Pulp and paper education-A review of inputs

RAO, N. J.*

Indian paper industry has come a long way since the first mill was established in 1812 at Serampore near Calcutta. Today we have an installed capacity of 1.95 million tonnes of paper and paper-board and our capacity utilisation is 72% in large mills and is 58% in smaller units. We plan to raise our per capital consumption of from the present 2.0 Kg to about 4.5 Kg by the year 2000. This calls for an installed capacity in the neighbourhood of 4.25 million tons.

Many short comings indicated for low capacity utilization include shortages in fibrous raw materials; shortages in coal and chemicals, and shortages in fresh water supply, poor maintenance and house keeping, power cuts, absence of preventive maintenance programmes, obsolete plant and equipment, inadequate financial inputs for renovation, modernisation and reconstruction, absence of investment in replacement of worn out parts and inefficient equipments and not keeping abreast with technological development besides strained labour-management relationships. All these indicate that the 3 M's namely Material, Money and Manpower need to be augmented to a very large extent. Efficient and proper utilization of material and money will come only from a competent manpower base. It is to be noted with concern that investments in the sector relating to manpower planning and training has been grossly neglected over the decades. The Indian Pulp and Paper Industry on its part did not give it proper weightage. A strong technical manpower base with access to modern technology would have provided a platform for meeting the various external challenges confronting the industry. There is an urgent necessity to take a closer look at this vital sector for the very survival of paper industry in the decades ahead.

The teaching and training programmes in any discipline are ment to create a cadre of persons to meet the various tasks requirements in different spheres of activity. Pulp and Paper Industry is a very specialised sector of activity demanding people with many special skills and talents. Limiting ourselves to the production and related activities the work force available should meet the four basic areas of work. These are as under :

1) Shop floor operator levels with necessary skills,
2) Shop-floor supervisory level with some exposure to the technology and practices,
3) Cadres to meet the requirements of R & D, teaching and training and developmental activities including senior positions in manufacture requiring a good engineering and technological base.
4) Personnel who can design, plan, fabricate, erect and trouble shoot activities. These are personnel with good technical exposure and good specialised experience.

The 30 year experience indicates that we have catered to the first two groups fairly well. The last two groups are neglected so far.

Eversince civilisation came in and necessity for records occured, man started using leaves and bank for writing. Hindus are on record to be making thin fine glazed sheet from cotton wool way back in 327 B.C., the time of Alexander the great. Handmade paper was a household tradition for centuries. Practical training must have started first time after the first pulp and paper mill came up at Serampore in 1812. Records indicate some formal training was introduced in India by M/s. Titaghur Paper Mills and M/s. India Paper and Pulp Company at Naihati around 1930. All of us are aware of the spectacular growth of the Indian Paper Industry since then and the establishment of Forest Research Institute at Dehradun in 1906. The development of regular class room teaching and training started at FRI around 1957.

The Institute of Paper Technology meant exclusively for teaching and training started functioning since 1964 as a result of agreement between government of India and Royal Swedish government. The initial Scientific and technical equipment was provided by the Swedish International Development Authority. The Institute trained people in

*Professor in Chemical Engineering and Director
Institute of Paper Technology (UOR).
Saharanpur-247001 (U.P.)

this specialised area at the level of operators and middle level supervisors by offering a 3-year post matric certificate and a 2-year post B.Sc. diploma courses. These courses have served the industry well and provided a dependable production oriented manpower for the growing industry. The institute was merged with Roorkee University in 1978 and the first 4-year engineering degree course in Pulp and Paper was started the same year. Plans are under way to start masters degree programmes, condensed courses and other continuing education programmes. The analysis given in this paper are based on these experiences.

Pulp and Paper Technology is a highly specialised professional area. It is interdisciplinary in nature and the industry is a process industry demanding lot of inputs based on plant practices. High cost of equipments, difficulty in maintaining them, due to paucity of funds effected the training, High calibre talented staff is required for teaching and they are under a constant pull from industry due to better working conditions. These have been continuously posing problems in maintaining high academic standards in teaching and traning. This can be sorted out by a pragmatic look at the functioning at the teaching institutions, making them more independent and flexible, providing heavier funding and improved working conditions and above all a close industry institutional interaction for efficient transfer of knowledge for the younger upcoming manpower.

