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LEARNING PACKAGE FOR HYDROLOGY



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Preface

In order to fulfill the democratic aspiration of the disadvantaged section of the society for universal education, novel methods of imparting education have been devised. Also the economic condition of the third world have not been so favourable to employ sufficient number of teachers who are well qualified and knowledgeable, other methods of imparting effective education have to be developed. As a consequence of this the distance learning has acquired a new meaning in the field of teaching and learning the world over. Also the distance learning is increasingly becoming popular.

In India also the use of computers along with multimedia and Internet applications is being used for imparting knowledge to the disadvantaged learners has developed a big way. Keeping all this in view, the software "Learning Package for Hydrology" has been developed by Mrs. Deepa Chalisgaonkar, Scientist 'E', Sri Manoj Goel, R.A and Sri Rajesh Agrawal, R.A. of the Institute.


(S.M.Seth)

Abstract

Computers have become an integral part of everyday life. In the new millennium everybody should be computer literate as early as possible to keep pace with the developments taking place in the field of Information technology. Any country's social and economic wellbeing depends entirely on how well we educate people for a literacy intensive technological world.

The computers have become a major tool for becoming competitive in the market. Considering the increasing popularity of the computers in day to day functioning in all kinds of work, there is a good reason to welcome their appearance in the teaching process.

The report emphasises the necessity of Computer Aided Learning and presents a Learning Package on Hydrology covering various important elements of hydrology including various terminology and definitions used in the field of hydrology.

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1.0 WHAT IS HYDROLOGY

Water is one of the important natural resources available to mankind. Due to its multiple benefits and the problems created by its excess, shortage and quality deterioration, the water has a unique role as a resource and deserves special attention of development and planners. The science of hydrology deals with all waters of earth, in the atmosphere and underground, their occurrence, distribution, properties, their reaction with the environment including their relation with human being. It is defined strictly as the study of the hydrologic cycle, which is the perpetual circulation of water between the earth and its atmosphere.

With the growth of human civilization, man's requirement of water have increased considerably to meet demands for irrigation, power generation, navigation, industries, recreation etc. apart from domestic supplies. With the increasing pressure of rising population, there is growing need for finding, developing and maintaining suitable source of water supply and for proper management of this natural resource. Practical aspects of Hydrology study are found in such tests as the design and operation of the hydraulic structures, water supply, waste water treatment and disposal, irrigation, drainage, hydropower generation, flood control, navigation, erosion and sediment control, pollution control, recreational use of water, fish and wild life protection etc.

Hydrology input form an integral component of all development programme aimed at judicious and efficient management of land and water resources involving design of soil and water conservation structures, water resources development, erosion controls, treatment of flood prone and drought prone areas and command area development etc.

1.1 Education and Training In Hydrology

There are 67 major river basins and a few hundred medium river basins in the country which can be identified for intensive study and integrated development. The techniques will have to be developed for the collection of reliable and representative data of precipitation, evapotranspiration, infiltration, groundwater recharge soil moisture, runoff, baseflow groundwater, floods and droughts in addition to other data relating to physiographic and climatic characteristics of river basins, This will involve setting up of good data collection network and facilities of processing and analysis of data. In order to meet the requirements of

long range plan for optimal use of water resources, a vast manpower resource will be needed with specialised knowledge and training in various aspects of hydrology.

Water resources has been a relatively neglected subject in the education curricula in the developing countries especially at the under graduate level. Most institutions concentrate on scientific education leaving application of the knowledge to be learnt during the course of employment. In order to meet the needs of short term and long term plans for water resources development in the country, creation of suitable mechanism for education and training for increasing the awareness of hydrology is necessary. Adequate trained manpower is necessary to improve the capabilities of operational organisations. The aims and content of education in hydrology are :

- (a) To develop and improve the awareness of the totally of interconnected (mainly physical) processes involved in the hydrological cycle;
- (b) To provide the maximum possible training in relevant area of the basic scientific discipline underpinning hydrology;
- (c) To develop the connections between those basic disciplines and the scientific study of various hydrological processes;
- (d) To develop more fully and clearly the connections between scientific knowledge of hydrologic processes and the current and potentially improved professional practice of hydrology.

