CHAPTER : IV

METHODOLOGY

In this report the first two chapters dealt with necessa-
ry background to shape the framework for the investigation
in order to develop the needed methodology; in addition to
NCERT's guidelines for evaluation of textbooks, mainly studies
carried out during the past two decades, i.e.,from 1971-90
were used in finalising the methodologies for the 8 objectives
of this study.

In this study content analysis has been the main tech-
nique used; hence, in this report, perhaps it is necessary
to provide some sort of conceptual foundation for this
important technique, with special reference to this investi-
gation. Questionnaires, opinionnaire and interview techni-
ques have also been employed for collection of data in this
study.

4.1: CONTENT ANALYSIS AS A RESEARCH TECHNIQUE:

Any document has 'content' in it, if it can be represen-
ted by an organized set of statements or propositions. These
statements may include definitions, statements of facts,
generalizations and principles. In an educational set-up,
the term 'content' is well known; the content of a textbook
is supposed to be the content of the curriculum; because it
is the content of the curriculum which is supposed to be
broken down into an ordered set of propositions and these
propositions and their order represent the knowledge to be
communicated to students mainly in the form of a textbook.
There should be proper organisation in the propositions
representing the content of an area though the organization
may differ from field to field. The term 'content' can be
used not only in educational field, but can also be very
broadly used in other forms of human communication system;

in general communication is nothing but the exchange of nor-
mally well organized symbols between a source and a recipient
of information;and the well organized symbols, which may be
oral/written, form a 'message'; and this message is nothing
but the actual content. In any communication process,
'content' occupies the central position. It represents the
means through which people communicate with each other; so it
is very essential to describe communication research with
high degree of accuracy. Communication content is full of
human experiences and its causes and effects are very much
varied; hence it is very difficult to have a single system
of substantive categories to discribe it; however, a scien-
tific method has been developed to describe various aspects
of communication content in a summary fashion and this method
is known as 'content analysis' (or document analysis); this
technique of content analysis is appropriate for the analysis
of a great range of verbal communications such as newspaper
writings, public lectures, minutes of meetings, textbooks,
informal teacher-pupil interactions, written compositions of
pupils, examination question papers and answer scripts, or
in fact any document either in the form of written one or in
an audio or video cassettee form. In the case of educational
communications, one can safely assume that the content of a
curriculum is specified by a particular textbook used; if
the textbook contains an ordered set of propositions of the
content of the curriculum, those propositions and their
order represent the knowledge to be communicated to the
students; hence analysis of curricular content can also be
done, though not fully, by analysing the communications in
a textbook, and this is known as 'textbook analysis', which
is very important in the evaluation of textbooks. According
to Kerlinger (1964)[1] content analysis :

is a method of observation; instead of observing
peoples' behaviour directly, asking them to res-
pond to scales, or interviewing them, the inves-
tigator takes the communications that people
have produced and asks questions of the communi-
cations.

According to Fox (1969)[2]:

content analysis is a procedure for the catego-
risation of verbal or behavioural data for the
purpose of classification, summarization and
tabulation.

Krippendorff (1980)[3] defines it:

as a research technique for making replicable
and valid inferences from data to their context.

Like all other research techniques, the purpose of content
analysis is to provide knowledge, new insights, a represen-
tation of facts and practical guide to action; it is
supposed to be systematic and objective.

Educational research can be broadly classified into three
categories: (1) Historical Research (2) Descriptive Research and
(3) Experimental Research. Content Analysis is a technique
within the Descriptive Research; this technique is basically
for a qualitative research; this does not mean that numerical
measures are never used; but that other means of description
may also be emphasized.

The two major dimensions to be studied in content analysis
are: (1) Frequency: Traditionally, content analysis is carried
out by counting number of times particular idea/s or term/s
are presented: e.g., in a social studies textbook, emphasis
on 'democracy' can be measured by counting the number of
times the term 'democracy' and 'democratic' are used. In the

case of a science/physics textbook, emphasis on scientific
attitude can be measured by counting the number of times the
behavioural intensions such as, interest, open-mindedness,
suspended judgement, critical thinking, etc., are reflected
directly or indirectly through the content of the textbooks;
but this index is not likely to fare well, unless it is
accompanied by the analytical remarks about its content and
its 'intensity', because here the high frequency of occurence
can be with a derogatory connotation too; of course the
frequency indices are simple to obtain and can be easily
compared with other frequencies from other sources, by using
percentage frequencies. (2) Intensity: Intensity indicates
the affective emphasis given to a particular aspect of
communication; eg., in the content analysis of newspaper,
the size of the headline devoted to a particular topic, or
the number of words devoted to it or the number of affectively
loaded words can be ascertained; these measures indicate the
'bias' in reporting; based on this intensity, emphasis given
to various political parties or organizations can be compared;
but people are sceptic about the value of such intensity
measures though these have widespread use in studies of
propaganda. In a science textbook, the isolation effects as
discussed in Ch.II(pp.79-80), reflect on intensity measures.

In some analysis, depending on its nature, in addition
to frequency measures and percentage, terms like 'more',
'always', 'increase', 'often', 'somewhat', 'positive',
'negative',etc., can be used for coding the analysed observa-
tions. Through content analysis, one can find out the ratio
between different types of words, compare style with speci-
fied criteria, prepare an index, etc.; through the analysis
it is possible to bring together terms under theoretically
relevant categories and variables. Content analysis observa-
tions can also be analysed and interpreted using a serious

inspection or concentrated attention with intuition or deduction. As such content analysis can be done at two levels: (1) At manifest level: at this level, content analysis of what the respondent said - strictly bound by the response, with nothing added to that or with nothing assumed about it; it is simply a direct transcription of the response in terms of some code. (2) At latent level : This is in contrast to the first one; here the researcher attempts to code the meaning of the response or the underlying dynamics motivating the behaviour described; at this level, the researcher has to go beyond the transcription of what was said directly and seeks to infer what was implied or meant. At manifest level, content analysis is more reliable and valid (Fox-1964), whereas at latent level, one cannot be always sure.

In this investigation, content analysis has been carried out at manifest as well as latent level; at the former level, this has been done by keeping in mind, certain sets of criteria, for each objective/sub-objective; these criteria were developed based on the information available from the previous works which were referred to in earlier chapters; moreover, the investigator's background and several years of experience in teaching physics as well as education courses at various levels by making use of different textbooks in India and abroad, were also useful in concretising certain criteria for the analysis at manifest level as well as in carrying out the analysis at latent level.