LEVELS OF EDUCATION AND TRAINING :

The level of technical education in any discipline including pulp and paper can be divided into six categories as under :

- —Post high school programmes
- —Post B.Sc. programmes
- —First degree level programmes in Engineering Pulp and Paper
- —Master of Engineering programmes
- —Research programmes.
- —Continuing education programmes including sandwitch course, refresher courses etc.

The first three can be considered as basic formal programmes and the last three can be considered as advanced level programmes. Let us analyse the structure of these pragrammes as prevalent.

POST HIGH SCHOOL PROGRAMMES :

These are similar to polytechnic diplomas and are usually of 3-years duration. The earstwhile Certificate Course of IPT was a similar programme and the persons trained are capable of taking shopfloor jobs as operators. The course lays a great stress on elementery pulp, paper and recovery subjects, besides engineering and sciences. There is invariably one years practical training in a mill to give first hand operational experience of the shopfloor and make the trainee realise the hard facts of plant operation.

The programmes are meant to train people at the first level for process industry. The courses did not prove a success due to insufficient technical base, weak academic training and job aspirations of the trainees which did not match with what industry was offering. The success of this course will depend on the three components namely, good laboratory facilities, competent teaching staff and industry acceptance of the product. Being highly professional, to create good laboratory facilities or to have competent staff is going to be very difficult.

One alternative to the present system, seems to be to take well trained diploma/ITI students in such disciplines as Chemical and Mechanical Engineering and provide a 6-month crash course on pulp and paper technology in an institution with sufficient infrastructural facilities. This can be followed by a dose of 6 months shop.floor training. This should work well for mill sponsored nominees and should give a greater flexibility and depth from both the utility and aspirational angles. New institutions can plan such courses carefully.

There are some institutions in the country which are running or planning to run 3 to 4 year courses after high school where a B. Sc. type degree is awarded. These courses lack the engineering inputs and they need a closer look as to the contents and industry acceptability.

POST B.SC. COURSES :

The Institute of paper Techuology has been running such courses for over last 15 years and awarding diploma (now University Diploma) in Pulp and Paper. These two year programmes with technology base have been quite popular at the middle level supervisory positions. The admission to these courses has possibilities to take mill sponsored candidates satisfying the admission requirements. The course inputs have a good stress on pulp and paper technology. But the stress on engineering and design aspects is weak. The analysis indicate that to make the diploma holders on par with engineering degree holders will need academic inputs for about 18 months mostly in engineering subjects. One aspect which needs consideration is the possibility to bring this course

on a national Pattern. The views of all concerned in this regard can help in arriving at any decision.

FIRST DEGREE LEVEL ENGINEERING TEACHING :

This 4-year programme is now on for nearly 6 years old and 2 batches of engineering gradutes have entered the professional field. The feedback so far received on this programme is good. The curriculum for the programme has been formed on the basis of the experiences in teaching the first degree course in Chemical Engineering on one hand and the post B. Sc. diploma level courses on the other. The graduater should be able to face the problems of process industry with confidence.

The course lays emphasis on the fundamental subjects like stoichiometry, thermodynamics, unit operations, reaction engineering. The Problem solving approach is adopted to provide a thinking base to the students. Compulsory courses on instrumentation and process control are provided. Design courses from a good percentage of the inputs. A large stress is given on courses related to pulp, paper, recovery and pollution. Basic sciences have a strong weightage. The balance between practicals and class room lectures is maintained.

COMPARISON OF BASIC FORMAL PROGRAMMES :

Post matric and post B.Sc. courses have 24 units of teaching in semesters of about 15-16 weeks each (100 working days). The corresponding figures in first engineering degree teaching is about 50 units in 8 semesters. The formulation of various courses is a balance between the available time span, entry level of the student, the expectation from output product, emphasis on core, relative weights of theory and practice, flexibility for adopting to varying industrial environs. The normal weekly teacher student contact is maintained between 30-35 hours. The emphasis on all the corriculum is to help student develop the skills to operate, analyse and develop innovative habits.

A comparision of the various inputs in post matric, post B.Sc. and first degree level courses in engineering in Pulp and Paper is given in Table-1. The relative weights, contact hours in lectures/ tutorials and practical is given in this table. This will clearly indicate the trend in each course. The table is based on experiences at IPT, Saharanpur in last couple of years.