2.0 DISTANCE LEARNING

Distance learning is playing an important role in providing education to the masses. For about two decades the planners and educators have been putting great efforts to use radio and television in education. A number of satellite communication projects have been undertaken and evaluated in terms of their utility in the field of education. By now, these programmes have been utilising one way communication, which lacks both pedagogical, and communication effectiveness. However, latest communication technologies have made it possible to use the two way communication in education, to increase the quality of learning, reduce the cost and decrease the time taken for learner to attain the desired goal.

2.1 Distance Education in Hydrology

Only a few years ago there were many places on the world where it was not possible to get training as a professional in hydrology. Most work was being done by people whose education was in a more traditional field such as civil engineering or geology. In order to fulfil the aspiration of the disadvantaged section of the society for universal education, novel methods of imparting education have been devised. Also the economic condition of the third world have not been so favourable to employ sufficient number of teachers who are well qualified and knowledgeable, other methods of imparting effective education have to be developed. Probably there is an advantage in well prepared lesson to be given through recently available multimedia / internet techniques as the impact is much greater. As a consequence of this the distance education has acquired a new meaning in the field of teaching and learning the world over. Also the distance education is increasingly becoming popular.

In India also the use of multimedia / internet for imparting knowledge to the disadvantaged learner has developed in a big way. The efforts by the National Council of Educational Research and Training and University Grants Commission with the open universities are really praise worthy. -

Distance learning began with a concern to reach individuals who could not attend regular classes and who do not have access to the libraries. A distance learning programme may teach to persons who never met a teacher and have little or no contact with regular educational system. At the other end, distance learning methods are used to support schools and to supplement the ordinary work of a classroom teacher.

Distance learning attracts the economist because it uses mass-production methods, which change the structure of the educational cost. With traditional classroom methods, the costs of education rise in proportion to the number of persons being educated. Salaries and buildings swallow up most of an educational budget. Distance teaching is not necessarily a cheap way of solving educational problems. In some cases, there is no alternative : distance learning methods may, for example, be the only means of providing in-service training to teachers who cannot be taken out of the school. Under the circumstances, DL methods can be cheaper than their orthodox alternatives.

Once an instructor decides he will teach his student something, several kinds of activity are necessary on his part, if he is to succeed. He must first decide upon the goals he intends to reach at the end of his course. He must then select procedures, contents and methods that are relevant to the objectives; cause the student to interact with appropriate subject matter in accordance with principles of learning and finally evaluate the student's performance.

Technology, particularly the computer, affects how we view teaching and learning. Indeed, technology influences all of society in ways greater than most people know. The computers can have revolutionary effect on all of education, from increasing the occurrence of self-directed learning through computers in the home to changing the relationship of student to teacher in the classroom. The computers can enter the educational process in a profoundly different way.

With the popularity of Internet and Multimedia applications computer has become an interface in long distance communications with other people. Because computers can handle vast amounts of information so efficiently, it is easy to see the computer as one more means of information transfer. The computer's vast potential for storage, organisation and retrieval of information makes it an attractive information transfer device.

3.0 COMPUTER AIDED LEARNING

With the advent of the information technology as emergence of a new social order, there has been an urgent indispensability of computer literacy among the computer-aided learning. Rapid progress in the area of micro electronics and space technology has contributed substantially to time phenomena. It is necessary to become familiar with the new skills to make the most out of it.

Computers are an integral part of everyday life. They contribute to education as aids to learning. Computers are found to be active partners in the learning process, which may be most effective teaching subjects that are either not taught at all, or, taught well. The interactive nature of the computer-based learning and the ability to individualise the learning experience to the needs of the learner, are the two most important aspects of the computer-assisted learning. With the help of computers, the learner will be able to learn at their own pace. Using quality

educational software packages, good learning environments can be created. Hence, for the teacher the challenge is to learn to be a facilitator of the learning process rather than the source of knowledge.

