CHAPTER IV

DEVELOPMENT OF THE PACKAGE : PHASE-I

4.1 INTRODUCTION :

Details process regarding the development of the package has been mentioned in the chapter -III i.e. Plan and Procedure of the Study. As it has been mentioned for the development of the software package, three chapters were selected-one each from three branches of Chemistry based on the opinion of teachers and students regarding the difficulty level of these chapters. On the basis of their opinion as given in Table-1 in chapter - III, the following three chapters were selected.

(1) Organic compounds

(2) Bonding and Molecular structure

(3) Energy.

After selecting the chapters, content analysis was carried out as described in the previous chapter. The detailed content analysis of the three chapters is presented here under.

4.2 CONTENT ANALYSIS OF THE SELECTED CHAPTERS

(1) CHAPTER - I - ORGANIC COMPOUNDS :

This chapter introduces students to the large variety of `C' compounds known as Organic Chemistry and to know the reasons for the multiplicity of organic compounds and how these compounds are classified. Due to existence of these

compounds in varied forms, there are set of rules to be followed for naming these compounds which is known as IUPAC Nomenclature of organic compounds. This chapter also introduces them about different types of isomerism that exists in these compounds. The content analysis of this chapter is presented in Table-3. For carrying out content analysis, the following books were referred

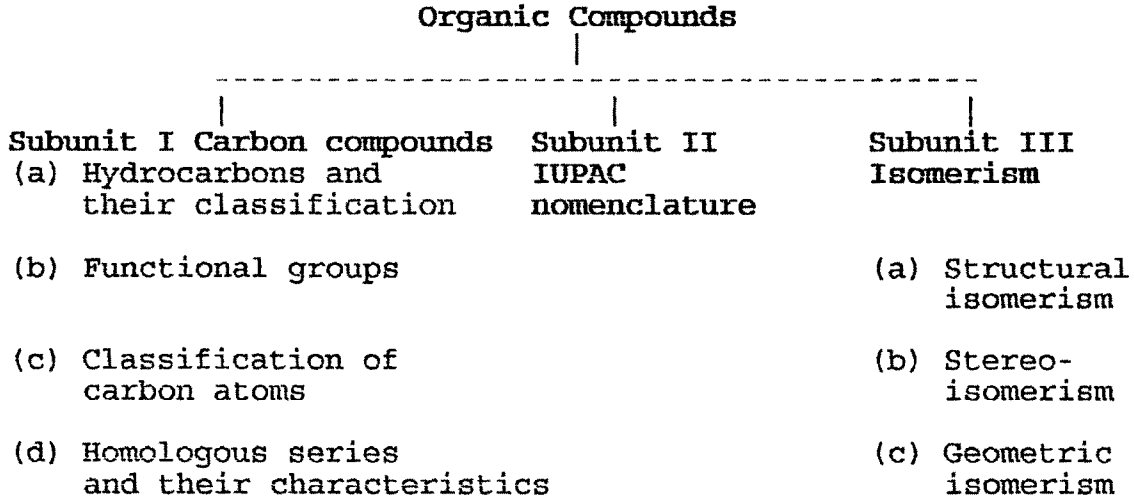
(1) Finar, I.L., (ed.) "Organic Chemistry Vol. I; The Fundamental Principles" Sixth edition; Longman Singapore Pub. Pvt. Ltd., Singapore (1973).

(2) Soni, P.L. and Chawla, H.M., "Text book of organic chemistry", Twenty fifth edition, Sultanchand & Sons Pub., New Delhi (1992).

(3) Chemisry, Standard XI, pub. by Gujarat State Board of School Textbooks, Gandhinagar, 1st edition (1994).

This unit has three subunits and these three subunits were given the weightage according to their importance.

Figure 1 : CONTENT ANALYSIS OF UNIT "ORGANIC COMPOUNDS"



Board of School Textbooks, Gandhinagar, 1st Edition, (1994).

