WITH THE BEST COMPLIMENTS

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T E C H N I C A L E D U C A T I O N

I N I N D I A

A SURVEY

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PRESENT POSITION AND FUTURE NEEDS

TECHNICAL EDUCATION IN INDIA

A SURVEY OF PRESENT POSITION AND FUTURE NEEDS

Technical Education has to respond continually to both socio-economic changes and scientific and technological advance. Ideas, beliefs and values change; the faster the change, the more interesting the picture. Problems tend to become diverse as achievements become impressive.

In all industrially advanced countries Technical Education has received much attention not only because of its immediate utility in securing economic prosperity for the people, but because of its long-range relationship to social order. As the application of science & technology to industry, agriculture, transport and communications, public health and other activities becomes wider and more intensive, the need for engineers, technologists and technicians of various kinds increases. The provision for technical education becomes the mainspring of all these activities. The engineer is a responsible professional man, whose every professional act has human and social consequences. Whether he is aware of this or not, he is instrumental in the creation of a new society and a new economic order, as well as a new physical environment. One result of his professional accomplishments is that he is called upon to accept an increasingly responsible role as leader of his community. To fulfil his growing responsibilities, he needs depth, flexibility and a capacity for growth in directions which we ourselves today only dimly visualise. The business of engineering education is not merely narrow specialisation in certain technical disciplines; it has a wider social significance in the modern world.

The output of engineers and technologists in different countries in 1954 is given in Table I.

TABLE I

Country	Total No. of first degrees	No. per million of population.
U.S.S.R.	60,000	260
U.S.A.	22,500	137
West Germany	4,450	86
France	2,990	70
U.K.	2,800	57
Italy	2,200	45
Switzerland	400	82
India	3,210	9

The figures speak for themselves. In the last three to four years vigorous efforts are being made in the U.S.S.R. & U.S.A. to increase the outturn of scientific and technical manpower at all levels. U.S.S.R. reached a figure of 460 engineers per million of population in 1958. The U.S.A. expects to double its output of engineers within the next four-five years. The important point, however, is that it is being increasingly realised that in the modern world, national prosperity depends upon national education, and more particularly on Technical Education. No country can advance even with immense potential natural resources, if it remains educationally backward.

Although the first technical institution in India was established well over a century ago, technical education remained almost static for a long time; and this condition is reflected in a large measure in the lack of scientific and technological progress of the country all those years. It was only when the Second World War broke out that the need for technicians for the war effort was felt and some attention was paid to the problem of technical education and training. The problem was, however, regarded only as a war-time emergency unrelated to the fundamental & economic aspects of national life and no long-range measures were adopted to improve the situation. Nevertheless, an important outcome of our World War II experiences was the formulation of post-War reconstruction plans in all fields. An appreciation that scientific and technical personnel were necessary for the successful execution of these plans also grew gradually in responsible quarters.

At about that time two important decisions taken by the then Government exercised a far-reaching influence on the course of development of technical education in subsequent years. One was the establishment of an All India Council for Technical Education in 1946 to advise on all aspects of improvement and co-ordinated development of Technical education. Another, was the appointment of a Scientific Manpower Committee in 1947 to assess the requirements for various categories of scientific & technical personnel and to recommend measures to meet them.

The All India Council carried out a comprehensive survey of the state of technical institutions in the country and formulated a scheme for their immediate improvement and development with financial assistance provided by the Central Government. It also set up Boards of Technical Studies in various fields to prepare courses of a suitable standard and for various levels of training which could serve as a model for the institutions and facilitate reorganisation of technical education in the country. Four Regional Committees, one for each region of the country, were set up to survey the needs on a regional basis, to formulate and implement development programmes in a co-ordinated manner and to help in the establishment of liaison between industry and technical institutions. The Council also initiated various other measures for the development of technical education.

The Scientific Manpower Committee carried out a quantitative & qualitative assessment of the requirement technical personnel over a ten-year period, estimated ex: shortages in training facilities and recommended various measures to meet the requirements. What is more importar that the Committee established for the first time in the country the concept of integrated planning in technical education with a capacity to foresee future requirements i manpower and to meet them through organised effort.