Any country's social and economic wellbeing depends entirely on how well we educate people for a literacy intensive technological world. If computers can assist us in the teaching process then there is a good reason to welcome their appearance. Hence, it is absolutely essential for all those involved in education to become computer literate.

Computer-aided learning has sparked several heated debates - people have different views about the computer-aided learning, and also disagree substantially about the various which underpin different paradigms of courseware development. Some of the aspects are :

3.1 Financial and Educational Effectiveness

Opinions about the effectiveness of computer-aided learning differ considerably. The old "handicraft methods" of education are expensive, ineffective and outdated, and should be replaced by computer-based education. At the other end of the spectrum, view the drive to computerise education as merely one component of the general technological collision course of late twentieth-century society - at best, expensive and misguided, and at worst, a disastrous mistake with dire social and educational consequences.

3.2 Interactivity

For many, multimedia's major advantage over other educational media (and over traditional lecture-based teaching) is its interactive potential. Students of all ages learn better when they are actively engaged in a process, whether that process comes in the form of a sophisticated multimedia package or a low-tech classroom debate on current events

Actually, most of the so-called interactive stuff is pretty uninteractive. It has to do with some fixed menu, not with being able to probe as you would a person or to judge or be moved as you would in a live interaction.

4.0 MULTIMEDIA APPLICATIONS IN LEARNING

Computers have much potential in helping the developing world. This potential is augmented by multimedia. A range of applications is described from student tutorial support, collaborative learning, access to educational resources on the Internet, through to full delivery of all materials electronically. It can contain text, still pictures, music, sounds and even moving pictures such as short movies or little moving cartoons. Various drawbacks associated with language and culture and economics are identified, but on balance the recommendation is to use computers for learning. With the recent extraordinary growth of digital telecommunications, the Internet, and the World Wide Web, the delivery of education using multimedia across the Internet has now taken prominence.

Educational use of multimedia is being actively investigated across the world. At the moment the best medium for the delivery of multimedia is no doubt the CD-ROM. Currently, these are limited to 640MB, sufficient capacity for massive amounts of text, but for very limited quantities of video and audio. However, new technologies are now being developed that will raise the capacity of CDs to many gigabytes. Even so, in the longer term it is generally agreed that delivery, across the Internet will supplant this, as the bandwidth of communication channels increases to the Megabits per second region, and platform independent execution environments like Java become established.

Multimedia is clearly good for reference works, like encyclopaedias and dictionaries, and for very focused uses like micro-world simulations or virtual laboratories.

5.0 HTML and BROWSERS

The modern way of presenting the documents are using Hyper Text Media Language (HTML) for formatting the documents. The HTML formatted documents are attractive documents and at the same time it allows these documents to contain hypertext links to other documents on other documents on the Internet (Fig.1).

Hypertext is a way of presenting information so that it can be looked at in a nonsequential way, regardless of how the original topics were organised in the document. Hypertext was designed to allow the computer to respond to the

nonlinear way that humans think and access information. In other words, by association, rather than by the linear arrangement of films, books.

The hypertext applications can be browsed with great flexibility. A different path can be followed through the information each time it is accessed something which cannot be done with video or recorded information.

A hypertext document can contain a hyperlink to any other document or resource on the Internet, as this link is managed by HyperText Transmission Protocol (HTTP). When this link is selected, the browser pulls the associated document and displays it, even though it may be on a different computer system, thousands of miles away. The software that makes this process happen is called a Browser. Fig.2 illustrates the process of a browser retrieving a page from a server. The architecture of a browser is shown in fig.3. To browse the document, it contains various types of viewers like HTML viewer, GIF viewer, JPEG viewer, sound player, video viewer. Depending upon the application, it selects a particular viewer. Today many companies, including Microsoft and IBM, offer browser software and because they are all based on an open standard defined by HTML and HTTP, they all work in a pretty much the same way.