4.1.1: DETAILED METHODOLOGIES_ USING CONTENT ANALYSES :

For objectives No.1-6 and No.8, the main research
technique used was 'content analysis'; in the case of all
these 7 Objectives, the main sources of data were the
complete textbooks themselves and there was no question of
sampling of the pages; but in the case of some objectives
certain other documents were also used. In most of the
cases 'Information Sheets' were used as tools to enter,
classify and to summarise the data obtained through rigo-
rous content analyses; these information sheets were develo-
ped by the investigator by keeping in mind the objectives/
sub-objectives and criteria set for the evaluation. Initially
to determine the suitability of the developed tools some seven
chapters of Std.XI textbook were content analyzed and entries
were made; the completed information sheets were examined
thoroughly by making use of the expertise of the guide of
the investigator; in some cases, expertise from some of the
highly experienced Snr.Sec. teachers of physics as well as
english (for language aspects), a few science teacher
educators and a few physicists at the University level, was
also used. The rows and columns of information sheets in
the tabular form, were altered or modified according to the
needs based on the experience gained during the process of
initial content analyses, and the discussions with the
experts. In some cases, certain criteria were to be added,
cancelled or modified and accordingly changes were made in
the rows and columns of the information sheets; these infor-
mation sheets were compared with those suggested by NCERT
and other researchers in the field; as such a sort of
"evolving methodology" arose in the case of a few sub-object-
ives, and accordingly changes were made in the tools; the
whole process of content analyses for all the 7 Objectives
were repeated and carried   further till the last objective.

In most of the cases, the nature of the data was mainly
qualitative and, quantitative in some cases. Because of the
nature of data obtained, it was not possible to enter all
the details in the developed 'Information Sheets'; in such
cases, the methods of presenting brief statements as such,
were used.

The above details regarding the methodologies were
common to the Objectives No.1-6 and No.8; now, what follows
would be the specific details connected with each Objective.

4.1.1.1: FOR CONTENT ANALYSIS FOR OBJECTIVE NO.1: i.e., TO MAKE
A DETAILED STUDY OF CONTENT OF THE PHYSICS TEXTBOOKS
UNDER STUDY IN TERMS OF SUITABILITY OF :

(a)   PRE-TEXT PAGES.
(b)   EACH CHAPTER, IN CONNECTION WITH THE FOLLOWING AREAS:

     (i)   INTRODUCTION.
     (ii)   PRE-REQUISITE/ENTRY BEHAVIOUR.
    (iii)   CONTENT IN EACH SECTION.
    (iv)   INTEGRATED SCIENCE APPROACH.
     (v)   REFERENCE TO SCIENTISTS AND HISTORY OF
        SCIENCE.

(c)   POST-TEXT PAGES.

In this study, all the pages of the textbooks, including
the cover page preceding the first chapter in the concerned
book are considered as pre-text pages; and all pages after
the last chapter in the concerned book are considered as post-
text pages.

4.1.1.1 (a):CONTENT ANALYSIS FOR OBJECTIVE No.1(a) i.e.,
        TO MAKE A DETAILED STUDY OF CONTENT OF THE
        PHYSICS TEXTBOOKS UNDER STUDY IN TERMS OF
        SUITABILITY OF PRE-TEXT PAGES:

CRITERIA FOR EVALUATION:

The pre-text pages of a Snr. Sec. physics textbook should satisfy the following criteria :

(1) The cover page is clear, attractive and related to the content of the textbook.

(2) The title includes the exact title of the book, authors' names and publisher's name and address.

(3) Rear side of the title page contains information about the year of publication, position of editions and reprints, copyright, price of the book, publisher's name and address, printer's name and address, etc.

(4) Foreword by the publishers contains the background behind the textbook production and publication.

(5) Editorial information contains the details during the time of writing and publishing.

(6) Preface by the authors contains the purpose and scope of the textbook and the level for which it is meant, along with the acknowledgements.

(7) Introduction to the textbook to the teachers as well as to the students regarding its effective use, is included.

(8) Table of contents contains titles of units, chapters, sections, sub-sections and page numbers.

(9) List of tables, figures, diagrams, plates, abbreviations used, units used, etc., are included.

Based on the above criteria, the pre-text pages were content analysed and the observations along with their interpretations were listed down in terms of positive aspects and inadequacies by reflecting the analyses at manifest and latent level.

FOR
4.1.1.1 (b)(i): ^CONTENT ANALYSIS FOR OBJECTIVE NO.1(b)(i):
              (i.e.,FOR SUITABILITY OF INTRODUCTION IN
              EACH CHAPTER):

CRITERIA FOR EVALUATION :

(1) Every chapter should contain motivating introduction, to develop, on the spot interest in the topics.

(2) Introduction should be related to the previous class or the previous relevant chapters.

(3) It should be suitable-neither too simple nor complicated.

(4) It should be neither too short nor long.

(5) It should give an overall idea of the chapter.

Based on the above criteria, observations and interpretations of the content analyses of the pages containing introductions in each chapter were recorded on the developed information sheets (Table No.5·1   pp.180-184). The suitabilities of the introductions were judged in terms of three categories i.e., quite suitable, somewhat suitable and not suitable; wherever needed/possible, the reasons behind the judgements were provided by the investigator at times by making use of latent level analysis. Based on the data obtained from the information sheets as well as based directly on the introductory pages, a few positive aspects as well as inadequacies were pointed out.

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4.1.1.1 (b)(ii)ᴧCONTENT ANALYSIS FOR OBJECTIVE NO.1(b)ii:
(i.e.,FOR SUITABILITY OF PRE REQUISITE/
ENTRY BEHAVIOUR FOR EACH CHAPTER):

CRITERIA FOR EVALUATION :

(1) Each chapter should contain a list of prerequisite/entry
     behaviour, given immediately after the introduction.

(2) The topics discussed in a chapter should be properly
     integrated with the related topics of the preceding
     class/chapter.

(3) Brief prior information needed to understand topics
     should be given in the chapters, to enable the learners
     to recall details and to connect them to new content.

(4) Needed information should not be missing or not be
     insufficient to understand new content.

(5) Chapters should not contain information from the previous
     classes/chapters, which are repeated/unnecessary/
     irrelevant.

