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FUTURE DIRECTIONS IN HYDROLOGY EDUCATION IN INDIA

Subhash Chander
Professor, Civil Engg. Deptt,
I.I.T., Hauz Khas, New Delhi

INTRODUCTION

National Water Policy (1987) describes water as a prime natural resources, a basic human need and a precious national asset which need to be developed from national perspective. The manpower required to develop this resource should be able to implement integrated plans to satisfy drinking water, Irrigation, Hydropower, Navigation and other needs. They should be able to use latest techniques of analysis and design to leading to scientifically develop and manage this precious resource.

Chander (1993) identified the type of institutions involved in generating this manpower under three heads.

1. Institutions imparting education leading to award of Bachelor's degree in Civil Engineering, Master's and Doctoral degree in Hydrology/Water Resources.
2. Institutions admitting students leading to award of Bachelor's degree in Agriculture Engineering and Master's Ph.D. degree in Water Resources or allied areas.
3. University departments of Geophysics awarding Master's and Ph.D.degrees in Hydrometeorology, Limnology, Geohydrology and Atmospheric Sciences.

It was also reasoned in this paper that the academic role of any such unit is to impart instruction at undergraduate, post graduate and doctoral level. The main role of these units at undergraduate level M.Sc. is to produce Civil Engineers, Agricultural Engineers, Geophysicists Hydrometeorologist and atmospheric Scientists. The students at this level are exposed to Physics, Chemistry, Mathematics, Computation, Environmental Science, Hydraulics, System Engineering, Remote Sensing and Hydrology Courses so that they could appreciate the complexity of this 'Science of Water' in their branches and are in a position to receive postgraduate Education in the area of Hydrology/Water Resources.

The Goal of instruction at the postgraduate level is to produce hydrologists who are well versed in the latest concepts and tools. They should be in a position to use these concepts and tools to analyse water resources problems and develop up-to-date plans and management systems. The exposure should enable them to keep abreast with the current literature and thinking in hydrology and water resources.

In this paper the desirables thrust in undergraduate course on hydrology and the spectrum of courses and their thrust to achieve the goal of providing leadership with credibility at the postgraduate level is presented.

HYDROLOGY COURSE AT UNDERGRADUATE LEVEL

It is assumed that the students in the U.G. programme have been exposed to courses in Physics and Chemistry related to water, Hydraulics, Environmental Science, Maths (Integral, Differential Calculus, Probability and Statistics and Numerical methods) and computation courses. Further, they would have training in system Engineering and remote sensing technology. Hydrology Course for such graduates should be taught on a scientific basis wherein we talk of the hydrosphere as a heat engine in which both heat and water cycles mesh when water changes phase. The hydrological cycle at Global, Regional and Basin scale along with the physical processes including elementary methods to analyse the processes involved in various subsystems of

the cycle need to be stressed. It is also important to bring home to the students various methods which hydrologists use to simulate the hydrological cycle on the above mentioned scales so that they can investigate the impact of man's intervention. (Such as deforestation, Ground water extraction etc.) on the water balance components.

In describing the physics and mathematical representation of various hydrological processes and their interrelationships the findings of hydrologists that larger space scales simplify the response functions describing the interrelationships between components of hydrological cycle need to be clearly brought out.

Another important point concerns how the intervention in the water cycle relates to the ecological and environmental structures and gives rise to social and economic problems and involves politicians in water related development decisions.

About 30 percent of the course at the undergraduate level be devoted to hydrologic design. The topics will need to be chosen by the institutions awarding the degree. The usual choice for Civil Engineering students is, Design Flood, storage reservoir design, spillway design, storm drain design and River forecasting.

POSTGRADUATE LEVEL COURSES

The goals at postgraduate level relate to understanding of concepts, knowledge of tools and their choice so that these students can analyse the water related problems and develop plans for new water use/disposal schemes or develop management programs for better operation of existing systems. The concepts relate to the understanding of physics of various hydrological processes. Dynamics of movement of water/water vapour from the atmosphere to the surface/subsurface and back to the atmosphere. The techniques of quantitative estimation of these quantities at Global, regional and catchment scales using both remotely sensed data and ground based sensors would need to be taught. Quality and use of water are interrelated, therefore estimation of water quality in space and time both for surface and ground water need to be introduced at the graduate level. The ever shrinking fresh water supply because of increased population and environmental impact of development is another area which must find place in future hydrology courses.

As mentioned earlier these students shall be engaged in analysing hydrologic systems leading to estimation of design values of hydrological variables. These variables by and large are stochastic. Therefore it is necessary that stochastic treatment and analysis of these variables must be taught to the students.

The planning of new water use schemes give rise to systems which have socio-economic, environmental and technological constraints. These constraints can be handled using optimisation and simulation techniques. A thorough grounding in these techniques and formulation of these problems so that these techniques can be used to choose from viable plans is a must.

The solution of these problems require thorough knowledge of computer technology and application software. Therefore it is suggested that students must be well versed in using PCs and applications software such as spreadsheets, data base management software, and G.I.S. etc. They be introduced to existing decision support and expert systems. The development of such softwares should form part of the training of postgraduate students.

The above courses would impart the necessary background for developing new plans or managing existing water resources systems. How this knowledge can be converted to achieve the goals be taught through case studies and projects in which group of students involve themselves to develop the plans and get first hand knowledge of integrating various capabilities.

Some of these students would aspire to choose R&D careers in hydrology & Water resources. They be encouraged to take higher level courses in Stochastic Processes, Time Series Analysis and Control, Estimation Theory, Decision Support and knowledge based systems, and other new tools such as Fuzzy Sets and its application in decision making, Fractal Geometry, Neural networks etc.

The postgraduate course is usually capped with a 6 month project wherein a student is expected to choose a problem and work on it after reviewing the existing knowledge in the area. It could be a research project or development of software integrating the latest/acquired knowledge in the courses leading to integrated planning and development of water resources.

INFRASTRUCTURE REQUIREMENTS

The courses in last two paras require major investment in these institutions in computer hardware, and software for scientific decision making based on information analysis. Imageries and equipment such as Image processing system and related softwares are the other prerequisites for teaching these courses. Ministry of Human Resources Development has allocated funds to Engineering institutions in the country under thrust area project to acquire this infrastructure. A concerted effort is also needed by the Water Resources Ministries at the Centre and states in this direction to upgrate other institutions.

CONCLUSIONS

Hydrology Education goals at undergraduate and postgraduate levels in India are stated. The skills required at both the levels to achieve these goals are identified. The infrastructure requirement for implementations of these goals are also described.

REFERENCE

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