIONS:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>1. Set and its elements.</td>
<td>76</td>
<td>54</td>
<td>90</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2.</td>
<td>2. Set of Natural numbers.</td>
<td>77</td>
<td>60</td>
<td>83</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3.</td>
<td>3. Set of Integers</td>
<td>85</td>
<td>36</td>
<td>99</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4.</td>
<td>4. Set of Rational numbers.</td>
<td>71</td>
<td>66</td>
<td>83</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>---</td>
<td>------------------------</td>
<td>---------------------------</td>
<td>-------------</td>
<td>--------------------------</td>
<td>-----------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td></td>
<td>86</td>
<td>67</td>
<td>67</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>165</td>
<td>43</td>
<td>12</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>176</td>
<td>30</td>
<td>14</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>191</td>
<td>14</td>
<td>15</td>
<td>x</td>
<td>x</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>17. First degree equation with one unknown.</td>
<td>147</td>
<td>53</td>
<td>20</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>18. Problems involving 1st degree equation.</td>
<td>136</td>
<td>64</td>
<td>30</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>19. Quadratic equation with one unknown.</td>
<td>129</td>
<td>62</td>
<td>29</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>20. Simultaneous equations of first degree with two unknowns.</td>
<td>137</td>
<td>44</td>
<td>39</td>
<td>x</td>
<td>x</td>
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<tr>
<td>21. Problems involving simultaneous equations with two unknowns.</td>
<td>136</td>
<td>54</td>
<td>30</td>
<td>x</td>
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<tr>
<td>22. Laws of indices</td>
<td>138</td>
<td>38</td>
<td>24</td>
<td>x</td>
<td>x</td>
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<tr>
<td>23. Logarithms</td>
<td>65</td>
<td>71</td>
<td>55</td>
<td>29</td>
<td>x</td>
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<tr>
<td>24. Graphs of linear equations.</td>
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<td>66</td>
<td>36</td>
<td>x</td>
<td>x</td>
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<tr>
<td>25. Collection and presentation of data.</td>
<td>91</td>
<td>85</td>
<td>22</td>
<td>19</td>
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<tr>
<td>26. Statistical graphs.</td>
<td>72</td>
<td>66</td>
<td>43</td>
<td>19</td>
<td>20</td>
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<tr>
<td>27. Factorisation</td>
<td>135</td>
<td>40</td>
<td>45</td>
<td>x</td>
<td>x</td>
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<tr>
<td>28. Numbers we use—Rational, irrational, real &amp; imaginary.</td>
<td>134</td>
<td>52</td>
<td>24</td>
<td>x</td>
<td>x</td>
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</table>
30. Simultaneous equations involving two to three unknowns.
31. Inequalities and graphical representation of \( ax+by+c = 0 \)
32. Graphs of equation of the form \( y=ax^2+bx+c \)
33. Second degree equations.