     For this sub-objective, an attempt was made to record
     observations and interpretations on a tabular form after the
     content analysis based on the above criteria.
     (Table No.5-2, pp. 187-189)

FOR
4.1.1.1 (b)(iii):ᴧCONTENT ANALYSIS FOR OBJECTIVE NO.1(b)(iii)
(i.e.,FOR SUITABILITY OF EACH SECTION IN
EACH CHAPTER):

     In this study, a section is conceptualized as a sub-
division of the chapter containing a major concept/s or theme/s
or term/s, as the case may be.

CRITERIA FOR EVALUATION :

Each section/s should satisfy the following criteria:

(1) It is clearly written.

(2) It contains interesting/exciting information.

(3) There are no sections which seem unnecessary in a chapter.

(4) Sections do not contain any concept/theme/term, which require more explanation.

(5) Sections do not seem to be difficult for students or above their level.

(6) Sections are not abruptly introduced or discontinued.

(7) Sections contain a few real life examples wherever possible.

(8) In each section, content is presented in the increasing order of complexity, i.e., simple to complex - familiar to unfamiliar; i.e., by keeping in mind the applications of psychology of learning.

(9) Sections contain accurate and up-to-date content; technical data presented are from authentic sources.

(10) Each section contains content, meeting the needs of learners in terms of their age level, examinations, etc.

(11) Most of the sections are for average students and a few topics within the sections or a few sections are for above-average students.

(12) Sections contain solved problems/answered questions, which are useful in overall understanding of the section and in solving related end-of-chapter exercises.

Based on the above criteria rigorous content analyses were carried out for the total of 122 and 133 sections in Std.XI and Std.XII textbooks respectively. Observations and interpretations were presented using the constructed tools - 'Information Sheets' as shown on Table No.5·3   (pp. 191 - 216);

wherever possible, codings such as Yes(Y), No(N), Somewhat(SW),
Positive Aspect (+ve), Inadequacy (-ve), were used in the
observations and interpretations in the Tables; additional
remarks in each section were made using +ve and -ve codes.
From the above detailed content analyses information sheets,
two comprehensive Tables were culled , one to show certain
positive aspects of the content of the section (Table No.5·4
P.217) and the second to show certain inadequacies
(Table No. 5·5   P.218). Based on these two Tables(No.5·4₂),
                                                         5·5
overall positive aspects as well as inadequacies of the
content in all sections of the chapters of both the textbooks
were listed down to give an overall view of the academic
aspects.

4.1.1.1 (b)(iv): FOR CONTENT ANALYSIS FOR OBJECTIVE No.1(b)(iv):
                (i.e., FOR SUITABILITY OF INTEGRATED
                SCIENCE APPROACH):

CRITERIA FOR EVALUATION :

(1)   Suitability of integrated science approach should be
      judged mainly in terms of number of cases of the content
      in each chapter in the physics textbooks, which are
      related to the areas of chemistry, biology, geology,
      astronomy, geography, engineering, technology, industry,
      medicine, agriculture, physical education,etc.

(2)   Wherever possible and appropriate, physics content in
      the textbook should emphasize references to integrated
      science approach and the importance of interdisciplinary
      nature of scientific development, in the past and present.

Based on the 1st criterion, a frequency table (Table No.5·6
p. 222) was prepared for both the physics textbooks with
respect to each chapter. Based on the second general criterion,

certain positive aspects as well as inadequacies were noted chapterwise; based on both the criteria, an overall position of the integrated science approach was noted.

4.1.1.1 (b)(v): FoR
CONTENT ANALYSIS FOR OBJECTIVE NO.1(b)(v) ;
(i.e., FOR SUITABILITY OF REFERENCES TO
SCIENTISTS AND HISTORY OF SCIENCE):

CRITERIA FOR EVALUATION :

The textbooks should satisfy the following criteria :

(1) There are a number of references to scientists wherever possible/needed, with their photographs and biographical sketches, popular quotations, etc., in each chapter of a physics textbook; in addition to scientists there are references to philosophers as well as other eminent personalities.

(2) Development of concepts in physics are discussed in the light of references to history of science/physics, during ancient, medieval and modern period.

(3) Glorious ancient past of India in the field of science is stressed to develop national identity and self-confidence among young Indians.

(4) Contributions by scientists from different nations are stressed to develop the spirit of international understanding and co-operation in the pursuit of knowledge.

Based on the above criteria, content analyses of all the chapters were carried out and relevant observations and interpretations were recorded on Table No. 5.7   (pp.224-234): referred names of all scientists/others were noted in each chapter and their details with photographs were also noted;

regarding the sufficiency of the details available observations were made in terms of coding, Yes/Somewhat/No (Y/SW/N).
The references made to history of science/physics were noted as positive aspects (coded as +ve) and inadequacies (coded as -ve), in each chapter.

Based on the data available from Table No. 5-7 (pp.224-234), overall findings for the sub-objective were recorded.

4.1.1.1 (c): FOR CONTENT ANALYSIS FOR OBJECTIVE NO.1(c), i.e., FOR SUITABILITY OF POST-TEXT PAGES):

CRITERIA FOR EVALUATION :

The post-text pages of a physics textbook should contain the following :

(1) An epilogue after the last chapter with an attempt to give the overall summary of all the chapters and key issues and a further connection to the preface/prologue and the introduction made in the textbook, before the beginning of the 1st chapter.

(2) A glossary of important technical terms and additional notes wherever needed.

(3) Appendices giving additional important information which are relevant to the main text.

(4) A few comprehensive test papers with brief answers, to enable the students, to carry out self-assessment exercises and to prepare for end-of-term examination.

(5) An index of important terms/names used in the textbooks.

(6) List of additional books, journals, etc. for further reading with specific chapters, page numbers, etc.

Based on the above criteria, the post-text pages were content analysed and the observations along with their interpretations were prepared in the form of positive aspects and inadequacies to reflect analyses at manifest as well as latent level.

4.1.1.2 : FOR
CONTENT ANALYSIS FOR OBJECTIVE NO.2 i.e. TO CRITICALLY EXAMINE THE PHYSICS TEXTBOOKS AS TO THEIR SUITABILITY TO THE DEVELOPMENT OF SOME OF THE PROCESSES OF SCIENTIFIC INQUIRY :

As discussed in Ch.II (pp. 56 - 57), textbooks as such, cannot directly develop the processes of scientific inquiry but can only help to develop, once they contain certain relevant aspects such as statements, terms, situations, activities, suggestions, etc., which are related to scientific inquiry. The processes of scientific inquiry have been conceptualized in terms of scientific attitude, scientific method and process skills, (Ch.II,pp. 52-62) which are very much interrelated.