The total contact hour in B.E./Post B.Sc. Diploma/and post matric Certificate courses during the entire course are respectively 3997, 2105 and 2100 hours. The relative weightages of the times spent in class room for theory and tutorial classes on one hand and practicals on the other are 57.4% and 43.6%, 52.7% and 47.3% : and 63.1% and 36.9% respectively. This might give a feeling that the engineering degree courses are week in practical content. This is far from true. The total time spent in practicals during the entire course is about 1477 hours for engineering degree course against 995 hourse for post B.Sc. diploma and 915 for the post high school certificate course.

The degree students spend a significant proportion of their time in studying Chemical and mechanical engineering subjects 945 hours) Humanities and Social Seiences (285 hours), Basic Sciences (155 hours). These inputs are significantly different from post B.Sc. diploma input. Similarly the stress of design courses, economics and projects make engineering degree students to take up such jobs relating to R & D, project planning, engineering designs after suitable experience. The weightage in pulp, paper and recovery subjects is 1012, 975 and 630 hours in degree. post B.Sc. diploma and post high school certificate course.

In all the programmes a direction is given to provide the trainees to acquire practical information on plant practices. This is achieved through mill training during the course and summer mill training and active industry-institutional interaction. The total time spent in degree and post B.Sc. diploma courses in practical training is around 90 hours during the course and 6-weeks training during summer.

Another camparision in terms of Unit Weights in various courses is given in table-2. The diploma course has about 45.8% weight in pulp, paper, recovery subjects against 23 2% in B.E and 29.1% in Certificate making it a technology type course. In B, E., the inputs in Mechanical and Chemical Engineering is about 24.2%.

MODEL B. E. PROGRAMME :

A recent model curriculum for 4-year degree course in engieering published by Ministry of Education suggests that the curriculum has two main objectives as under :

(1) Preparation of a student for technical and analytical skills that he will require as a professional manager.

(2) To equip the student with adequate background of humanities in social sciences that may enable him to play an effective role of an engineering for the benefit of society.

Accordingly they suggest a model programme containing 55-65% lecture tutorial load and 45-35% practical load with about $5\frac{1}{2}$ to $6\frac{1}{2}$ units per semester. They further suggest the weightage for

TABLE—1 COMPARISION OF TIME SPENT ON VARIOUS ACADEMIC INPUTS IN 4-YEAR B. E., 2-YEAR POST B.Sc. UNIVERSITY DIPLOMA AND 3-YEAR POST-HIGH SCHOOL CERTIFICATE PROGRAMME IN PULP AND PAPER.

INPUT COMPONENT	B.E. DEGREE				University Diploma				Certificate[3]			
	Unit	Total hours of Contact			Unit	TOTAL hours of Contact			Unit	TOTAL hours of Contact		
		Lectures +Tutorials	Practicals	Total		Lectures +Tutorials	Practicals	Total		Lectures +Tutorials	Practicals	Total
Sciences	10.5	675	180	855	—	—	—	—	65	405	180	585
Humanities	3.5	285	—	285	1.5	120	—	120	1.5	135	—	135
Workshop/Drawing	3	30	240	270	2.5	45	180	225	3	45	2_0	255
Mechanical/Chemical Engineering	12	660	285	945	5	330	90	420	3	195	45	240
Electrical/ Instrumentation	3	90	75	165	2	90	90	180	2	90	75	165
Pulp/Paper/Recovery	11.5	675	337	1012	11	525	450	975	7	315	315	630
Mill Training/ Seminar	1	—	90	90	1	—	90	90	1	—	90	90
Management/ Economics	1.5	105	—	105	—	—	—	—	—	—	—	—
Project	3.5	—	270	270	1	—	75	75	—	—	—	—
TOTAL	49.5	2520	1477	3997	24	1110	995	2105	24	1185	915	2100
Relative %	—	63.1	36.9			52.7	47.3			57.4	43.6	

No. of Hours Lecture/Tutorial/Practical	1665/855/1477	705/405/995	780/405/915
Relative contact % Lecture/Tutorial/Practical	41.7%21.4/36.9	33.5/19.2/47.3	37.1/19.3/43.6

One year compulsory mill training.