Thus, when India attained independence in 1947 a certain amount of awareness of the importance of technical education to national development had grown in many quarte: This awareness grew steadily in the post-independence peric The First and Second Five Year Plans accorded high priority technical education and a large financial provision was mad both at the centre and in the states for the establishment (new institutions and for the development of existing ones. remarkable expansion of technical education was achieved in course of ten to 12 years.

In 1947, when India attained independence, there we: in the country 38 institutions with a total admission capaci of 2940 students per year for first degree courses. There we also 53 polytechnics with a total admission capacity of 3670 students per year for diploma courses. By 1960, the number o institutions for first degree courses increased to 97 and polytechnics to 193. The total admission capacity of the institutions increased to 13,500 students for first degree courses and to 25,290 for diploma courses. The progressive expansion of training facilities over the years is given in Table II.

These are impressive numbers, especially for a country like India that has to build from scratch within a time. But, numbers are not everything. What of quality?

CHART II

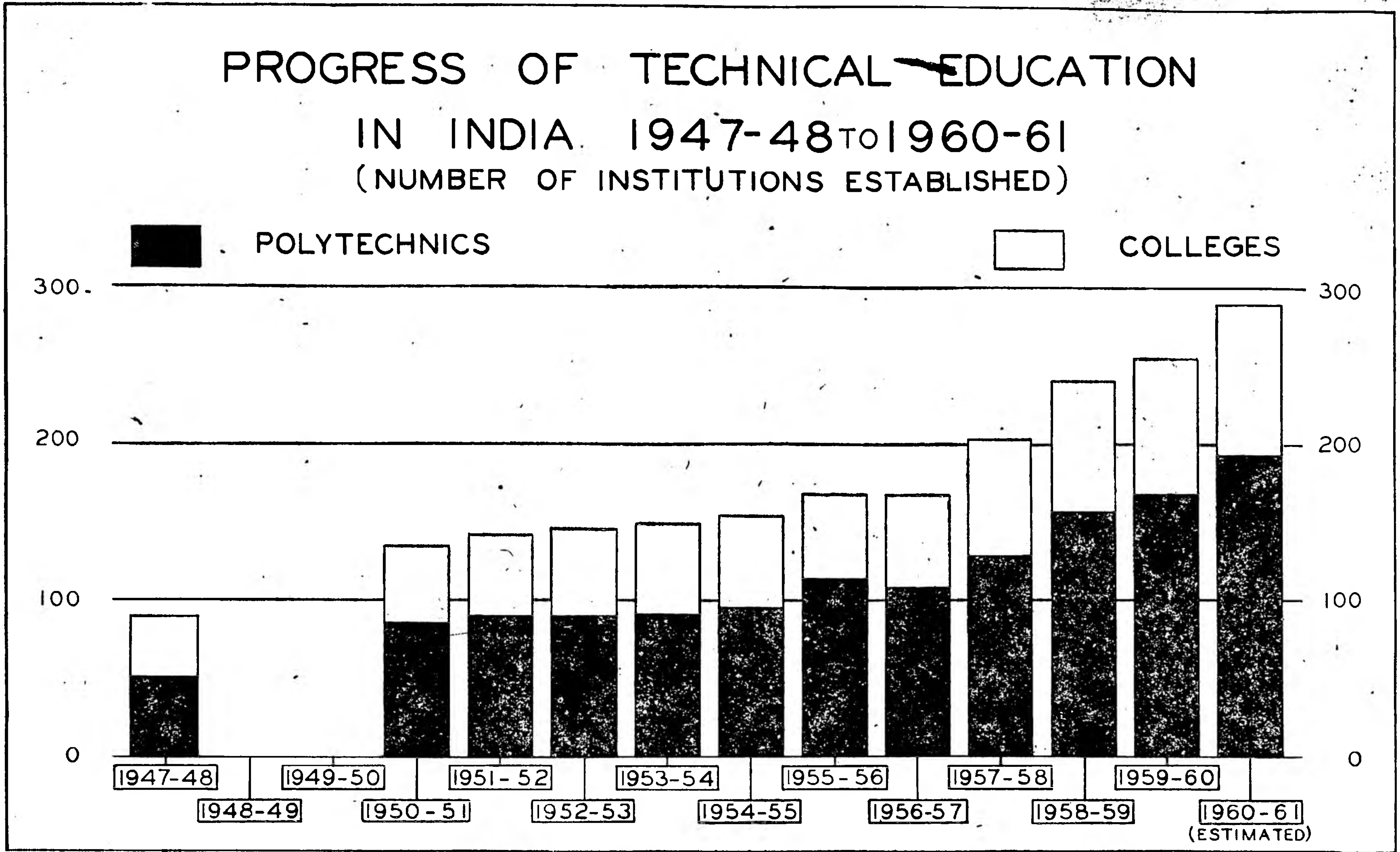

PROGRESS OF TECHNICAL EDUCATION
IN INDIA 1947-48 TO 1960-61
(NUMBER OF INSTITUTIONS ESTABLISHED)
POLYTECHNICS
COLLEGES
300
200
100
0
1947-48
1948-49
1949-50
1950-51
1951-52
1952-53
1953-54
1954-55
1955-56
1956-57
1957-58
1958-59
1959-60
1960-61
(ESTIMATED)