CRITERIA FOR EVALUATION :

(1) Wherever possible, textbook chapters should contain statements/terms, situations, activities, suggestions, etc., which may help to develop:

(a) interest, curiosity, humility, scepticism, open-mindedness, suspended judgement, critical thinking, avoidance of dogmatism/ and superstition, determination, positive approach to failure, etc., in order to help the learners to develop scientific attitude.

(b) major steps of procedures such as statement of a problem, observation, hypothesization, theorisation, experimentation, drawing conclusion, verification, application in a new situation, etc.,in order to help the learners to develop scientific method.

(c) skills such as, observing, measuring, classifying, using numbers,using space-time relationship, defining operationally, formulating hypotheses, formulating models, theorisation, controlling variables, experimenting, interpreting data, infering, predicting, communicating,etc., in order to help the learners to develop science process skills.

(2) Ample references should be made available in physics textbooks for biographies of physicists, history of physics, popular experimentations which emphasize the landmarks in the development of physics as a discipline, daily life situations, latest thrilling information, applications in engg/technology/medicine/agriculture, scientific hobbies, home experiments, use of improvised apparatus, etc., in order to develop some of the processes of scientific inquiry.

Based on the above criteria,content analyses of all the chapters were done mainly at latent level; here it may be noted that product and process aspects of physics are interconnected and it is not very meaningful to separate them; in this study the investigator made an attempt to indentify seemingly striking cases of process aspects as they got reflected in the overall content or product presentation.

4.1.1.3 : FOR CONTENT ANALYSIS FOR OBJECTIVE NO.3: i.e.,
TO CRITICALLY EXAMINE THE COMMUNICATION
STRATEGIES IN THE TEXTBOOKS IN TERMS OF:
(a) QUESTIONING STRATEGIES.
(b) STATUS OF TERMS.
(c) STATUS OF ILLUSTRATIONS.

As discussed in Ch.II of this report, communication strategies go a long way in making the text to 'talk' to learners and to interact indirectly but effectively; usual

language media alone may not be sufficient to carry out this interaction process; questioning strategies and status of terms, through the usual language,of course, are to be thought of,by authors to communicate well with the learners; and there is/need of producing suitable illustrations with figures, diagrams, tables, photographs, etc.; in illustration the role of language may not be prominent, but the artistic skills would lead to aesthetic beauty to motivate and strengthen learning.

4.1.1.3.(a) : FOR

CONTENT ANALYSIS FOR OBJECTIVE NO.3(a): i.e. TO CRITICALLY EXAMINE THE COMMUNICATION STRATEGIES IN THE TEXTBOOKS IN TERMS OF QUESTIONING STRATEGIES:

CRITERIA FOR EVALUATION :

(1) There should be atleast three distinct types of questions used in the presentation of the textual content.

(a) Simple or lower order questions: e.g., factual - direct identification/recall of facts; rhetorical - obvious questions that require no answer; convergent questions -using, 'what, when, where,etc.'

(b) Activity - oriented questions: leading to inquiry as well as discovery.

(c) Higher order questions: which require organisations, deductions, comparisons, contrasts, generalizations, identifications of causes and effect,etc.; these questions can be divergent as well as probing type, which require critical thinking.

(2) Activity-oriented and higher order questions should be more in number in Snr. Sec. physics textbooks, compared to the simple/lower order questions.

(3) Every section in every chapter should contain a few good questions.

The investigator went through all the pages of each chapter by carefully noting all the questions presented by classifying them into three categories mentioned above by marking a talley in the prepared information sheet, against their columns; the final versions (Table No. 5·8 pp. 256-257) with actual number of questions in each category were prepared for both the textbooks; in these tables, number of questions per section in each chapter were also shown.

4.1.1.3 (b): FoR

CONTENT ANALYSIS FOR OBJECTIVE NO.3(b): i.e., TO CRITICALLY EXAMINE THE COMMUNICATION STRATEGIES WITH RESPECT TO THE STATUS OF TECHNICAL TERMS :

CRITERIA FOR EVALUATION :

(1) Whenever a new technical term is introduced in any chapter, as far as possible it should be defined or its meaning should be stated immediately; if not, _

(2) Atleast it should be done within a few pages of the chapter.

(3) Cross references from the preceding chapters of the same textbook or from the junior class textbooks if by the same publishers, should be given to all important terms, in any chapter, if they were presented earlier.

(4) All the new terms should be included in the index at the end of the textbook.

(5) All the important terms among the new terms should be included in the 'glossary of terms' given at the end of the textbook.

(6) Textbooks/chapters should not contain any new technical term whose meanings are not given anywhere in any chapter.

Based on the above criteria, information sheet was developed to contain the following columns: book reference, new term, whether defined/meaning stated (Yes/No), if no, whether done later (Yes/No,Where), whether it is clear (Yes/Somewhat/No) and whether included in the index (Yes/No); the clarity of the terms were judged based on their actual positioning in the text, their exact definitions/meanings and the investigator's experience; these data were shown on Table No. 5.9(a)&(b) (pp. 260-288) for both the textbooks. From these tables, two more Tables, i.e. Table No. 5.10(a)&(b)(pp. 289-290) were culled, in which total number of terms in each chapter and the percentage of cases from the different columns of the earlier Tables where shown; based on these Tables and the set criteria, several interpretations were made in terms of positive aspects and inadequacies.

4.1.1.3(c) :

FoR

ₙCONTENT ANALYSIS FOR OBJECTIVE NO.3(c): i.e. TO CRITICALLY
EXAMINE THE COMMUNICATION STARTEGIES IN THE TEXTBOOKS IN
TERMS OF ILLUSTRATIONS :

CRITERIA FOR EVALUATION :

The textbook illustrations should satisfy the following
criteria :

(1) The illustrations are relevant to the textual content;
they help in understanding even abstract concepts
especially in micro and cosmo aspects of physics. They
are properly positioned in the chapter pages, to
strengthen the immediate understanding of the concepts
discussed.

(2) The illustrations are adequate in number, size, content
carried, accuracy, up-to-dateness, printing, attraction,
etc.

(3) All illustrations are properly captioned, labelled and
numbered for easy cross reference and their lists with
page number are provided among the pre-text pages.

(4) Illustrations are interesting/exciting and are suitable
to the age-group/ mental maturity of learners.

(5) Illustrations are attractive with good graphic work and
with different, relevant colours.

(6) Illustrations reflect real life situations wherever
possible.

(7) As far as possible, every section in all chapters needs
to contain atleast a few illustrations to get rid of
the boredom of continuous reading.