TABLE 3 : DISTRIBUTION OF - WEIGHTAGE TO THE SUBUNITS OF THE UNIT "ORGANIC COMPOUNDS"

Sr. No.	Subunits	Weightage (in %)
1)	Subunit I Carbon compounds	30
2)	Subunit II IUPAC Nomenclature	45
3)	Subunit III Isomerism	25
	Total	100

While arranging the subunits, utmost care was taken to observe the logical continuity among these subunits and the points covered under them. For example, here in this chapter, first of all students should know about carbon and hydrogen compounds i.e. hydrocarbons & their classification, functional groups and their classification, classification of carbon atoms and homologous series. Knowledge of subunit I, would help students to understand the IUPAC nomenclature & rules for carrying out the naming of these organic compounds. Knowledge of these two subunits help the students to know about the different types of isomerism and causes of existence of these isomerism in organic compounds.

Thus, based on the content analysis carried as above, the subunits were sequenced and few additional points were added like causes for existence of large no. of carbon compounds, homologous series and their characteristics; what is plane polarized light and ways to obtain plane polarized light. This was done after consulting the subject experts & Chemistry teachers. Thus the final draft of the chapter was prepared. It is given in the Appendix (VIII).

Subunit I Carbon Compounds deals with the basic knowledge about the classification of hydrocarbons, functional groups, their importance and classification. Hence, this unit was given 30% weightage while Subunit II deals with the nomenelature of hydrocarbons which is very important for the students to understand the rules of nomenclature and apply these rules for naming of hydrocarbons. Therefore, this unit being important is given maximum weightage of 45%. The subunit unit-III of the chapter introduces students to the different types of possible isomerism in organic compounds. It is important for the students to know and understand the possibilities of isomerism due to which this subunit is assigned a weightage of 25%. Based on the weightage given to each subunit, evaluation items of different levels were framed.

(2) **CHAPTER II - BONDING AND MOLECULAR STRUCTURE :**

This chapter deals with the various types of bonds which can exist among different elements. Students are familiar about different names of the bond which are possible among different compounds, from the content that is covered in standard 8th, 9th and 10th. Here in this chapter, students can get a detail knowledge and understanding about why do elements combine to form bonds & formation of different kinds of bonds among elements of same group and different groups, and how the existence of these molecules in their solid state is dependent on the type of bond they form. The content analysis of this chapter is presented in Figure 2.

Figure 2 : CONTENT ANALYSIS OF THE UNIT ON BONDING AND MOLECULAR STRUCTURE

BONDING AND MOLECULAR STRUCTURE

Subunit I	Subunit II
Lewis Structures and Octet Rule	Types of Bonds and Related solid states i) Ionic bond and Ionic solids ii) Covalent bond, Quantum theory for covalent bond, molecular and net work solids iii) Co-ordinate - covalent bond iv) Metallic bond & metallic solid v) Van - der - waal's forces vi) Hydrogen bond and related compounds

For carrying out the content analysis, following books were referred.

1) Soni, P.L., "Fundamental Inorganic Chemistry" fourth editions, Pub. Sultan Chand & Sons, New Delhi, (1973).

2) Sattya Prakash, Tuli, G.D., Basu, S.K., and Madan, R.D., "Advanced Inorganic Chemistry", Sixteenth Revised edition, Pub, S. Chand & Company Ltd., New Delhi, (1980).

3) Verma, N.K., Khanna, S.K., "Comprehensive Chemistry", Vth Edition, Laxmi Publications, New Delhi, (1993).

4) Chemistry, Standard XI, Pub. by Gujarat State Board of school Text Books, Gandhinagar, 1st Edition (1994).

This chapter was divided into two subunits and the weightage given to the subunits are presented in Table-4.

Table 4 : DISTRIBUTION OF WEIGHTAGE TO THE SUBUNITS OF THE UNIT "BONDING AND MOLECULAR STRUCTURE"

Sr. No.	Subunits	Weightage in %
1	I	20
2	II	80
	Total	100

Students know about the Octet Rule as they have studied it in their previous classes. Based on Octet Rule and electronic configuration, students can easily understand about the Lewis Structure and therefore this subunit was given 20% weightage. While Subunit II was given 80% weightage. This is because in Subunit II, students are going to learn in detail about the different types of bonds, formation of these bonds and their related solid structures. Therefore, 80% weightage was allotted to Subunit-III in this unit. Based on the content analysis and logical sequencing of the subunits and the points covered under them, the text was prepared and shown to the subject experts and Chemistry teachers of higher secondary schools for further modification. The final draft was thus prepared by adding extra examples related to Lewis Structure, characteristics of solids related to different types of bonds and detailed description about coordination number of metal ion. Based on these suggestions, the final draft of the chapter was prepared. Final draft of this chapter is attached in the

Appendix (X). While framing the evaluation items of different levels, the weightage given to the subunits was kept in mind.