6.0 ABOUT THE PACKAGE

Considering the importance of computer aided learning, a software package has been developed for learning hydrology using computers. The features of the developed package are :

6.1 HARDWARE AND SOFTWARE REQUIREMENTS

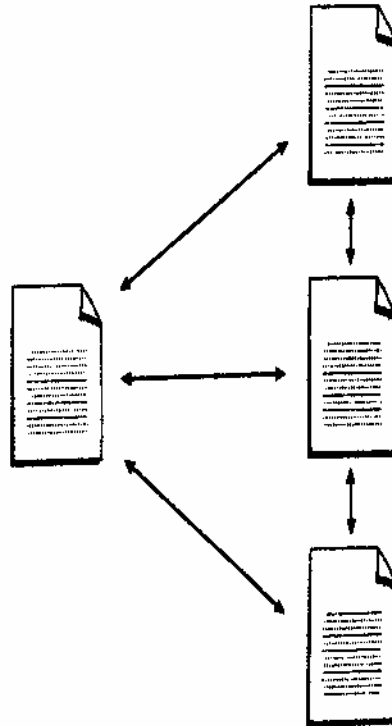
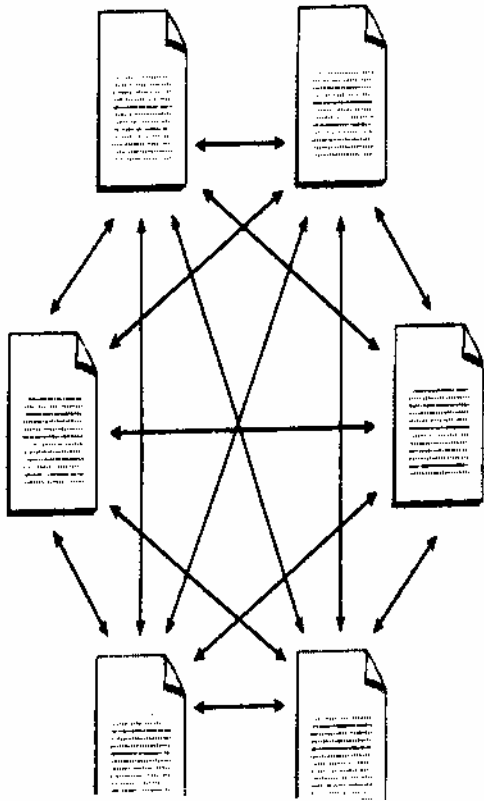
The software has been written in the programming language HTML. The hardware and software requirements for using the package are:

- o IBM compatible PC-486 or above
- o Window 95/98 operating system
- o Any of the browser software like Internet explorer, netscape etc.
- o Graphic card
- o For pleasant operation, a colour monitor is preferred.
- o A compatible printer with graphical capabilities.