(8) There are varieties in illustrations; e.g. figures/ diagrams, tables,plates, photographs, etc.; among the figures/diagrams, there are further varieties such as sketch diagrams, graphical/mathematical/geometrical diagrams,etc.

(9) Plates and photographs are presented in high quality papers and they are from real/experimental situations.

Relevancy and adequacy were the two major characteristics which were looked into, in each illustration; these were judged mainly based on the criteria laid down above and noted through codes, Yes/Somewhat/No (Y/SW/N) on the information sheets developed for the purpose i.e., on Table No. $5 \cdot 11$, $5 \cdot 12$ & $5 \cdot 13$ (a)+(b)ₐ(pp.295-333)   ; based on the data obtained from these tables, interpretations were made in terms of positive aspects and inadequacies for the illustrations through figures, tables and photographs.

4.1.1.4;

ₐCONTENT ANALYSIS FOR OBJECTIVE NO.4: i.e.,TO MAKE A DETAILED STUDY OF LANGUAGE ASPECTS IN THE TEXTBOOKS, IN TERMS OF (a) LANGUAGE SPECIALITIES (b) VOCABULARIES AND (c) MAJOR ERRORS:

CRITERIA FOR EVALUATION :

The language aspects of the textbooks should satisfy the following criteria:

(1) Simple,correct, precise and comprehensible language is used in textbooks.

(2) At Snr. Sec. level, appropriate language specialities such as analogies, phrases, idioms, exclamatory statements, rhymes, etc., are helpful in physics textbook in making some of the abstract ideas simpler to comprehend and to develop the abilities to compare and to think critically. These language specialities should be adequate in terms of their placement, clear statements, direct or indirect but easy comparability of variables from the physical contexts to that of the language speciality contexts, their ability to create interest or excite the learners to continue to think and read the textbooks, etc.

(3) By keeping in mind the adolescent age group of learners at Snr. Sec. level,physics textbooks should contain slightly higher but interesting vocabularies, to make a good reading, provided they do not lead to misconceptions in physics; however vocabularies used should be within the learner's limit at Snr. Sec. level (based on English language teaching).

(4) The sentences are properly structured, simple, short, clear, without any editorial/printing error in language/ spelling/grammar,etc.

All the pages of the textbooks were carefully examined for language aspects; in the case of language specialities the developed information sheets were used (Table No. 5-14 pp. 343-345) to record observations; the relevancies and adequacies of the observed specialities were coded in terms of Yes/Somewhat/No (Y/SW/N) based on the judgement mainly by using the 2nd criterion given above.

Errors of various types were observed and recorded in the developed information sheets for error analysis (Table No.5·15 pp.346-347), by pointing out the major errors, their nature and possible corrections. Errors due to printing/~editing~and their possible corrections were prepared separately . as partial 'errata' (Table No.5-16   pp.353-358) which is missing in both the textbooks (Treated under Objective No.5 i.e., physical aspects).

4.1.5 :
For
CONTENT ANALYSIS FOR OBJECTIVE NO.5 i.e. TO STUDY THE
FOLLOWING PHYSICAL ASPECTS OF THE TEXTBOOKS: TYPE SIZE,
TYPE FACE, SIZE, PRINT AREA, INTERLINE SPACING, MARGINS,
PAPER, COVER, INK & COLOUR, STRENGTHENING OF TEXTUAL
MESSAGE, ATTRACTION, BULK, STYLE OF BINDING, ETC.

CRITERIA FOR EVALUATION : were set mainly based on the standards specified by NCERT (1987) in their publication, "A study of the Evalution of the Textbook"; these standards along with certain important information available from the articles and studies referred to in the preceding chapters of this report (pp.74-80 & pp.104,107 & 117) were interpreted and slightly modified mainly based on the technical assistance obtained from an expert in printing technology i.e., the Manager of the M.S.University Press at Baroda.

The following major criteria were used in evaluating the physical aspects of the physics textbooks for Snr. Sec. level:

(1)   Standard type size: For chapter number - lower capital
                                                        lems=
       18 Pt. bold (1=72 Point = 6 empicas or 6 ems;≠ 12 Pt.,
       'Pica' is printer's unit or the size of type); for
       chapter heading: 24 Pt bold; for section headings : 12 Pt.
       bold; for sub-section heading: 10 Pt. bold; and for actual

text: 10 Pt. light; for solved examples, additional information/foot notes, end-of-chapters exercises etc.: 8 Pt.

(2) Type face: Roman type face; but for matters printed with 8 Pt. type size (i.e., footnotes, exercises,etc.), it is better to have 'Helvitica' or Universe type face.

(3) Size of textbook: Double crown 8 V O (or approximately 7.0" x 9.5" : trimmed size).

(4) Print area : Approximately 34 ems x 46 ems.

(5) Interline spacing : 2 Pt.

(6) Margins : Top 6 ems; bottom : 7 ems; gutter: 5 ems; and foreedge; 6 ems.

(7) Paper: For Text: White, S.C. (Super Calender) in 70 GSM (Grams per Square Metre) substance. For cover pages : Pulp board of 250 GSM.

(8) Ink and colour for Printing : Uniform use of ink, mainly black and other attractive colours, wherever relevant.

(9) Strengthening of textual message: using italics for important new terms: using underlinings, boxes, circles, colours,etc., for important formulae, theories, laws, thrilling facts,etc., to produce isolation effects for better retention (as discussed in pp.7 8 - 8 0).

(10) Attraction: Lamination and attractive coloured photographs/ pictures for cover pages; use of different colours in the presentation of textual material with coloured photographs/ diagrams/plates, etc.

(11) Convenient bulk of textbook: On an average 128-208 pages.

(12) Style of Binding: Section-Sewn with thread, cover creased and end-paper pasted with full cloth on the spine and flush.

Based on the above criteria, the technical expert and the investigator went through carefully both the textbooks, measured dimen ions wherever needed and identified the materials used in them to come out with important findings in terms of positive aspects and inadequacies as shown in the next chapter (pp. 349 -359).

FOR
4.1.1.6 : CONTENT ANALYSIS FOR OBJECTIVE NO.6: i.e., TO MAKE
        A DETAILED STUDY OF END-OF-CHAPTER EXERCISE:

Traditionally, analysis of end-of-chapter physics exercises may look like mainly the solving of mathematical problems or deciding the expected answers to other questions; but in this study, the investigator made an attempt to go beyond that by trying to make use of content analysis as a technique for analysis of exercises at manifest as well as latent level.