**GEOMETRY AND ITS APPLICATIONS.**

**VIII 1. Plane geometry and geometry of two dimensions.**

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<tr>
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<td>132</td>
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<td>24</td>
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<td>x</td>
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<tr>
<td>4. Parallel straight lines.</td>
<td>151</td>
<td>46</td>
<td>23</td>
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<td>5. Angles formed by parallel straight lines.</td>
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<td>51</td>
<td>19</td>
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<td>6. Congruency of two triangles.</td>
<td>136</td>
<td>46</td>
<td>38</td>
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<td>7. Area of triangles.</td>
<td>148</td>
<td>37</td>
<td>35</td>
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<td>8. Area of rectangles rhombus.</td>
<td>132</td>
<td>69</td>
<td>21</td>
</tr>
<tr>
<td>9. Trapezium</td>
<td>131</td>
<td>61</td>
<td>26</td>
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<td>10. Area of quadrilaterals.</td>
<td>114</td>
<td>82</td>
<td>.24</td>
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<tr>
<td>11. Construction of</td>
<td></td>
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<tr>
<td>a/Equilateral triangles.</td>
<td>122</td>
<td>59</td>
<td>39</td>
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<tr>
<td>b/Right angled triangles</td>
<td>131</td>
<td>51</td>
<td>38</td>
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<tr>
<td>c/Isosceles triangles.</td>
<td>125</td>
<td>53</td>
<td>42</td>
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<td>IX 12. Inequalities between sides and angles of triangles.</td>
<td>103</td>
<td>61</td>
<td>56</td>
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<tr>
<td>13. Distance and Perpendicular distance between a point and a straight line.</td>
<td>122</td>
<td>64</td>
<td>10</td>
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<tr>
<td>14. Area of some figures formed by straight lines having the same base and altitude.</td>
<td>116</td>
<td>75</td>
<td>29</td>
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<tr>
<td>15. Projections and relations connecting the sides of a triangle.</td>
<td>104</td>
<td>69</td>
<td>47</td>
</tr>
<tr>
<td>16. Rectangular Paralleloiped.</td>
<td>117</td>
<td>59</td>
<td>44</td>
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<tr>
<td>17. Trigonometric ratios.</td>
<td>126</td>
<td>51</td>
<td>20</td>
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<tr>
<td>18. Solutions of right angled triangles.</td>
<td>123</td>
<td>48</td>
<td>26</td>
</tr>
<tr>
<td>19. Construction of triangles and quadrilaterals.</td>
<td>141</td>
<td>51</td>
<td>28</td>
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<tr>
<td>X</td>
<td>20. Circles</td>
<td>133</td>
<td>49</td>
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<tr>
<td></td>
<td>21. Theorems on circles.</td>
<td>143</td>
<td>61</td>
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<td>22. Concurrent straight lines.</td>
<td>112</td>
<td>49</td>
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<td></td>
<td>23. Constructions from 24-33.</td>
<td>120</td>
<td>82</td>
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<tr>
<td></td>
<td>24. Circumference and length of an arc.</td>
<td>124</td>
<td>77</td>
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</tbody>
</table>
25. Area of a circle and sector of a circle.
27. Right prism
28. Right circular cone.
29. Sphere
30. Conversion of areas of triangles to squares, rectangles, right angled triangles etc.

| Topic                                | Rating | Importance | | | |
|--------------------------------------|--------|------------|---|---|
| Area of a circle and sector of a circle | 135    | 53         | 32 | x | x |
| Right circular cylinder             | 129    | 61         | 30 | x | x |
| Right prism                         | 118    | 64         | 38 | x | x |
| Right circular cone                 | 126    | 74         | 20 | x | x |
| Sphere                               | 130    | 39         | 51 | x | x |
| Conversion of areas of triangles to squares, rectangles, right angled triangles etc. | 151    | 43         | 26 | x | x |

(Vide Question No. 20 in the 'Style of Writing' section of the Teachers' Questionnaire.)

The analysis with regard to the importance of the topics included in the textbooks in conformity with the syllabus of the BSE, Orissa, revealed that:

1. All the topics were considered either very important, important or moderately important by all the mathematics teachers.
of Orissa except a very few topics considered 'unimportant' and 'should not be included' by a negligible number of teachers.

2. In "Algebra and its applications" section, a very few number of teachers considered logarithm, collection and representation of data, statistical graphs and tabulations, simultaneous equations involving two to three unknowns, inequalities and graphical representation of the form $ax + by + c = 0$ and graphs of equation of the form $y = ax^2 + bx + c$ unimportant.

It is quite obvious that the newly incorporated topics were considered unimportant by some teachers. At present, statistics has entered into all branches of learning, and, therefore, can never be an unimportant topic or subject in mathematics. Logarithm is similarly an important subject. Equations, inequalities and graphs are important topics on which basic knowledge is essential.

Similarly 'collection of data' and 'statistical graphs' are considered useless topics by some teachers.

In "Geometry and its application" section some teachers have considered "Distance and perpendicular distance between a point and a straight line, Trigonometric ratio, solution of right-angled triangles", as the topics 'not to be
included' in the secondary school curriculum. These topics have been included in other two syllabi. Moreover, these topics relate to the basic knowledge so far as the knowledge of Geometry is concerned.

The opinions of the teachers on the relative importance of the various topics of Mathematics indicate that:

i. By and large, teachers of mathematics were conservative in their outlook and had given higher ranking to the traditional topics.

ii. In general, they resist the intrusion of 'new' topics into mathematics as they disturb their traditional tenor of teaching; and expose their obsolescence and outdated outlook.

iii. They were blissfully unaware of the importance of the expanding horizons of mathematics.

To remedy the situation the Board of Secondary Education, Orissa must mount a large number of refresher courses for the mathematics teachers to acquaint them with the emerging developments in the field of mathematics and its teaching.
Topics Liked:

All topics of Mathematics were not liked in equal measure by all the students. Individual differences were found to exist. An attempt was made by the researcher to know the topics liked by the students both in "Algebra and its applications" and "Geometry and its applications". Some students did not mention even a single topic liked by them. Most of the students had mentioned one or two topics which they liked the most. The topics have been presented in the table 4.4 in order.