CHART III

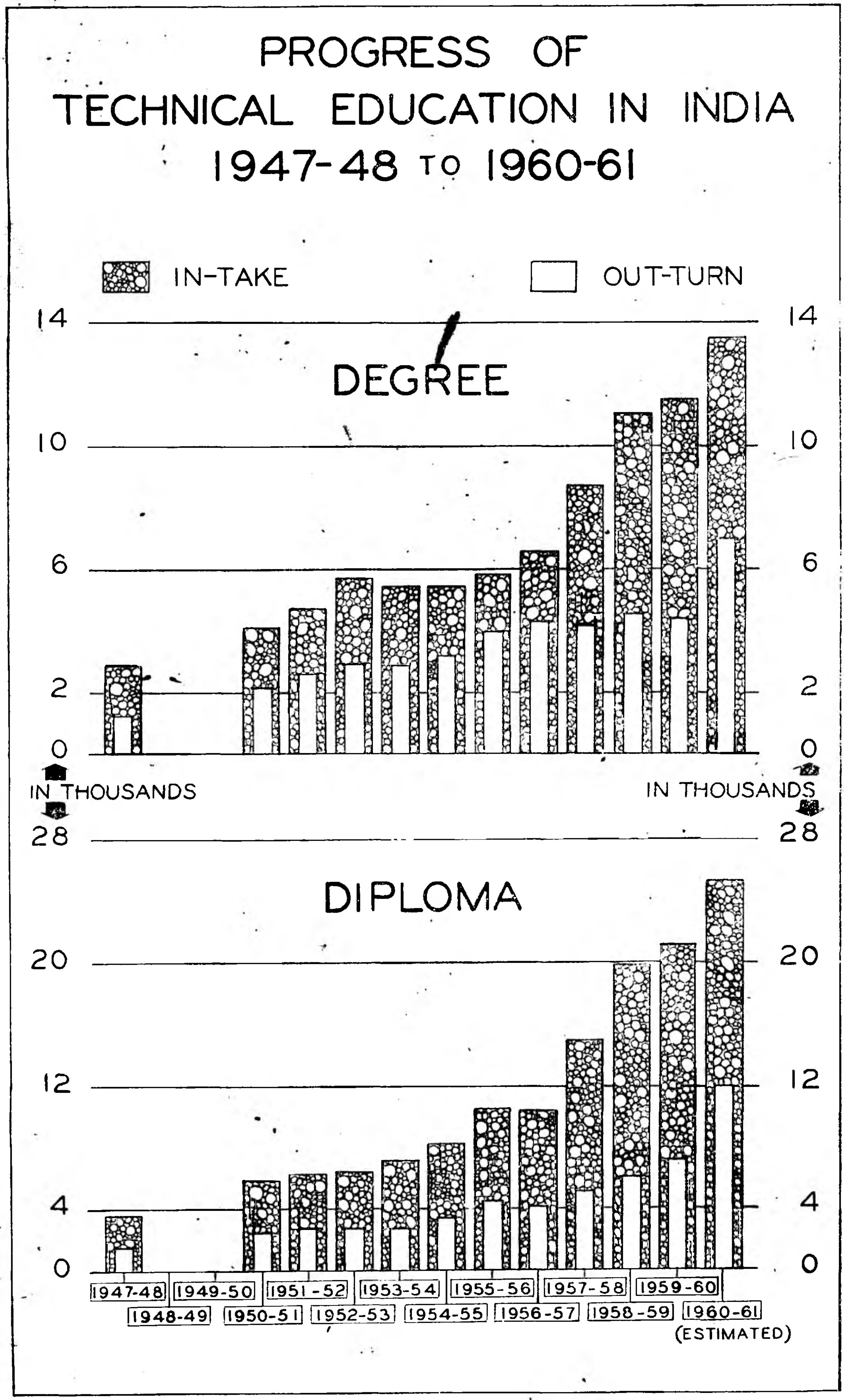

PROGRESS OF
TECHNICAL EDUCATION IN INDIA
1947-48 TO 1960-61
IN-TAKE
OUT-TURN
DEGREE
14
10
6
2
0
IN THOUSANDS
28
20
12
4
0
DIPLOMA
1947-48
1948-49
1949-50
1950-51
1951-52
1952-53
1953-54
1954-55
1955-56
1956-57
1957-58
1958-59
1959-60
1960-61
(ESTIMATED)

TABLE II

Year	Degree Courses: Number of Institutions	Degree Courses: Admission capacity	Degree Courses: Output of graduates	Diploma Courses: Number of Institutions	Diploma Courses: Admission capacity	Diploma Courses: Output of Diploma holders
1947	38	2,940	1,270	53	3,670	1,440
1950	49	4,120	2,200	86	5,900	2,480
1951	53	4,790	2,690	89	6,220	2,630
1955	65	5,890	4,020	114	10,480	4,500
1960	97	13,500	7,000*	193	25,290	12,000*

(*Estimated)

The crux of the problem of standards in technical education is three-fold - teacher, equipment and buildings. The All India Council for Technical Education and its Regional Committees have carried out a comprehensive survey of the state of each institution in the country and have formulated schemes for its improvement and development, which envisage _inter alia_ provision of adequate instructional facilities including teachers that are necessary for maintaining proper standards of education. On the recommendations of the All India Council large grants are being given by the Central Government, University Grants Commission and also by the State Governments to the institutions for buildings, equipment, staff and maintenance. The All India Council has also drawn up model plans and estimates for an engineering college and polytechnic. New technical institutions are being established in accordance with this model.

