

ACADEMIA AND INDUSTRY INTERFACE FOR A GLOBALISED INDIA - NEED FOR STRENGTHENING OF OUR TECHNICAL INSTITUTIONS

By
Prof. S.K. Mazumder
Adviser, ICT & SWI Pvt. Ltd., New Delhi
(Former AICTE Emeritus Professor of Civil Engineering
Delhi College of Engineering)

INTRODUCTION

Although our country has progressed a lot after independence, of late it is noticed that many of our technical institutions which played a significant role in the development process after independence are not up to the mark compared to those in other developed countries in the world. Institutional development is closely linked with the development of a country. All institutions - academic, scientific, industrial, social, political etc. at central, state, district or panchayat levels - play a significant role in the transformation of a country to a developed nation. It is the health of the institutions in a country which primarily determine the health of a nation. While the quality of the people employed in an institution largely determines the health and status of the institution, it is the quality of education and training that a person receives in an educational institution that transforms the person to become worthy, efficient and capable to deliver the goods to the society. Quality of work, modernization, innovation and excellence can be achieved only through proper education and research. Since the author is associated with technical education, research and consultancy over the last 48 years, he will confine himself to the need for further strengthening of our institutions related technical education, research and consultancy only. Author wishes to examine the existing status of the technical institutions related to education, research and consultancy in India, analyse the various reasons for deterioration of their quality and suggest some remedial measures for strengthening these institutions.

INSTITUTIONS OFFERING TECHNICAL EDUCATION IN INDIA

Technical education in our country is offered at various levels by different categories of institutions, namely,

(i) Industrial Training Institutes (ITIs)- providing certificate type courses with the objectives of producing qualified and trained mechanics in various trades e.g. Electricians, Instrument Mechanics, Radio/Electronic/Computer Mechanics, Carpenter, Mason, Welder etc. The duration of ITI courses varies from six months to two years or more.. Usually, high school pass a students (after class -X) opt for these trade courses.

(ii) Polytechnics- providing diploma level courses with the objective of producing supervisory level technicians in various engineering disciplines e.g. civil, mechanical, electrical, electronics, computer engineering etc. Duration of the courses is 3 years after 10+2

(iii) Engineering Colleges- offering 4-year undergraduate courses with B.E./B.Tech/B.Sc (Engineering) in different disciplines e.g. Agriculture, Aeronautics, Civil, Mechanical, electrical, Metallurgy, Mining etc with the objective of producing qualified and trained engineers needed by industries, Govt. and private institutions to investigate, plan, design, construct and maintain projects financed by Govt./private/ world bodies etc.

(iv) Universities / Deemed Universities / IITs / NITs/IIESTs / Govt. & Pvt. Institutes of Higher Education in Engg. and Technology -offering both undergraduate and postgraduate courses leading to M.E./M.Tech./M.Sc. (Engg.) degrees of 2- year duration in different specialities in Civil (e.g. Structural, Environmental, Geotechnical Engg., Earth Sciences, Construction Technology, Transportation, Water Resources etc.), Mechanical (e.g.

Thermal, Fluid Power, Machine Design, Automobile, Industrial, Refrigeration & Air conditioning etc.), Electrical (e.g. Electrical Machines, Power Electronics, Power Distribution, Systems and other disciplines of Aeronautics, Agriculture, Chemical, Metallurgy, Mining etc. Facilities are available for both full time and part time study. Most of these Institutions also offer Ph.D. program of minimum 2 years duration (after Master's Degree) and 3-years duration (for graduates) - both full and part time. Post graduate and Ph.D. scholars who are full time are given monthly scholarships except those who are sponsored by their respective employers.

Since the author is associated with teaching, research and consultancy in Engineering at degree and PG levels for the last 48 years, this paper will mainly be addressed to the present status and problems of engineering institutions of category (iii) and (iv) only.

PRESENT STATUS OF TECHNICAL INSTITUTIONS AT UG & PG LEVEL

Except IITs, IESTs, IISCs & IIMs which are directly under the Ministry of HRD, all other technical institutions are under the control of AICTE. The All India Council for Technical Education (AICTE) was established by an Act of Parliament in the year 1987 with a view to promote proper planning and coordinated development of technical education system throughout the country. The AICTE promotes qualitative improvement in technical education in relation to the planned quantitative growth and regulates proper maintenance of norms and standards and matters connected therewith. The technical education covers programmes of education, research and training in Engineering & Technology, Architecture, Town Planning, Management, Pharmacy, Applied Arts and Crafts and other related areas.