As discussed in Ch.II (pp. 80-82) the major reference for analysis of end-of-chapters exercises should be the taxonomy of educational objectives developed by Bloom et al (1956); this taxonomy is expected to shape the structure (format) and nature for end-of-chapter exercises.

To begin with all the 426 items of end-of-chapter exercises in Std.XI and 432 items in Std.XII were carefully solved (for mathematical problems) or their expected answers were determined (for other questions) as the case may be. For their detailed analysis the following criteria were set :

CRITERIA FOR EVALUATION :

The end-of-chapter exercises in the two textbooks should satisfy the following criteria: .

(1) End-of-chapter exercises help the learners in self-evaluation in terms of reviewing and recapitulating all the main textual matter in the chapters; and they are directly or indirectly related to the content in its chapter or previous chapters.

(2) The exercises are structured based on different types (Ch.II pp.$_{80}$-$_{82}$) by focussing the nature and structure of physics and its various instructional objectives.

   (a) Mathematics being the main language used in the treatment of physics, there are large number of mathematical problems, by referring to mainly its product aspects and by relating to proaess aspects (experimental/actual/hypothetical situations) wherever possible.

   (b) There are activity-oriented questions reflecting on process aspects of physics, and promoting the spirit of inquiry.

   (c) There are various forms of questions, essay (long answer), short answer, true/false with reasons, completion, matching, multiple choice, etc., depending on the nature of the instructional objectives to be tested.

(3) The given exercises test knowledge, comprehension, application and other higher order objectives (Bloom et al. 1956) If answers for the questions/ problems need 'recall' and 'recognition' of the content such as 'facts, terminology, symbols, classification, theories, laws, structures, etc.', such questions/problems are considered as,

at knowledge level; if they require mental operations such as, 'seek relationship, cite examples,discriminate, classify, verify, interpret, generalise, etc.', such questions/problems are considered as, at comprehension level; if they need operations like, 'reason, hypothesize, infer, predict, analyse synthesize, evaluate, etc.', such questions/problems are considered as, at application and higher order level. The above three major levels are hierarchical in nature and ideally in a discipline like physics, number of questions/ problems based on the above three levels are supposed to be approximately 25%, 35% and 40% respectively, according to experts' opinions.

(4) There are items of exercises which are challenging/ interesting and they are suitable to the mental maturity of Snr. Sec. level average as well as above-average students; and they provide motivation for further study. They are neither very easy nor very difficult.

(5) Exercises are made interesting by including cases related to areas such as, engineering/technology, medical, daily life situations, games & sports, archeology, economics, etc.

(6) Exercises are given in simple, precise and unambiguous language and all the new terms used are well explained.

(7) Exercises are provided with sufficient data and expected answers are given to all of them at the end of the textbook (in post-text pages).

(8) Exercises are presented in a graded form; i.e. starting from simple to complex as far as possible and at the same time they are expected to reflect the development of the content of the chapter.

Based on the above criteria, all the exercises in both the textbooks were analysed and classified; two tables (Table No.5·17&5·18 & pp.360-361), one for the structure of the end-of-chapters and the second for their nature, were prepared to show all the classifications; on the basis of information available on these two Tables, several interpretations in terms of positive aspects and inadequacies of the end-of-chapter exercises in both the textbooks were noted (pp. 359 -366).

4.1.1.7 :
FoR
CONTENT ANALYSIS FOR OBJECTIVE NO.3, i.e. TO CARRY OUT AN
OVERALL EVALUATION OF THE TEXTBOOKS ON THE BASIS OF :

(a) PRESCRIBED CBSE SYLLABUS FOR SNR. SEC. SCH. PHYSICS COURSE.
(b) NATURE AND STRUCTURE OF SCIENCE IN GENERAL AND PHYSICS IN PARTICULAR.
(c) GOALS AND BROAD OBJECTIVES OF EDUCATION/SCIENCE EDUCATION IN GENERAL AND SNR. SEC. SCHOOL PHYSICS CURRICULUM IN PARTICULAR.

For the above objectives, because of its very special status (i.e. as it is the 'overall' one), the methodological treatment has had to be the collection, analysis and interpretation of data based on rigorous content analyses of certain documents as well as the analysed data and their interpretations for the previous first 6 objectives.

4.1.1.7 (a) :

FOR
ᴧCONTENT ANALYSIS FOR OBJECTIVE NO.8(a): i.e., TO CARRY OUT
AN OVERALL EVALUATION OF THE TEXTBOOKS ON THE BASIS OF
PRESCRIBED CBSE SYLLABUS FOR SNR. SEC. SCHOOL PHYSICS COURSE:

At the time of publication of the physics textbooks,
CBSE syllabus for the year 1987 was available; later this
syllabus was revised in 1991 and once again in 1993; these
are the three copies of the CBSE syllabi which were made
available to the CBSE affiliated schools during the time of
implementation of new textbooks based on NPE (1986); and all
the three copies of the physics syllabi were content analysed
to relate them to the present physics textbooks.

CRITERIA FOR EVALUATION :

(1)   The content of the physics textbook should be the
      systematic elaboration of the content of the prescribed
      syllabus.

(2)   The textbooks cover all the units, chapters, sections
      and sub-section (topics) given in the syllabus.

(3)   The textbooks reflect proper delineation of the prescribed
      syallabus in accordance with the mental maturity of the
      learners at Snr. Sec. level.

(4)   The textbooks should not repeat the contents from the
      preceding classes but systematically enable the learner
      to recall and integrate the major concepts learnt earlier.

(5)   There is proper coordination in the content presentation
      in physics and mathematics/chemistry in the textbooks of
      the preceding and succeeding classes.

By keeping in mind the above criteria, detailed content
analyses were carried out, observations were noted, and
interpretations were made.

4.1.7(b) : FOR 8(b) i.e. TO CARRY OUT AN OVERALL EVALUATION
OF THE PHYSICS TEXTBOOKS IN TERMS OF NATURE AND STRUCTURE
OF SCIENCE IN GENERAL AND PHYSICS IN PARTICULAR :

CRITERIA FOR EVALUATION :

The textbooks under study are expected to satisfy the
following criteria related to nature and structure of
science/physics:

(1) A science textbook reflects systematized body of know-
ledge (content-product) as well as scientific processes
of inquiry.

(2) A physics textbook contentwise emphasises throughout,
its two major components (matter and energy) at
microscopic, macroscopic as well as at cosmological level.