Highly Linked Structure

Linear Structure

Tree-like Structure



Highly Linked Structure

Linear Structure

Tree-like Structure



Fig.1 Structure of a Hypertext document with Hyperlinks

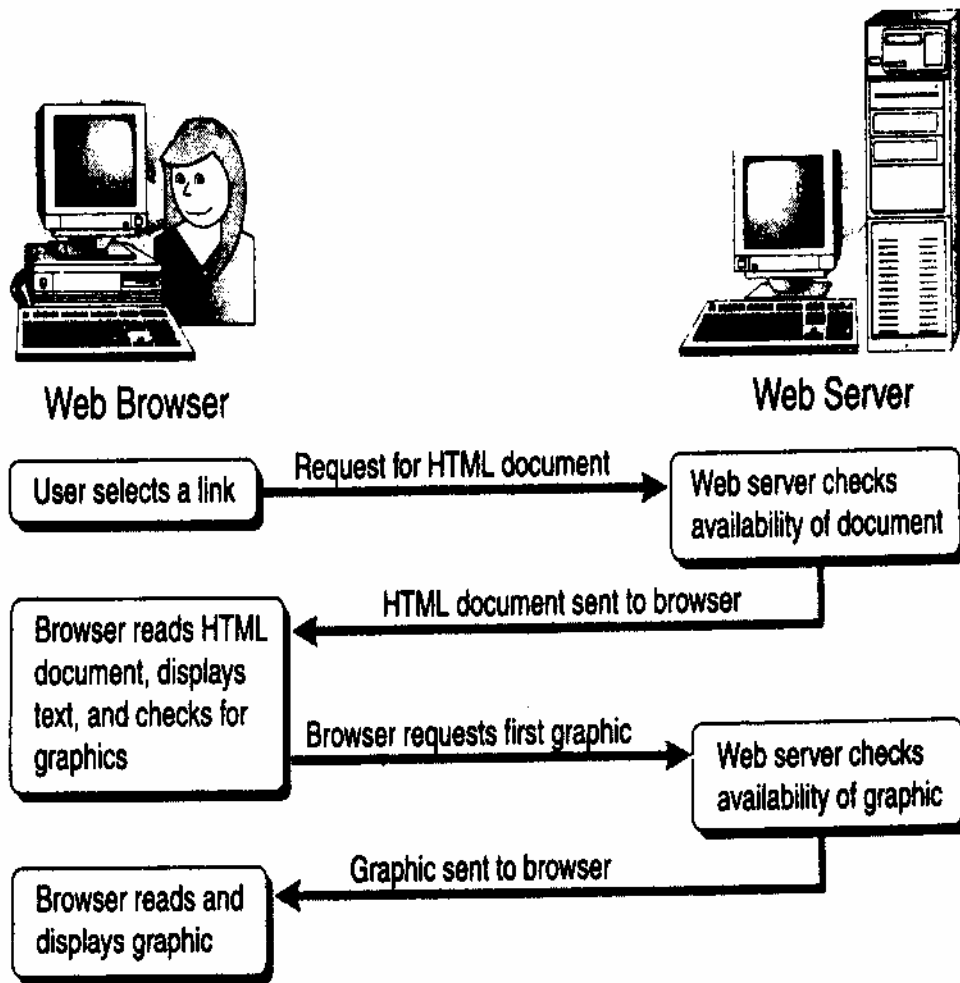


Fig. 2 A Browser Retrieving a Page from the Server

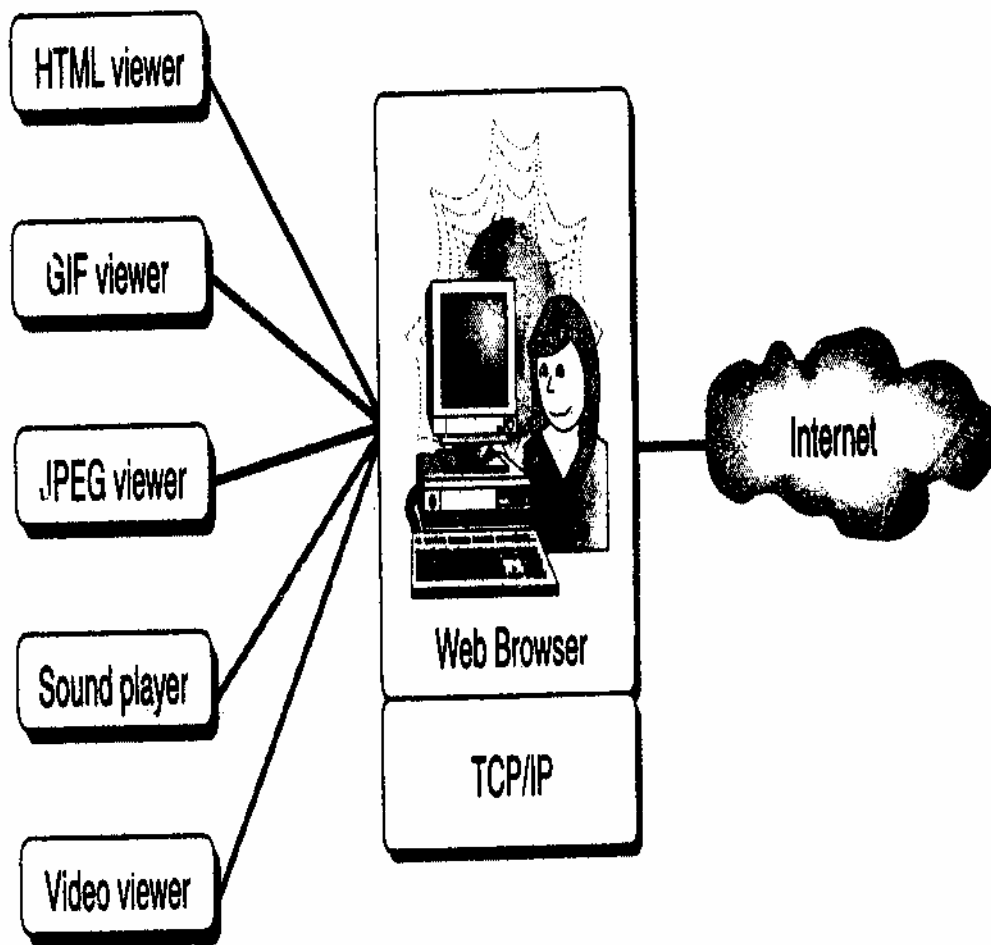


Fig. 3 The Architecture of a Browser

6.2 Software Description

The software is a menu driven and user friendly software. It can display in colours, if a colour monitor is used. The user can move forward to submenus by moving the cursor to the desired position and then pressing the ENTER key.

The user can read the document in a nonsequential way just by clicking the mouse on the hyperlinks provided in the software at a large number of important points. He can also move backward in the same fashion. It is not necessary to follow a common path for forward and backward reading. When a hyperlink is selected by clicking it, the related information is automatically displayed on the screen.

In this package an attempt has been made to bring out a brief idea about Hydrology. It is assumed that the learner has already been exposed to courses in physics and chemistry related to water, hydraulics, environmental sciences, mathematics and computations. The hydrological cycle along with the physical processes including elementary methods to analyse the processes involved in various subsystems of the cycle has been stressed. The main topics covered are Introduction (fig.4), Precipitation (fig.5), Abstraction from Precipitation (fig.6), Streamflow Measurement (fig.7), Runoff (fig.8), Hydrograph (fig.9), Floods (fig.10), Flood Routing (fig.11) and Ground Water (fig.12). It also covers a large number of definitions. It contains various terminologies, definitions and various sections and sub-sections of the topics mentioned above.