TABLE—2 COMPARISION OF UNIT WEIGHTS OF VARIOUS ACADEMIC INPUTS 4-YEAR BACHELOR OF ENGINEERING, 2-YEAR POST B. Sc. UNIVERSITY DIPLOMA AND 3-YEAR POST HIGH-SCHOOL CERTIFICATE PROGRAMMES IN PULP AND PAPER.

INPUT COMPONENT	B. E. PROGRAMME		UNIVERSITY DIPLOMA		CERTIFICATE	
	UNITS	% WEIGHT	UNITS	%WEIGHT	UNITS	%WEIGHT
Sciences	10.5	21-21	—	—	6.5	27.08
Hnmanities	3.5	7.07	1.5	6.25	1.5	6.25
Workshop/Drawing	3	6.06	2.5	10.43	3.0	12.50
Mechanical/Chemical Engineering	12	24.24	5	20.84	3	12.50
Electrical/ Instrumentation	3	6.06	2	8.33	2	8.33
Pulp/Paper/Recovery	11.5	23.24	11	45.83	7	29.18
Mill Training/Seminar	1.0	2.02	1	4.16	1	4.16
Management/Economics	1.5	3.03	—	—	—	—
Project	3.5	7.07	1	4.16	—	—
	49.5	100.00	24	100.00	24	100.00

various major areas as given in table–3. Further in a week more than 50% time should not beallo-ted lecture and a minimum contact time of 3% for practicals and minimum 10% for tutorials should be allotted. Further practicals and tutorials should occupy 40-50% of the total alloted time.

A comparision of the B. E. programme in Pulp and paper at IPT matches very well with the model curriculum including the core subjects as suggested by Ministry of Education. Further the Pulp and Paper degree course in content has about 65% in common with Chemical Engineering and about 25% weightage in pulp and paper subjects. This gives the students a great flexibility in adopting themseves to a specific process industry namely pulp and paper. These contents need a continuous evaluation as there can be no set pattern for any engineering discipline which fits into the environmental needs without change.

PRACTICAL TRAINING :

Pulp and paper Course is a highly professional course with direct application. The success of the curriculum and effectiveness of education can be gauged by the amount of practical knowledge being imparted in the class rooms and the degree of acceptability of the product by the industry. For this reason a regular mill training of 1-unit is introduced durind the semester both for degree and diploma students. This is supplemented by summer mill training and factory visits. The situation in this regard can improve by the following measures:

— Direct involvement of persons from paper industry in teaching at the institute for periods beyond 3 months to bring in the proctical shop floor information into the class room.

— By arranged lectures/extramural lectures on topics of interest by eminent people from industry of short duration.

— Well planned integrated mill training programmes with supervision and monitoring. This will have to be under the direct supervision of mill personnel.

TABLE- 3

INPUTS IN A MODEL 4-YEAR ENGINEERING DEGREE PROGRAMME

INPUT COMPONENT	UNITS RANGE	WEIGHTAGE RANGE %
Humanities and Social Sciences	3—6	5—10
Sciences	7—12	15—25
Engineering Science and Technical Art (including necessarily drawing, workshop, Mechanics, Electrical Engineering, Thermodynamics and heat transfer, Material Science and Instrumentation)	8—12	15—25
Professional Subjects	—	45—65
Electives	—	10
Total Units (excluding 3 units of final project)	41—45	

— Partcipation of teaching faculty and students in solving industry problems.
— Greater thrust on research.

MASTER OF ENGINEERING PROGRAMMES :

There is a need to start post graduate studies in pulp and paper to provide personnel with advanced level of information to tackle the technological problems facing the industry. This is also needed to keep the faculty at such levels that they are abreast with latest development. Master degree course is the first pre-requisite of a good R and D base. The course must include such newer areas like bioconversion, enzymatic pulping, non-wood fibre pulping, energy conservation, membrance technology, new separation processes, pollution abatement, simulation, and optimisation. The programme has to be of 18 months duration with a final thesis There is a need to open such programme to graduates in chemical and mechanical engineering besides the pulp and paper engineers. Accordingly a suitable core with a list of electives should be offered to provide flexibility. Also there is a need to have a possibility of having some students specialise on technology and practice while others can specialise in design and development. The success of such a programme will depend on the industry's willingness to accept the product and give them the responsibility of tackling the immediate and anticipated technological problems The courses must have a dose of practical information either in form of mill based projects or practice school based study.