(3) Wherever possible integrated science gets reflected in
a physics textbook.

(4) Mathematics as a special language for physics is fully
taken care of in the presentation of the textbook content.

By keeping in mind in above overall considerations, the
two physics textbooks and the first 6 objectives with their
relevant findings were carefully gone through several times
to analyse and to come out with the salient features of the
evaluation of the physics textbooks (as given in Ch.V.pp.420-423)
in terms of nature and structure of science/physics.

For Objective No. 8(c)·1·2·,

4.14.7(c) : ∧TO CARRY OUT AN OVERALL EVALUATION OF THE PHYSICS TEXTBOOKS ON THE BASIS OF GOALS AND BROAD OBJECTIVES OF EDUCATION/SCIENCE EDUCATION IN GENERAL AND SNR. SEC. SCHOOL PHYSICS CURRICULUM IN PARTICULAR :

Here it must be recalled again that textbook alone, though it is one of the major teaching-learning tools, may not really fulfill the goals and broad objectives of Education; but it can definitely help to fulfill, if its contents are properly presented by consciously and seriously keeping in mind the goals and broad objectives of curriculum.

CRITERIA FOR EVALUATION :

The following were considered as general guidelines for evaluation of the above sub-objective:

(1) The overall planning of and presentation in the textbooks are based on goals and broad objectives of Education/ Science Education in general, as reflected in various (preferably latest) policy documents that are available at the national level.

(2) The overall planning, the nature, structure, depth and usability of the content, the instructional objectives, expected terminal behaviours of the learners, etc., particularly depend on the goals and broad objectives of Snr. Sec. School physics curriculum, specified by the National body for the examinations and certifications at the Snr. Sec. level (i.e., CBSE in this case).

To deal with the above sub-objective, mainly the relevant portions of documents such as Taradevi Report (1965) of the "All India Seminar of the Broad Objectives of Teaching of Science" at Simla, previous Education Commission Reports as well as the present NPE (1986)[7], POA (1986)[8], 'Foreward' and 'Preface' of the present physics textbooks under study, CBSE's Snr. Sec. School physics syllabi (1987, 1991, 1993), etc., were content analysed to come out with findings as shown in next chapter (Ch.VI. pp. 424-432).

4.2.: METHODOLOGY FOR OBJECTIVE NO.7: TO STUDY OPINIONS OF STUDENTS, TEACHERS AND SOME EXPERTS REGARDING THE SUITABILITY OF THE PHYSICS TEXTBOOKS :

4.2.1 : TO STUDY STUDENTS' AND TEACHERS' OPINIONS :

4.2.1.1 : TOOLS: The investigator developed two different questionnaires for collecting opinions of Snr. Sec. students and teachers, as they are the main clientele of the textbooks. The formats for questionnaires were more or less based on those developed by NCERT and other research workers, which were referred to in the preceding chapters; but many modifications were needed to make them suitable for the present Snr. Sec. physics textbooks. Both the questionnaires were essentially based on the other 7 objectives of the study; i.e.,they consisted of 45 items related to their opinions of the textbooks, regarding their content, reflections on nature and structure of physics/science, communication strategies, language aspects, end-of-chapters exercises, physical aspects and overall suitability.

These aspects were not specifically printed in the case
of students' questionnaires, so that they do not get scared
of these; instead their questionnaires contained simple, 30
items, framed using simple language and they were requested
to respond by encircling the codes Yes/No/Uncertain (Y/N/U).
In addition to the items, the students' questionnaire provided
space for general information, i.e. name of the school, age
and class. Students were also requested through a covering
letter to provide additional information on the enclosed two
sheets of paper, especially for starred items in their
questionnaire; certain items were starred to indicate that
additional information was expected in their case.

In the case of teachers' questionnaires, they were
constructed with a little more technicality compared to the
simplicity attempted in students' questionnaire; the teachers
were also requested to respond by encircling the code Y/N/U.
Some space was also provided in the beginning of the questio-
nnaire to state general information; i.e., name of the school,
qualifications, experience, etc. At the end of the teachers'
questionnaire glossary of some important technical terms
used in its construction was provided to enable, especially
the untrained postgraduate teachers, to get ready reference.
Teachers were specially urged through the covering letter to
provide as many additional information as possible on the
enclosed four sheets of paper, especially for the starred
items in their questionnaire; as in the case of students'
questionnaire, certain items were starred to indicate that
additional information was expected in their case.

The two covering letters for the two questionnaires
contained a brief purpose of the study, information regarding
the method to complete the questionnaire and an appeal for

co-operation; and all these papers were attached to another covering (Appendix A) letter to the Principals of the Snr. Sec. schools with an earnest appeal for full cooperation and prompt response from their teachers and students. The draft tools to study students' and teachers' opinions were made available to the following experts with an appeal to give their frank opinions and suggestions to improve the workability of the same:

(1) Five experts in the field.
(2) One English language expert.
(3) Three Senior physics teachers of Snr.Sec. Schools.
(4) One Senior English language teacher of Snr.Sec. school.

In order to ascertain the workability of the instrument the draft copies of the concerned questionnaires were administered to 7 physics teachers and 18 physics students (randomly selected - 9 average and 9 above- average students- 8 from Std.XI and 10 from Std.XII) in two Snr. Sec. Schools, one in Bombay area and another in Baroda area;their written responses were examined and through informal interviews with the teachers and the students, expected clarity of the items was attempted to be realised.

Based on the feedback from the involved experts, teachers, and students , some of the items in the concerned questionnaires were deleted/added and modified accordingly. The final versions of the teachers' and students' questionnaires respectively consisted of 32 main items (totally with 67 sub-items/responses) and of 21 main items (totally with 40 sub-items/responses) (Appendices C & D).

4.2.1.2 : SAMPLE :

All the 108 CBSE affiliated Snr. Sec. Schools in the western states of Maharashtra, Gujarat and Rajasthan were taken as sample schools for the study; most of the schools involved were under KVS; in all the chosen schools, all the Snr. Sec. physics teachers were requested to respond to the questionnaires (normally only one or two, with some exceptions of three teachers in very few schools - this information was made available in the case of KVS schools; additional copies of questionnaires were sent to such schools, based on the available data);in the case of students, the Principals and the Snr. Physics teachers were requested (through the covering letters) to randomly select one average physics student and one above-average physics student each from Std.XI and XII; in almost all the KVS schools, it was found that there are only one section each in both the standards; however based on the available data, additional copies of the students' questionnaires were sent wherever needed.