Engineering education to be effective in terms of a national plan must be dynamic. It must facilitate adaptability to changing conditions in technology. It must constantly raise the level of attainments of products of technical institutions. India needs not only skilled workers and technicians but also design-engineers and engineer-scientists. Before 1947, there was hardly an institution which provided facilities for post-graduate studies and research in engineering. Indian students had to go abroad to the U.K., Europe, U.S.A. and other countries for advanced training. Today, over a dozen institutions have been developed within the country where facilities for post-graduate studies and research work are available for nearly 500 scholars. The fields of study also cover a wide range of subjects, some of which, as for instance, Power Engineering, Dam Construction and Irrigational Engineering, Production Engineering, Advanced Electronics, Aeronautical Engineering are of special importance to the development of the country. Such facilities will be expanded in the course of next five years so as to provide for [illegible],000 scholars.

II. THE MEANING OF TECHNICAL EDUCATION

There is no universally accepted definition of 'Technical Education'. It varies from country to country and is also sometimes identified by particular types of institutions and their courses of study. In India, Technical Education represents a complex of activities that include Post-graduate courses & research; under-graduate courses leading to the first degree or equivalent award; Diploma courses, certificate courses; junior technical schools and technical studies at Secondary School level; apprenticeship etc. In this complex, the most predominant aim that characterises technical education is what may be called the double finality of educational development of the individual and imparting of techniques and skill. The emphasis on one or another may vary from course to course; the organisational arrangements may differ; or the types of institutions may be diverse. But, both form essential components of technical education.