Table-1 is a zone wise and state wise list giving the numbers of technical institutions (NOI) at undergraduate (UG) and post graduate (PG) level approved by AICTE, except IITs, IESTs, IISCs and IIMs which are directly under the Ministry of Human Resources & Development (MHRD). The table also gives a break up of the institutes under government/university control and private institutes. The last two columns in the table provides sanctioned intake at UG and PG level. The list includes all types of technical institutions covering various disciplines under the jurisdiction of AICTE. It may be noticed that out of a total of 1728 technical institutions, 1493 are financed by private bodies most of which are of commercial type, except a few run by philanthropic societies and missions. They charge huge sum of money for admission and annual fees apart from heavy capitation and donation. Many of these institutes do not have requisite infrastructures and adequate number of faculty and supporting staff. Unless there is a strict control, the product from most of these private institutions are bound to be substandard. Perhaps, it would have been a wise policy to upgrade the Govt. polytechnics offering diploma level technical courses. Total number of polytechnics in India, largely under Govt. control, is about 1250 with an annual intake of about 2, 65,500. Products of these polytechnics and private engineering colleges are currently being engaged by many of the private companies with poor pay and perks compared to a graduate/post graduate students coming out from IITs/IIMs/IISCs. Many of the diploma students join AMIE/Part time BE or B. Tech. courses offered in the evening. There is no practical/Design classes for AMIE students resulting in an inherent draw back in their concept and confidence which are gradually built up in steps through laboratory experiments, tutorials, design classes and project works. Engineering education, unlike arts, commerce and science, is a professional course where a lot of emphasis is to be laid on practical.

It is of utmost importance to properly regulate and control the standard of our technical institutions if we have to achieve quality and standard of the different projects. Under the university system, there is a provision for annual inspection of the institutions affiliated to it and place the report before academic council for approval. The private institutions are also affiliated to nearby universities. Such inspection team must consist of eminent persons having integrity and expertise in the subject and above all a national outlook to achieve excellence comparable to any such institution in the developed countries in the world. It is true that the large requirement of our technical manpower can not be met by the government alone. But it is to be kept in mind that substandard institutions producing substandard

products will in the long run be damaging many of the good things we are planning for our socio-economic development.

QUALITY OF INSTITUTIONS OFFERING POST GRADUATE EDUCATION

Except a few IITs (most of whose products seek job elsewhere), the faculty position and infrastructures available for teaching postgraduate courses are extremely poor and the quality of our postgraduates are not at all satisfactory. Most of our postgraduate students join the program after clearing GATE (an all India examination called Graduate Aptitude Test in Engineering), only when they do not qualify in all India examinations like IIM, IAS, IES etc. or do not get any appropriate job. Even in the prestigious institutes like IITs, post graduate students attend the classes for drawing fellowship and spend rest of the time for preparing for all India examinations or examinations like TOEFL, GRE etc for higher study abroad. Under such circumstances, the background of either undergraduate (especially those passing out from commercial type private institutions) or post graduate students are far from satisfactory. The present status of our post-graduate education in engineering and technology can be gauged from the fact that out of a sanctioned annual intake (up to 2004) of 32,752, actual intakes were about 25,000 whereas actual outturn was about 15,000 only. For private participation in funding of professional and higher education, AICTE has not only compromised with essential qualifications required for lecturers, it has allowed mushroom growth of engineering institutions all over the country which look more as teaching shops selling their degrees for commercial purpose. All the advanced countries in the world have developed professional institutions in the pattern of universities with facilities for teaching, research and consultancy. Except a few IITs, such facilities do not exist in majority of engineering institutions and the teachers are so overburdened with undergraduate teaching and other administrative and examination duties that they have hardly any time for research, development, consultancy, professional activities etc. without which no profession can ever develop. Standard of our institutions must be geared up to meet the present and future need of the country in all sector as spelt out by the government in the national policies and plans. Otherwise, the lofty ideals of development and progress will remain in the policy papers only. Are the graduates and the post graduates in engineering equipped with requisite knowledge and skill to meet the various challenges of this millennium? If not, we must ponder as to how to solve the problems to be faced by our budding engineers and technocrats in the future.