RESEARCH PROGRAMMES :

A strong faculty comes from continuous research in areas of relevance. The R and D base of nation depends on such efforts. The interdisciplinary character of a process industry demands inter disciplinary approach to research problems. This alone will create a base from where the war on technological obsolence can be fought. A strong research atmosphere will provide a good teaching environ. IPT is trying to create this environment by taking up basic and applied research for the award of Ph.D. degrees. The sustained research work needs a goods input to develop the facilities in the laboratories and a first rate library and documentation centre besides a computer centre. These are requirements which will boost the potential to do better quality work. Hence funds are required both from government and private agencies for taking up basic and sponsored research, creating the infrastructural facilities. A strong research team gives the guarantee of an excellent under-graduate teaching.

CONTINUING EDUCATION PROGRAMMES :

In this advanced technological age knowledge is ever expanding. People will find it difficult to keep pace with this progress. Continuing education programmes for practicing professionals is an important step in maintaining competence at the highest levels and in ensuring that technological obsolescence does not over take us. Continuing programmes will improve the quality of the teachers. Well framed short term courses and advanced appreciation courses on specific subjects with intensive depth can be planned. Infact IPT has been in this area and has run a few courses in the past with active co-operation of Industry and research establishment with those in teaching faculty. These short term courses can be from one to four weeks duration and can be arranged at the teaching Institute or in the industry centre or in a metropolis.

Similarly some short term courses can be run as one, two or three day workshops, seminars for the benefit of professional community. These technical sessions will provide brain storming sessions on topics of current interest and will help generate the much needed dynamism for the change. Professional bodies like IPPTA, and academic research institutions can play a leading part in this aspect.

Another form of Continuing Education Programme is the Condensed and Sandwitch courses of terms varying from one month to one year.

These programmes will provide indepth study in specific areas with time for problem solving, tackling designs or conducting practicals. These type of programmes will be popular till we establish a strong base of people with high academic and research excellence. People with different backgrounds can take part and give a new dimension to multidisciplinary nature of pulp and paper industry.

CONTINUING EVALUATION SYSTEM :

Any student undergoing a professional course needs monitering and evaluation. Continuing evaluation is a necessary step. The evaluation schemes include periodic class room and home-assignments, class tests and quizes and viva voces, seminars and presentations, project report preparation besides the technical semester examinations. Continuous evaluation and feed back helps the student in knowing his weaknesses in time and setting himself back on the right track. The programmes must help in all round personality development of students. This is where some stress is necessary in monitoring the student beyond the class room and help him acquiring the traits of community living, skills in games and sports, leadership ability, develop human relations and fellow-feeling and ability to express himself. Thus a lot of stress is laid on such activities as games and sports, literary and cultural activities, N.C.C., N.S.S., self management. and hobbies by giving some weightage to items like proficiency and discipline. These evaluation techniques have been proving to be very useful.

Since the curriculum determines the specific actions and quality of the end product, namely the out going student, hence the user must evaluate the curriculum and the product and suggest modifications. This dialogue should be continuous to give a properly controlled end product attuned the industrial atmosphere and type of work to be handled Thus involvement of external examiners in paper setting and evaluation, setting project papers and evaluating project reports and conduct of vivo-examinations is necessary. This interaction will provide opportunity to user community to critically examine the system at work. Further their involvement in academic bodies like board of studies and academic council will help formulating the schemes of teaching and detailed syllabil which contain the changes required. This interaction has to be continuous. These evaluation technique will help in monitoring the leader performance, and help the teacher in attaining greater excellance. One method of providing encouragement is the institution of large a number of scholarships and prizes and medals. Teachers must also get opportunity to spend extended terms in industrial atmosphere in seeing, understanding and solving industrial problems. This will help evaluating himself and improving himself.

Success of any teaching programme lies in the sincerety and hard work of teacher and student alike. This is helped by proper monitoring and evaluation mechanising. Excellence in persuit of teaching and research will be the guarantee of a successful industrial activity.

The academic institution must provide an enviornment for growth and stability of teaching inputs. The teaching community must be provided neeessary pay scales and parks such that persons with excellence are attracted to this profession. In this aspect the industry can provide support. Similarly institutions need input for excellent laboratory and equipment facility. The inputs must be provided to maintain high standard of teaching. It is hoped that all concerned namely the teaching institutions, government and industry will rise to the occassion, do their bit, create a strong educational base for the benefit of all.