While speaking of Technical Education, the terms Engineering and Technology are sometimes used synonymously and sometimes differently, to distinguish between different subjects. Technical institutions are sometimes referred to as engineering colleges; sometimes as technological colleges; and in some cases as colleges of engineering and technology. There is no doubt that a certain amount of terminological confusion exists, but that is more in usage than in basic concepts. Historically, engineering included only the more well known fields such as Civil Engineering, Mechanical Engineering and Electrical Engineering. As the application of science to industry widened and the forces of nature were harnessed increasingly for the material prosperity of man, a large body of applied scientific knowledge grew and was called by the more comprehensive term Technology. Technology therefore includes all fields of engineering & applied sciences that are responsible for present day progress.

Confusion has also arisen out of the fact that between two words, Technologist and Technician which sound and look alike, there is a wide range of difference, but the words are often used synonymously. A trained Technician may be defined as a person who without aspiring ever to reach one of the directing positions in industry, is nevertheless fully competent to understand, control and maintain the technical processes committed to his charge. A Technologist on the other hand is a person capable of appreciating the latest progress in the research laboratories and applying scientific knowledge and method to industry. This distinction between Technologist and Technician is important since it determines the standard and scope of technical education at different levels.

III. THE STRUCTURE OF TECHNICAL EDUCATION

Technical education in India is a four-tiered structure comprising post-graduate courses and Research; First degree courses; diploma courses; and vocational or industrial training. Each tier is a self-contained aspect intended to serve a specific purpose and neither the diploma courses nor the industrial training courses are a preparation for the next higher tier. For post-graduate courses and research, however, only those candidates who possess a first degree in the relevant subjects are admitted. The objective of the first degree courses is to train technologists, some of whom may eventually become designers, research engineers or specialists in various fields either after further studies at post-graduate level or experience in the profession. They are not concerned with preparing persons for specific positions or jobs in industry, but to give them a broad-based education in the scientific principles and methods underlying technology. They are also not concerned with developing particular technical skills in the students but to acquaint them with various production methods in accordance with constructional requirements in a particular system that consists of an assembly of men, materials and machines.

These objectives are sought to be achieved through a formal course of theoretical and practical studies at an institution over several years. The duration is generally four years with the Intermediate in Science as the minimum admission qualification. The Intermediate in Science, a preparatory stage for university courses in science or technology is of two years' duration after the High School education that extends over a period generally of ten years. A few technological institutions in the country, particularly in the Western Region have, however, prescribed a three-year curriculum (instead of four years) for the first degree course. It therefore takes five to six years for a student to complete the first degree after his High School education. That, he does generally at the age of 21 or 22. Cases are not rare of boys taking their degrees at 18 or 19 by jumping classes at the primary or middle school stage. As regards age restrictions for admission to technical institutions, the present position is explained elsewhere.

Secondary education in the country is in the process of re-organisation and the new pattern envisages a 11-year schooling that prepares candidates for life and for direct entry to university. The existing Intermediate course is being abolished. As a result of these changes, the first degree courses are being re-organised into a five-year integrated course after higher secondary education. The advantages of a five-year integrated course; first, a more fruitful integration of fundamental sciences, technological subjects and literal arts will be possible. Second, a higher level of scientific and technical competence may be expected since the students can absorb the different subjects in more suitable stages and in the right combinations. (It is hardly necessary to emphasize that an advanced knowledge of science, particularly physics & mathematics is essential to a Technologist). Third, a five-year tutelage will give the teachers sufficient scope for not rushing students with too much of class work and for developing in them a capacity for growth and maturity. Finally, in these days of specialisation, a five-year curriculum permits of an adequate introduction of the different specialised fields and prepares the students for post-graduate studies or research.

The first degrees are awarded in the main fields of technology, viz. Civil Engineering, Mechanical Engineering; Electrical Engineering; Electrical Communication Engineering; Chemical Engineering; Mining; Metallurgy;

Textiles Technology; Agricultural Engineering; Leather Technology; Architecture. Courses in Instrument Technology, Automobile Engineering and Aeronautical Engineering are also offered by some institutions at the first degree or equivalent level.