**Table 4.4**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Topics Liked</th>
<th>f</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Equations</td>
<td>367</td>
</tr>
<tr>
<td>2</td>
<td>L. C. M.</td>
<td>237</td>
</tr>
<tr>
<td>3</td>
<td>Factorisation</td>
<td>188</td>
</tr>
<tr>
<td>4</td>
<td>H. C. F.</td>
<td>176</td>
</tr>
<tr>
<td>5</td>
<td>Logarithms</td>
<td>143</td>
</tr>
<tr>
<td>6</td>
<td>Identities</td>
<td>103</td>
</tr>
<tr>
<td>7</td>
<td>Graphs of Equations</td>
<td>97</td>
</tr>
<tr>
<td>8</td>
<td>Quadratic Equation</td>
<td>92</td>
</tr>
<tr>
<td>9</td>
<td>Formulae and their applications</td>
<td>84</td>
</tr>
<tr>
<td>10</td>
<td>Simplifications</td>
<td>81</td>
</tr>
</tbody>
</table>
The students did not mention any topic from "Geometry and its application".

**Topics Disliked:**

It is common knowledge that for some reason or the other certain topics fail to appeal to certain students. Students were asked to indicate topics of their dislike.

From an analysis, it was revealed that the majority of students did not mention any topic. Very few students mentioned only a topic or two. The topics, disliked by the students have been presented in the table 4.5.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Topics disliked</th>
<th>$f$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Indices</td>
<td>81</td>
</tr>
</tbody>
</table>
Table 4.4 throws light on the variance of approach amongst teachers and students. Teachers underrated the importance of such topics like 'Logarithms', 'Identities', 'Quadratic Equations' and 'Inequalities', whereas students listed them as the topics of both their liking and disliking. This confused picture presented by the students calls for an in-depth study. However, the researcher visited some of the schools where the topics were listed as favourites and found that the teaching was under the charge of the new generation of teachers. In the schools where the older and experienced teachers were teaching, there was an evident difference in approach.
With a view to knowing the exercises disliked by the students, they were asked to point out the exercises disliked by them. This has been presented in table 4.6.

**TABLE 4.6**

**EXERCISES DISLIKED**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Exercises</th>
<th>f</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Logarithms</td>
<td>49</td>
</tr>
<tr>
<td>2.</td>
<td>Graphs</td>
<td>34</td>
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<tr>
<td>3.</td>
<td>Sets</td>
<td>28</td>
</tr>
<tr>
<td>4.</td>
<td>Indices</td>
<td>17</td>
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<tr>
<td>5.</td>
<td>Factorisation</td>
<td>10</td>
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<tr>
<td>6.</td>
<td>Equations</td>
<td>8</td>
</tr>
<tr>
<td>7.</td>
<td>Quadratic Equations</td>
<td>5</td>
</tr>
<tr>
<td>8.</td>
<td>Statistical data</td>
<td>5</td>
</tr>
</tbody>
</table>

(Vide Question No. 6 of the Students' Questionnaire)

The analysis of Questions 3, 4 and 6 revealed that:

1. Some topics such as 'Equations', 'L.C. M.', 'Identities', 'Formulae and their applications', 'Simplifications' and 'Inequations' were liked by all the students who responded the items of the questionnaire.
The topics such as 'Factorisation', 'H.C.F.', 'Logarithms', Graphs of Equations', 'Quadratic Equations', 'Indices', 'Fractions', 'Number Systems' and 'Sets' were liked by some students and disliked by others.

So far as the exercises were concerned very few students disliked the exercises on 'Logarithm', 'Graphs' 'Sets', 'Indices', 'Factorization', 'Equations', 'Quadratic Equations' and 'Statistical Data'.

It was found that some of the easy topics commonly liked by the students such as 'Equations', 'Factorization', 'Logarithm' and 'Set' were very much disliked by a few students.

It is the mathematics teacher who can make an easy problem difficult and a difficult problem easy. Therefore, likes and dislikes depend, to a very greater extent, on the teacher and his method of teaching.

None of the students listed any topic, theorem or rider as one liked or disliked. Therefore, it may be presumed that the entire syllabus of Geometry and its applications was satisfying to the students.
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