QUALITY OF RESEARCH AND CONSULTANCY INSTITUTIONS

Although a majority of our engineers are engaged in construction and manufacturing industries, research and consultancy in engineering and technology act as the nucleus around which all other activities take place for further growth and excellence. Sound knowledge, expertise in various subjects, information; initiative, leadership, design capability, perseverance and above all a spirit of creativity are essentially required for pursuing teaching, research and consultancy works. Although there are some good consultants in engineering and technology, the present status of engineering research institutions in India is not up to the mark perhaps due to the reason that this sector is largely dependent and controlled by the government. Research schemes are funded by the different ministries of the Govt. of India. Scientific and technical research works are carried out in educational institutions funded by Govt. bodies e.g. D.S.T., C.S.I.R., U.G.C. A.I.C.T.E etc. Applied and fundamental research are carried out at ISRO, BARC, CSIR, CWPRS, CBRI, CMERI, CSMRS, CAZRI, DRDO, IARI, DRDO, IARI, and numerous other Govt. research institutions. Unlike Japan where 95% of research funding comes from industries, almost 99% of research funding is done by the Government in India.

Many of the current problems confronting our country could be solved or at least minimized through demand driven research and its application in design and field application through consultancy. Basic and fundamental research carried out in our educational institutions.

Many of the current problems confronting our country could be solved or at least minimized through demand driven research and its application in design and field application through

Table-1- Number of Institutions (NOI) and Intake in Engineering (UG & PG)

Region	State/Union Territory	ENGINEERING						
		NOI			NOI		Intake	
		UG	PG	Total	Govt./ Univ.	Private	UG	PG
Central	1. Madhya Pradesh	69	19	88	13	75	20,210	1,897
	2. Chhattisgarh	23	2	25	6	19	4,020	54
	3. Gujarat	24	9	33	8	25	12,965	1,291
	Total ----->	116	30	146	27	119	37,195	3,242
Eastern	1. Mizoram	1	0	1	1	0	120	0
	2. Sikkim	0	1	1	1	0	525	18
	3. West Bengal	39	13	52	19	33	15,477	1,300
	4. Tripura	1	1	2	1	1	180	54
	5. Meghalaya	1	0	1	0	1	240	0
	6. Arunachal Pradesh	1	1	2	1	1	210	54
	7. Andaman & Nicobar	0	0	0	0	0	0	0
	8. Assam	3	7	10	3	7	750	365
	9. Manipur	1	0	1	1	0	115	0
	10. Nagaland	0	0	0	0	0	0	0
	11. Orissa	32	11	43	2	41	13,014	729
	12. Jharkhand	10	4	14	4	10	3,385	537
	Total ----->	89	38	127	33	94	34,016	3,057
North	1. Bihar	7	4	11	3	8	1,905	528
	2. Uttar Pradesh	81	21	102	13	89	28,953	1,769
	3. Uttranchal	11	2	13	5	8	1,440	627
	Total ----->	99	27	126	21	105	32,298	2,924
North-West	1. Chandigarh	4	3	7	5	2	800	443
	2. Haryana	39	11	50	9	41	12,785	631
	3. Himachal Pradesh	5	1	6	2	4	1,260	73
	4. Jammu & Kashmir	8	1	9	2	7	1,545	36
	5. New Delhi	11	7	18	6	12	4,330	783
	6. Punjab	41	11	52	11	41	4,880	942
	7. Rajasthan	38	6	44	9	35	15,045	704
	Total ----->	146	40	186	44	142	40,645	3,612
South	1. Andhra Pradesh	236	44	280	3	277	82,970	4,216
	2. Pondicherry	6	2	8	1	7	2,370	137
	3. Tamil Nadu	300	92	392	20	372	80,417	7,126
	Total ----->	542	138	680	24	656	165,757	11,479
South-West	1. Karnataka	111	42	153	19	134	46,375	3,188
	2. Kerala	89	11	100	40	60	24,413	1,080
	Total ----->	200	53	253	59	194	70,788	4,268
West	1. Maharashtra	149	57	206	26	180	48,250	4,116
	2. Goa	2	2	4	1	3	740	54
	3. Daman & Dadar, N.H.	0	0	0	0	0	0	0
	Total ----->	151	59	210	27	183	48,990	4,170
	Grand Total ----->	1,343	385	1,728	235	1,493	429,689	32,752

consultancy. Basic and fundamental research carried out in our educational institutions mostly end in publication of papers in journals and conferences without much application. Except a few central govt. research institutions, most of the Govt. controlled research institutes are in miserable condition since these institutes appoint scientists/engineers/technologists from the Govt. cadre irrespective of whether they have adequate knowledge and aptitude in research. There is no proper scheme to improve and update their knowledge after their recruitment