Post-graduate courses leading to Master's degree or equivalent award are generally of one or two years and provide for specialisation in a branch of a major field in formal instruction, project work and independent study of a chosen problem presented as a dissertation. Research degrees like the Ph.D. or D.Sc. are awarded on the basis of original research done by candidates at recognised centres.

Next to first degree courses, diploma courses occupy an important position in technical education in India. These courses are conducted by a large number of institutions called Polytechnics and are designed to train technicians who will eventually occupy supervisory positions like Foremen, overseers etc. in industry and other technical organisations. They are three years long after High School education and have a practical bias. A view has, however, been advanced in recent years that the practical knowledge and experience required by a technician cannot be given to him in an adequate measure in a course that is wholly institution-based, and as such, the present three-year diploma courses do not always produce the right type of personnel. The All India Council for Technical Education has therefore designed a Sandwich course of four years in which practical training in industry and institutional studies alternate in suitable layers. The student spends stated periods in industry and in an educational institution, throughout the course and fulfils the academic requirements for the diploma. He also gains the practical experience necessary for a supervisory position. The scheme has been introduced at selected centres in co-operation with industry. As training facilities in industry expand, the sandwich course will become an important feature of technical education in India.

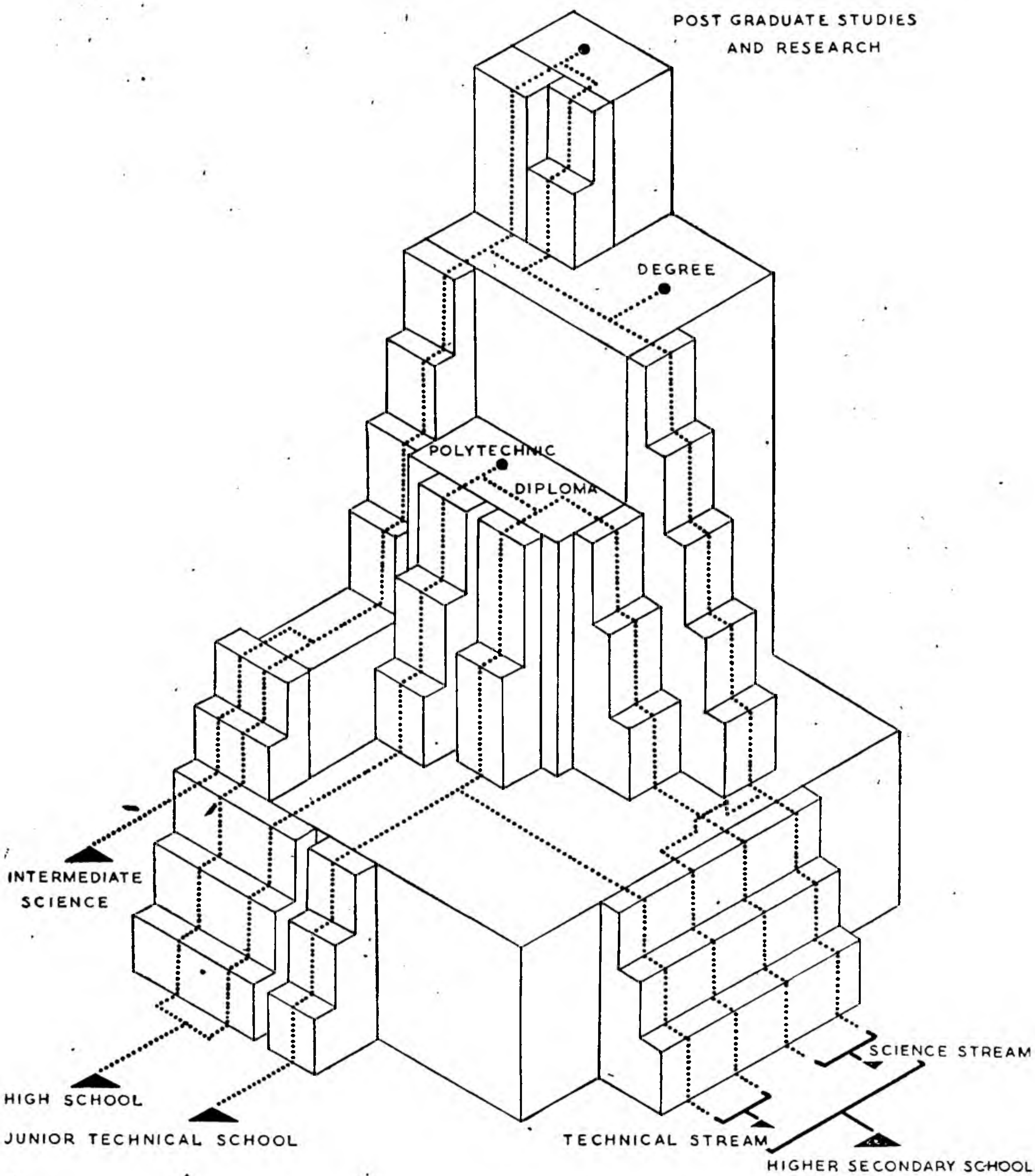
The diploma courses are offered in the main fields of civil, mechanical and electrical engineering. A few institutions also offer Textile technology, Leather technology, Mining engineering and other fields according to regional requirements for technical personnel at this level.