(3) CHAPTER III : ENERGY :

This chapter is from the Physical Chemistry section of GSTB, 1994. Here, energy as a concept is introduced to the student for the first time at Standard XI. It deals with the nature of energy changes in chemical reaction; distinction between exothermic and endothermic reactions, enthalpy concept for calculation of bond energy and energy changes in a reaction, different sources of energy and their importance in daily life and to predict the directions of a reaction using the entropy and the free energy concept.

The content analysis of Chapter III is done as after referring the following books.

1) Maron Samuel H. and Prutton C.F., "Principles of Physical Chemistry", Fourth edition, Pub-Macmillan Company, New York, (1969).

2) Bahl, B.S., Tuli, G.D., (ed.), "Essentials of Physical Chemistry", 16th Edition, S. Chand & Co., New Delhi, (1967).

3) Jain, D.V.S., Jauhar, S.P., "Physical Chemistry", First edition, Mathur Vinay (ed.), Tata Mc-Graw-Hill Pub. Co. Ltd., New Delhi, (1988).

4) Chemistry, Standard XI, Pub. by Gujarat State Board of School Textbooks, Gandhinagar, 1st edition (1994).

Figure - 3 below presents the details of the content analysis of chapter - III.

FIGURE 3 : DETAILS OF THE CONTENT PRESCRIBED IN THE CONTENT

ENERGY

Energy

Subunit I **Sources of Energy**	**Subunit II** **Energy Terms Associated with Matter**
(a) Sun as primary source of energy	(a) Internal energy
(b) Consumption of fuels	(b) Enthalpy
	(c) Hess's law of heat summations
	(d) Entropy
	(e) Free energy
	(f) Predicting the directions of a reaction using the entropy and free energy concept.

Subunit III

(A) **Heat of Reactions**

(a) Distinction between exothermic and endothermic reaction

(b) Heat of reaction

(c) Heat of neutralization

(d) Heat of combustion

(e) Heat of fusion

(f) Heat of vaporization, and

(B) **Examples Related to the Energy Changes during Chemical Reaction.**

Thus, this chapter was divided into a total of three subunits and the weightage given to the three subunits are presented in Table-5.

TABLE 5 : DISTRIBUTION OF WEIGHTAGE TO THE SUBUNITS:CHAPTER ENERGY

Sr. No.	Subunit	Weightage in %
1	I Sources of Energy	10 %
2	II Energy Terms Associated with matter	45 %
3	III Heat of Reaction & Examples related to energy changes	45 %
	Total	100 %

The first subunit deals with the different sources of energy. Students of Class XI are already familiar with this as they have studied it in their previous classes. Therefore this subunit has been given 10% weightage. The other two subunits i.e. II & III deals with the energy terms associated with matter and heat of reaction which can be used for calculating energy changes during chemical reaction. These two subunits are important from the point of view that they form the basis for learning further concepts at standard XII. Hence, these two subunits are given equal weightage which is relatively higher than the Subunit-I. The draft thus prepared was then shown to the subject experts and Chemistry teachers. The final draft of the text was prepared by incorporating the suggestions given by them. As per the suggestions of experts, few more examples related to the calculation of heat changes in a chemical reaction were included in the final draft of the chapter and a copy of the same is given in the Appendix

(IX). Evaluation items were framed based on the weightage given to the different subunits.

4.3 SELECTION OF THE PROGRAMMING OF LANGUAGE :

The programming language was selected on the basis of following requirements of the three chapters viz.