Regarding the schools chosen for the sample, out of 108 schools 32 are in Maharashtra 24 are in Gujarat and 52 are in Rajasthan States. By and large they are in urban as well as rural areas; and most of them are co-educational schools; (totally 37) though the private schools are likely to have student population normally within their locality and from upper SES group, KVS/schools (totally- 71) are likely to have very much mixed Public Sector SES group and are likely to be the cross-section of different regions of the country.

4.2.1.3 : COLLECTION OF DATA :

Formal permission was obtained from CBSE to carry out the investigation (Appendix B). All the packets containing the questionnaires and other enclosures (Appendices A-D, including a self-addressed stamped envelope for reply) were addressed to

the principals and dispatched under 'Certificate of Posting' in the case of a few schools in Gujarat (around Baroda) and in Maharashtra (around Bombay), the investigator personally contacted the principals and made arrangements for the administration of the questionnaires. Out of 108 Snr. Sec. Schools only 60 schools responded after a few weeks/months, inspite of two additional reminders and personal visits/telephone calls in some cases, wherever possible.

4.2.1.4: DATA ANALYSIS :

First of all the information given about the students and teachers in the beginning of their questionnaires were examined and classified accordingly; then, the data available from the students' (of two classes Std.XI & Std.XII separately) as well as from the teachers' questionnaires were analysed by finding the talleys and hence the frequencies for YES (Y-favourable), NO (N-unfavourable) and UNDECIDED (U-Uncertain) and average rating scores were calculated for each item in both the questionnaires separately by rating the responses 1, -1 and 0 (Zero) respectively for the codes, Y,N and U. In the case of students' questionnaires, for the items numbered 2,3,5,6,12 and 15, the code 'Y' represented unfavourable (Negative) and 'N' represented favourable (positive) response, because of their structures. Similarly in the case of teachers' questionnaires, for item numbers, I-7, 8(b), IV-2(a) & (b) and V-1(a) 1(b) & 3, 'Y' represented unfavourable and 'N' favourable.

CRITERIA FOR INTERPRETATION/EVALUATION :

(1) The values of average rating scores within the range of -1.00 to -0.50 were considered unfavourable for the different aspects of the textbooks.

(2) The values of average rating scores within the range of
     - 0.49 to + 0.49 were considered uncertain or undecided.

(3) The values of average rating scores within the range of
     0.50 to 1.00 were considered favourable for the different
     aspects of the textbooks.

Based on the above criteria interpretations were made for
each item as well as for groups of items under the seven
different aspects of the textbooks i.e., regarding content,
nature and structure of physics/science, communication strate-
gies, end-of-chapter exercises, language aspects, physical
aspects and the over all suitability of the textbooks.

As pointed out earlier, within the restricted type (Y/N/U)
response questionnaire, students and teachers were requested
to give additional responses for starred items. Some 53
students (65%) from Std.XI and 67 students (70%) from Std.XII
and 18 teachers (44 %) provided additional comments/infor-
mation for starred items as well as comments/information in
general. The investigator went through these huge descriptive
responses carefully and classified the relevant views of the
majority into the earlier mentioned seven aspects of the text-
books.

4.2.2 : TO STUDY EXPERTS' OPINIONS:

The textbooks under study are for Snr. Sec. level, where
the syallabus is quite high nowadays, compared to those of a
decade ago; at times one would notice that whatever was taught
in undergraduate physics courses 10-15 years ago appear now
at Snr. Sec. level; perhaps this is bound to be the trend in
all countries, as the amount of knowledge in science is incre-
asing in high proportions every time, through research and
development activities throughout the world. So, it was

decided that opinions of some experts who are very much active
in teaching as well as research activities especially in
higher physics at University level, should be consulted.

4.2.2.1 : TOOLS :

A draft opinionnaire consisting of 12 questions was
constructed; all these questions were directly or indirectly
based on the objectives of the investigation, to enable the
investigator to compare the results of content analyses with
the opinions of experts; most of the items in this opinionnaire
were linked with the items of questionnaires for teachers and
students. All the questions in the opinionnaire were of non-
restricted/open response type,,in this tools, the respondents
were also requested to state any other specific comment/s not
covered by the 12 questions.

The same five experts who were consulted earlier in the
case of finalising questionnaires, were requested to go
through the opinionnaire; based on their comments certain
deletions/additions and modifications were made and the draft
copy of the opinionnaire was finalised. Getting response to
the opinionnaire by the experts were to be followed up by semi-
structured interviews   -   . with them and as such, for these
interviews, the topics for discussion were mainly based on the
elaboration of the questions in the opinionnaire and their
responses to them; and more or less, they were intended to be
of informal type concentrating on academic and professional
issues in general and the present physics texts for Snr. Sec.
level in particular.

4.2.2.2 : SAMPLE :

The sample of five experts consisted of three senior members of the Dept. of Physics of the M.S.University, Baroda teaching at undergraduate as well as postgraduate level, and they are active in research work too; the fourth one is a retired member of the above Dept. of Physics. The last one is with a slightly different background; he was chosen because of his doctoral research in physics education as well as due to his position as a Snr. physics teacher and Vice-Principal for several years in a Snr. Sec. School at Baroda, where the present NCERT physics textbooks are used. Though the first 4 experts have been teaching at higher level, they all have had the opportunity to make use of the physics textbooks under study in certain occasions.

4.2.2.3 : COLLECTION OF DATA :

First of all the chosen experts were contacted by the investigator to develop much needed professional as well as academic rapport with them and hence to get their consent to respond to the opinionnaire. Though they are all very busy people, somehow they agreed to co-operate with the academic and professional spirit. They were supplied with the opinionnaire attached with sheets of paper for written responses and some of them, those who didn't have the copies of the textbooks, were supplied with the same.

As and when the written responses were ready, depending on the date and time of appointment available with the experts, somewhat informal but academically and professionally oriented three semi-structured interviews were held separately with them mainly to further discuss issues related to their responses. In this way, the investigator could collect a lot of information regarding the physics textbooks under study from the experts.

4.2.2.4 : DATA ANALYSIS :

The data analysis was done question-wise and presented in the statement form in Ch.V (pp.4o1-4o2) of this report. Among the large number of detailed responses *(as well as additional)* made by the experts during the interviews, the important and relevant responses were classified into two categories; i.e., positive aspects and inadequacies, of the physics textbooks, according to them; and these have been presented in Ch.V (pp.4o3-4o6).

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