Unlike construction activity, research engineers have no extra income for their devotion and knowledge and most of the Govt. engineers/scientists/technocrats posted in such research institutes often consider their transfer there as punishment posting. There is hardly any freedom and recognition of their work. As a result, meritorious persons feel frustrated and go abroad for better pay, perks, freedom of work and recognition they really deserve. After the independence, Indian institutions were headed by persons of high integrity and character with a sincere desire to develop and excel. To day many of these institutions are being headed by persons with political support or favor from top influential persons irrespective of their merit and contributions to their respective disciplines. Since the topmost and meritorious brains who are really worthy and capable are leaving the country, it is only the mediocre and residues who are manning such institutions. The quality of research and consultancy are largely dependent on the quality and capability of the person heading the institution. A mediocre or political person will always like to be surrounded by similar kind of persons resulting in gradual deterioration in the standards and reputation of the institution. Present status of research in engineering and technology in a vast country like India can be assessed from the fact the annual out turn of PhDs in engineering has decreased from 506 in 1979 to 374 in 1996 (AICTE-1999).

Proper research infrastructures and congenial environment do not exist in most of the research institutes in India. Research must have strong linkages with industry and social requirements. Since university professors and the research scholars working under the professors comprise an enormous pool of expertise and resources, appropriate link must be built up between the universities, the public and the private sector institutions dealing with real life problems. University curricula also must be upgraded to cover the emerging areas in science and technology (Madramootoo, 2000).

Scope of consultancy services are steadily increasing in our country due to the govt. policy of decentralization and private sector participation. The number of consultants in the different disciplines in engineering and technology are steadily increasing day by day due to the government decision to improve upon infrastructures. However, the quality of many of the Indian consultancy companies is not yet very satisfactory. The future of consultancy organizations depend on increasing use of information technology through internet, intranet, VSATS and improvement in their design capability by use of latest software, strengthening R&D base, organizing in house and external training program, quality improvement through continuing education of their engineers for updating knowledge as well as development of business and managerial skill. Analysis and conversion of information into efficient and economic designs will be a key element for their success in future. If commercial advantage and maneuvering become the sole criteria of our consultants, the future of our consultancy service is not encouraging, especially under the increasing trend of globalization.

NEED FOR INTER-INSTITUTE COLLABORATION

Inter-Institute collaboration between academic institutions and industries is vitally needed for improving the standard of both the educational institutions imparting knowledge and the practicing institutions making use of the knowledge.(Chakraborty, 1999). This can be achieved through exchange of faculties, supporting research funding and performing research and consultancies jointly, exchange of knowledge, information and experience, participation in workshops and conferences organized jointly on focused topics; offering short term refresher type courses jointly with faculty drawn from both academic institution and industries, organizing training / orientation program on selected topics of interest with faculties drawn

from field organizations as well as educational and research institutions; taking active role in strengthening professional societies; reading journals and contributing papers in the technical journals; writing text books / handbooks jointly; participating in the preparation of codes, manuals and guidelines etc. Since the process of any development is closely related to financial, socio-economic, environmental and legal issues, inter-institute collaboration should be limited not only between educational, research and practicing institutions, it should also involve other stake holders' e.g. Ministries and the different institutions under it, the universities, NGOs etc. at national, state, district and panchayat levels.

Engineering and Technology is a continuum of education, research and professional activities. Successful planning, economic design and effective implementation of projects require highest degree of co-ordination amongst the various agencies involved both at macro and micro levels. The advent of high speed computers, development of electronic instrumentation, communication, computational techniques, physical and numerical modeling techniques, remote sensing, ANN and GIS application etc. have opened up great promise for application of modern technology in solving intricate problems in a project. It is unfortunate that the research and development in our country is generally confined to a narrow circle of academicians and end in conference or journal papers or reports with very little field application. The main challenge of transfer of such R&D from laboratories to field lies in organizing, implementing and directing the efforts in a well coordinated manner and using them in the preparation of plans and programs for sustainable development in an environmentally friendly manner. Performance of many of the projects in our country. are not up to the mark because of lack of such collaborative and well coordinated efforts. Collaboration Strategies and Weaknesses of Consultancy Organizations in India have been discussed elsewhere (Diwan, 1999)