The learner can just go on clicking the mouse and learn the almost all the important areas of hydrology without referring the textbook. To make it more accessible it can be installed on a web server and attached to the Internet, so that people from any part of the globe can refer it.

Such a software has an immense potential for distance education as it reduces the physical distance. Even if the learner is not able to ask question, they can have access to all the information.

| Introduction |
|-----------------------------|
| Introduction |
| Hydrologic Cycle |
| World Water Inventory |
| History of Hydrology |
| Applications in Engineering |
| Sources of Data |

Fig.4 Various sections of the module 'Introduction'

| Precipitation |
|---|
| Introduction |
| Forms of Precipitation |
| Weather Systems for Precipitation |
| Characteristics of Precipitation on India |
| Measurement |
| Raingauge Network |
| Preparation of Data |
| Presentation of Rainfall Data |
| Mean Precipitation over an Area |
| Depth-Area-Duration Relationships |
| Frequency of Point Rainfall |
| Intensity-Duration-Frequency Relationship |
| Probable Maximum Precipitation |

Fig.5 Various sections of the module 'Precipitation'

| Abstractions from Precipitation |
|---|
| Losses from Precipitation |
| Evaporation |
| Evaporation Process |
| Evaporimeters |
| Empirical Evaporation Equations |
| Analytical Methods of Evaporation Estimation |
| Reservoir Evaporation and Methods for its Reduction |
| Evapotranspiration |
| Transpiration |
| Evapotranspiration |
| Measurement of Evapotranspiration |
| Evapotranspiration Equations |
| Potential Evapotranspiration over India |
| Initial Loss |
| Interception |
| Depression Storage |
| Infiltration |
| Infiltration Process |
| Infiltration Capacity |
| Measurement of Infiltration |
| Infiltration-Capacity Values |
| Infiltration Indices |