As a matter of established usage, the term Polytechnic represents today in India technical institutions that conduct diploma courses chiefly in civil, mechanical and electrical engineering. It indicates at once both the standard of training and the main fields of study. Except for a few institutions that are under the direct control of universities, all polytechnics are affiliated to State Boards of Technical Education in different States. The State Boards prescribe the courses of study, conduct examinations and award diplomas. Uniformity of standards on an all-India basis is maintained through the All-India Council for Technical Education which has formulated National Certificate courses to serve as a model for the diploma courses conducted at polytechnics.

An interesting feature of the pattern of technical education is the relative prominence of different fields of study which is also an indication of the state of industrial development in the country. On the basis of 1959 admissions to degree and diploma courses, distribution of seats between the various fields of technology are given in Table III.

Civil Engineering accounts for nearly 37% of the total seats at the first degree level and nearly 50% at the diploma level. Next in order are electrical and mechanical engineering that enjoy equal importance. This distribution is not accidental. It is the result of development of the

CHART I



STRUCTURE OF TECHNICAL EDUCATION

institutions over the past 50 years in accord with the pattern of employment of technical personnel.

TABLE III

Fields	Number of seats	
	Degree	Diploma
Civil Engineering	4192	10210
Mechanical Engineering	2325	4570
Electrical Engineering	2329	4580
Electrical Communication Engineering	375	240
Mining	290	455
Metallurgy	239	10
Chemical Engineering & Chemical Technology	485	-
Aeronautical Engineering	30	-
Textiles Technology	282	311
Leather Technology	20	115
Architecture	285	-
Other fields	658	819
Total =	11,[illegible]	21,370

Civil Engineering has constituted so far the largest field of activity in the country; and in terms of employment potential it has offered the largest scope for graduates and diploma-holders. Due to lack of industrial development, particularly in manufacturing industries, Mechanical engineering, Electrical engineering, Chemical engineering, Metallurgy and other branches have been rather restricted in so far as employment opportunities are concerned. In fact, in the recent past - less than ten years ago, there was a serious threat of unemployment among graduates who had qualified in these fields. However, the position is changing very rapidly, thanks to the five-year plans in which industrial development is emphasized. The future trend will be for larger numbers of mechanical, electrical, metallurgical, chemical and mining engineers as the industrial development of the country in respect of heavy & light engineering, mining, power, fuel & chemical industries etc. progresses. Such trends are already noticed and a stage will be reached in the near future when the demand for civil engineers will stabilise at a level not very different from the existing provision of training facilities and the demand for other types of engineers will steadily increase. In order to meet the latter as it arises, diversification of courses of study in the existing as well as in the new institutions have to be planned well in advance and adequate provision has to be created for training in various branches.

The Indian Constitution makes it essential for the state to seek to provide compulsory education for all children up to the age of 14 i.e. up to three classes below the new higher secondary course that is in process of introduction. The question is, how to provide diversified opportunities for education and training to a majority of students after 14, for gainful occupation in life? A scheme has since been formulated for the establishment of Junior Technical Schools which will offer a three-year integrated course of General Education, elementary technical education and technical training in various engineering trades and prepare students to enter industry as skilled workers and operatives. Some of the more promising students may enter polytechnics and complete the diploma course in about two years and enter the profession at a higher level.