Because of the very nature of day to day work and type of duties performed, a field engineer can not keep himself abreast with the latest academic development, except a few with an academic bent of mind in the planning, design or research. Similarly, an academic person has very little opportunity to gather field information, field data and the field problems, although he may be equipped with the latest mathematical tools and computational techniques. Inter-Institute collaboration between field organizations and educational institutions will help in pulling the resources together for the most economic, efficient and time bound solution of the problems being faced in the different aspects of planning, design, execution, operation and maintenance of projects.(Mazumder,2007).Such collaboration eventually helps in development of innovative methods, new technology, new software helping further growth of profession for the national development. All the collaborating institutions get enriched and attain a new height to face any challenge posed by the government and the society. Details of such collaboration between educational and practicing institutions in teaching, research, project and consultancy works, laboratory and curriculum developments, in organizing refresher courses etc. have been discussed in an earlier paper by the author (Mazumder-1999). Many of the challenges to be faced by the country in the millennium can be solved only through developing and improving the status of our institutions in the country - educational, research, consultancy, public and private institutions and their collaborative efforts. We are in utter need of more IIT/IIM/IISC all over the country with more autonomy and eminent persons with national outlook as their heads. One of the fundamental reasons why China is developing so fast is that they have developed chains of such institutions through out the country bringing the topmost Chinese brains from USA and other developed countries to head the institutions offering lucrative pay and perks.

ROLE OF AICTE TO STRENGTHEN INDUSTRY-INSTITUTE COLLABORATION FOR FURTHER DEVELOPMENT OF TECHNICAL INSTITUTIONS IN INDIA

Considering the challenges to be faced by the engineers in tackling problems in the different aspects of our socio-economic development in a sustainable and environmental friendly manner, as stated under national planning policy documents, it is of utmost importance to improve the quality of our scientists, engineers and technicians who have to be equipped

with wide technical knowledge based systems integrated with work experience, creative skill and dexterity in tune with the changing socio-economic and technological scenario in the fast changing world with global competition.. Unfortunately, due to the extreme shortage of qualified faculty and infrastructures as well as lack of motivation of students, many of our engineering graduates and post graduates coming out from most of the technical institutions (except IITs and a few such institutes of repute) are substandard. It will be desirable to run the graduate and postgraduate programs in collaboration with organizations dealing with the subject. Teachers without proper exposure to the real life problems are often found to be ineffective.

AICTE is well aware of this problem. It has already introduced several schemes like 'distinguished professor' wherein learned experts from field organizations and research/consultancy institutions are invited to join educational institutions to carry out teaching/research/laboratory and curriculum development. Institutions offering post graduate program must take up sponsored research program and consultancy works. The 'distinguished professors' can be of great help in bringing funds to the institutes for research and consultancy and sharing their experience to make them successful. Senior research scholars appointed in such schemes can also help in teaching theory, practical and tutorial classes. Such practice is prevalent in the developed countries like Europe, USA, and Canada etc where a large number of teaching and research assistants (at master's, doctoral and post doctoral levels) help the department and their supervisors in the conduct of theory, tutorial and laboratory classes. Under the guidance of their respective supervisors who bring funds for the project, post graduate students also carry out the jobs related to the sponsored research and consultancy works - a part or all of which may be included in their dissertations- both in MS and Ph.D. program. It is principally due to the contributions made by the young and energetic scholars that the department progresses and the laboratories develop. It also helps in creating manpower required for teaching, research, consultancy etc. AICTE provides financial assistance under various schemes of Modernization and Removal of Obsolescence (MODROBS), and Research Promotion Schemes (RPS) in the field of Technical Education D through the Bureau of Research and Institutional Development (RID). To ensure effective implementation of these schemes, the Council has setup a high-powered Board of Research and Institutional Development (BORID) comprising of eminent scientists, engineers, academicians, industrialists and technologists.

A major problem being faced by our educational institutions today is how to attract and retain qualified and meritorious persons in the teaching profession. A large number of such persons leave the country for higher education abroad, for better pay and perks, congenial environment for research, freedom of work and recognition for their achievements. Presently, highest priority of the meritorious students in India is administrative jobs (like IAS, IFS, and IRS.), software, management, banking and marketing jobs and then government and private jobs. Post graduate study or teaching is the last priority. If this situation continues, our technical institutions have no future and we are going to be dependent on foreign institutions for higher education and research. We had our political independence after 200 years of fight with British colonial power, but we will be again dependent on them and other advanced countries in regard to our scientific and technological development unless our educational institutions strive to acquire the standard of those advanced countries.