1) Size of the required letters on the screen.
2) Types of figures, graphs and animated figures.
3) Amount of information to be handled at a time.
4) Ease of processibility of information.

Based on the above requirements of the three chapters of Chemistry, Bor land `C' language was selected as it could satisfy the above requirements of software development.

After selecting the programming language, the software package was developed for the three selected chapters. For developing the software package, investigator took help from computer expert having expertise in Bortland `C' language. Eight months were devoted for the development of the software package. After developing the package, it was given to the subject teachers of the school, subject experts i.e., experts in Chemistry teaching and computer experts for making necessary modifications. Then the package was ready for the pilot study.

4.4 ANALYSIS AND INTERPRETATION OF THE DATA COLLECTED THROUGH PILOT STUDY :

The data was collected from the controlled and experimental groups having 15 students in each group regarding pre-test & post-test. Data were analysed with the help of Analysis of Covariance.

The summary of the ANCOVA is presented in Table-6 and 7 below

TABLE 6 : RESULTS OF THE ANALYSIS OF VARIANCE OF X AND Y SCORES, TAKEN SEPARATELY

Source of Variance	df	SSX	SSY	MSx(Vx)	MSy(Vy)
Among Means	1	34.93	700.8	34.93	700.8
Within Groups	13	909	1628	69.9	125.2
Total	14	943.93	2328.8		

$$Fx = \frac{34.93}{69.9} = 0.4997$$

$$Fy = \frac{700.8}{125.2} = 5.6$$

From Table F
For df 1/13

F at 0.05 level = 4.67
F at 0.01 level = 9.07

TABLE 7 : RESULTS OF ANALYSIS OF COVARIANCE

Source of Variance	df	SSX	SSY	SSxy	SSyx	MSyx (Vyx)	SDyx
Among Means	1	34.93	700.8	154.66	662	662	11.64
Within Groups	12	909	1628	42	1626	135.5	
Total	13	943.93	2328.8	196.66	2288		

$$Fyx = \frac{662}{135.5} = 4.88$$

From table F df 1/12
F at 0.05 level = 4.75
F at 0.01 level = 9.33

From Table 6 it can be seen that Fx of 0.4997 with 1/13 degree of freedom was insignificant at 0.05 level of significance. It means that both the groups were equal in terms of their previous knowledge. Further it can be seen that Fy value of 5.6 with 1/13 df was significant at 0.05 level of significance. it can therefore be said that the software package implemented was effective in terms of students' achievement. However to derive a valid result, it was felt necessary to nullify the effects of previous knowledge and some other uncontrolled variables. IQ and academic motivation were taken as co-variate. For this purpose analysis of covariance was applied. From the Analysis of Covariance the value of Fyx was found as 4.88 which was found to be significant at 0.05 level of significance with 1/12 degrees of freedom. From this it can be inferred that even after nullifying the effects of intervening variables that the results found through ANCOVA was significant. This clearly shows that the software package implemented was effective. At the end of the experiment, unstructured interview schedule was administered on the students and structured interview schedule was administered on the subject teacher to collect their reactions about the package. On the basis of some of the reactions, the necessary modifications were made in the software package in order to make it more effective.

4.5 CHANGES MADE IN THE PACKAGE AFTER PILOT-STUDY :

On the basis of comments and observations of the students and teachers about the software package, it was duly modified on the following points.

(1) Examples related to Hess's law of constant heat summation were added.

(2) Examples of energy changes during chemical reaction were added.

(3) Explanation related to functional groups was modified.

(4) Evaluation items related to the topic of classification of carbon atoms were added.

(5) Test items related to topic of Nomenclature of organic compounds were increased in number and simple test items were deleted.

(6) Figures related to isomerism were corrected and few figures were added for clarifying stereoisomerism.

(7) Examples related to Lewis structure and figures were added to improve upon the explanation of these terms.

(8) Figure showing Electrical conductivity of metals was corrected.

(9) No. of examples and figures related to Hydrogen bonding were added for explaining the properties of compounds having hydrogen bonding.

(10) Few spelling mistakes found in the text was corrected.

Thus, after making the necessary changes in the software package, it was ready for the final phase of the experiment.