Fig.6 Various sections of the module 'Abstractions from Precipitation'

| Streamflow Measurement |
|--|
| Introduction |
| Measurement of Stage |
| Measurement of Velocity |
| Area-Velocity Method |
| Dilution Technique of Streamflow Measurement |
| Electromagnetic Method |
| Ultrasonic Method |
| Indirect Methods |
| Stage-Discharge Relationship |
| Extrapolation of Rating Curve |
| Hydrometry Stations |

Fig.7 Various sections of the module 'Streamflow Measurement'

| Run Off |
|-----------------------------------|
| Introduction |
| Hydrograph |
| Runoff Characteristics of Streams |
| Yield (Annual Runoff Volume) |
| Flow Duration Curve |
| Flow Mass Curve |
| Surface Water Resources of India |

Fig.8 Various sections of the module 'Runoff'

| Hydrographs |
|---|
| Introduction |
| Factors Affecting Flood Hydrograph |
| Components of a Hydrograph |
| BaseFlow Separation |
| Effective Rainfall |
| Unit Hydrograph |
| Derivation of Unit Hydrographs |
| Unit Hydrographs of Different Durations |
| Use and Limitations of Unit Hydrograph |
| Duration of the Unit Hydrograph |
| Distribution Graph |
| Synthetic Unit Hydrograph |
| Instantaneous Unit Hydrograph |

Fig.9 Various sections of the module 'Hydrograph'

| Floods |
|-----------------------------------|
| Introduction |
| Rational Method |
| Empirical Formulae |
| Unit Hydrograph Method |
| Flood-Frequency Studies |
| Gumbel's method |
| Log Pearson Type III Distribution |
| Partial Duration Series |
| Regional Flood Frequency Analysis |
| Limitations of Frequency Studies |
| Design Flood |
| Design Storm |

Fig.10 Various sections of the module 'Floods'

| Flood Routing |
|--|
| Introduction |
| Basic Equations |
| Hydrologic Storage Routing |
| Attenuation |
| Hydrologic Channel Routing |
| Hydraulic Method of Flood Routing |
| Routing in Conceptual Hydrograph Development |
| Clark's Method for IUH |
| Flood Control |
| Flood Forecasting |
| Flood Control in India |

Fig.11 Various sections of the module 'Flood Routing'

| Groundwater |
|-------------------------------------|
| Introduction |
| Forms of Subsurface Water |
| Aquifer Properties |
| Geological Formations as Aquifers |
| Compressibility of Aquifers |
| Equation of Motion |
| Wells |
| Steady Flow into a Well |
| Unsteady Flow in a Confined Aquifer |
| Well Loss |
| Specific Capacity |
| Ground Water Budget |

Fig.12 Various sections of the module 'Ground Water'

7.0 STRENGTH AND WEAKNESS OF THE TECHNOLOGY

- In distance education, this software having the features of interactive tele-teaching using the Internet facility can be very effective. It can also be used without Internet facility. The contents can also be modified to include more details as per the requirements.
- It will attract the students/learners from various background and motivated them to use such package. It will enable the learner to learn at times and at places convenient to him.
- This software can be used as a reference also by the persons who donot have the access to the libraries.
- Economically also it is not a costly affair rather it would be cheaper because it is worth while exercise as it would obviously make the distance learning more lively, effective and meaningful.
- Some times linkage failure may be a problem, which may result in the wastage of precious time of transmission.
- No provision for asking questions was the serious drawback of this package, which prevents effective interaction.
- Ununderstability of English and technical content prevent many participants from using this package.

8.0 CONCLUSIONS

The Learning Package for Hydrology presented in the report clearly indicates the utility and usefulness of computer aided learning in hydrology. It covers all the important topics in the field of hydrology including definitions, figures etc in a simple and straight forward language. It can be used by a beginner for learning hydrology subject as well as by a hydrologist as a reference. However, this knowledge can be converted to achieve the goals be taught through case studies and projects in which group of learners involve themselves to develop the plan and get first hand knowledge of integrating various capabilities.

With the popularity if Internet, it can be installed on a webserver in a website, so that the learner from any part of the globe can access it on his computer. The package can help in distance learning.

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