In order to overcome the shortage of qualified, experienced and dedicated faculty for promoting higher education and research in engineering, AICTE has introduced several schemes like 'Distinguished professorship', EFIP (Early Faculty Induction Program), QIP (Quality Improvement Program), Research promotion scheme(RPS) etc. One of such schemes proposed by AICTE is 'Co-Operative Education'. Under this scheme, the material and human resources of the relevant industries and the educational institutions need to be integrated and optimally utilized for the ultimate development of human resources and to meet the need of trained manpower for both the industries and the academic institutes with adequate investments. People will be employed and will be allowed to have further education at their respective workplaces and it is expected that some of the motivated persons from

industries, especially those who are retired or seek voluntary retirement and wish to contribute for the development of education in the areas of their expertise, will be available for teaching. For the last 60 years, educational institutions have supplied the required manpower for the growth and development of the practicing institutions in engineering. Now it is the turn of the industries to help the educational institutions to supply manpower for further growth and development of technical institutions. Worthy and competent people from practicing institutions with academic zeal (as evinced from their publications and contributions towards the professional growth) should look back to their alma maters and provide required inputs for achieving excellence of the technical institutions in India..

SUGGESTED CHANGES IN TECHNICAL EDUCATION PROGRAM

Because of the failure of our post graduate educational program to meet the objective of supplying qualified hands needed by the industry, it may be wise to replace the present conventional undergraduate course in engineering by 4-years undergraduate courses or 5-year integrated postgraduate courses in different disciplines. For example, the current 4-year undergraduate program in civil engineering may be replaced by (i) Civil Engineering materials & construction (ii) Environmental engineering (iii) Geotechnical Engineering (iv) Structural Engineering (v) Transportation Engineering (vi) Water Resources Engineering etc. It is not necessary that all the colleges shall offer all the proposed undergraduate /postgraduate courses. The courses to be run by an institute will depend on available faculty and local requirement. However, if the present 4-year conventional degree program in engineering is to be replaced by specialized courses, as mentioned as an example, manpower requirement in the different disciplines in different branches of engineering & technology must be forecast and the number of seats have to be decided on the basis of manpower planning as per forecast. As in arts, science and commerce courses, we may also consider introducing honors courses in engineering & technology in the different disciplines in engineering (as in post graduate courses) for those with merit and aptitude for higher education and research.

REFERENCES

1. AICTE (1999), "Technical Education in India: 1947-1997", Prepared and Edited by Educational Consultants India Ltd., New Delhi
2. Chakraborty, S.S. (1999) "Identification of need and Areas of Inter-Institute Collaboration for Water Resources and Environmental Engineering Project" Proc. Workshop on Challenges in the Management of Water Resources and Environment in the Next Millennium- Need for Inter- Institute Collaboration" org. by Deptt. Of Civil Engg., Delhi College of Engg., ISH and IWRS, Oct. 8-9, Touchstone Publisher, Ansari Road, Daryaganj, New Delhi.
3. Diwan, P. L. (1999), "Collaboration Strategies and Weaknesses of Consultancy Organizations in India" Proc. Workshop org. by Deptt. Of Civil Engg., Delhi College of Engg., ISH and IWRS, Oct. 8-9, Touchstone Publisher, Ansari Road,, New Delhi.
4. Mazumder, S.K. (1999) "Inter- Institute Collaboration for Strengthening Water Resources and Environmental engineering Profession", Proc. Workshop org. by Deptt. Of Civil Engg., Delhi College of Engg., ISH and IWRS, Oct. 8-9, Touchstone Publisher, Ansari Road, Daryaganj, New Delhi.
5. Mazumder, S.K. (2007), "Need for Inter-Institute Collaboration for strengthening Civil Engineering Profession in the Area of Water Resources" key- Note paper presented in the International Conference "Civil Engineering in the New Millennium-Opportunities and Challenges - CENeM2007" organized by the Dept. Of Civil Engineering, BESU (formerly BE College) on the occasion of 150th year Celebration during Jan. 11-14.
6. Madramootoo (2000) "Improving Research and Training in the Water Sector" 8th ICID International Drainage Workshop, Jan 31st -Feb-4th ICID, New Delhi.