IV. FIRST DEGREE AND DIPLOMA COURSES

A list of institutions functioning in the country (1960) for first degree and diploma courses, courses of study offered by each and its sanctioned admission capacity, is given in Annexure I. The institutions are classified into Government, Non-government and University depending upon whether they are financed and managed by the Central or state governments, private agencies and universities, respectively.

There are at present 97 institutions for first degree or equivalent courses and 193 institutions for diploma courses. Except for the higher technological institutes at Kharagpur, Bombay and Madras, Indian Institute of Science, Bangalore, and the Madras Institute of Technology, which are a class in themselves, all first degree institutions are affiliated to universities and conduct courses as are prescribed by the universities. The higher technological institutes and Indian Institute of Science, Bangalore, award their own degrees. The latter awarded till recently only Diplomas and Associateships that had been recognised by the Central Government and other authorities, but since 1953 the Institute has been empowered to award conventional degrees. The Madras Institute of Technology awards diplomas for courses in Aeronautical Engineering, Instrument Technology, Automobile Engineering, Radio Engineering that are of first degree standard and the diplomas are recognised by the Central Government and other authorities.

A majority of the institutions only offer the three basic fields viz. Civil Engineering, Mechanical Engineering and Electrical Engineering. The other fields viz. Mining Engineering, Chemical Engineering, Metallurgy, Textiles Technology etc. are offered mainly by certain institutions that have been set-up specially for the purpose. As explained earlier, historically, 'Engineering' and 'Technology' were used to represent different fields and that distinction also found echo in the scope of work of technical institutions. Engineering colleges were set up mainly for civil, mechanical and electrical engineering; and separate institutions for the so-called Technologies. The distinction was purely scholastic, but the pattern set by history for technical institutions continued for a long time. The separate existence of engineering and applied sciences has not done either any good. Nevertheless, it is being increasingly realised that the progress of technological education and research depends in a large measure upon the integration of fundamental and applied sciences with engineering studies in our institutions. It is also accepted on all hands that establishment of separate institutions for individual fields is not only uneconomical but restricts their development. The move now is to have composite institutions as far as possible, or to diversify and develop the activities of existing institutions. The new institutes of technology that offer facilities in a wide range of subjects are cases in point.

Except for the higher technological institutes practically all technical institutions had till recently a maximum admission capacity of about 120 students per year. Some had even less. As compared to institutions in the U.S.A., U.S.S.R. and other technologically advanced countries, our institutions were certainly small units. Perhaps, in the past that could not have been helped. For one thing the demand for engineers & technicians was restricted; for another, regional aspirations for technical institutions could only be fulfilled on the basis of smaller units more widely dispersed. Also, there was no Central planning and [illegible]on of technical education that could have ensured [illegible]nciples governing the size and scope of work of institutions. In course of time, however, it was realised that large sized institutions were necessary to meet the increasing demand for engineers and such institutions should function on a national level. The higher technological institutes have therefore been planned for an admission capacity of 300-400 students per year (or a total student enrolment of 1500-2000) at the first degree level. A special scheme has been drawn up and is in process of implementation, to expand the the training capacity of selected existing institutions and develop them into larger units. Some of these institutions are now admitting 250-300 students per year. The establishment of nine large-sized regional engineering colleges has also been planned, each capable of admitting 250 students per year. Some polytechnics capable of admitting up to 300 students per year have been sponsored by the Central Government. The advantages of large-sized institutions are many. They are more economical and more efficient than the equivalent in small colleges. Nevertheless, their effect is to restrict dispersal of educational facilities over wider geographical areas, a factor of some importance in a large country like India. Out of this arises the problem, should technical and economic factors alone govern the size and location of future institutions or regional and local demands for technical education facilities be considered?

In any scheme of organised development of technical education, super-imposition is necessary, and institutions should be related to the needs of a rapid industrial growth. Nevertheless, as a people become socially and economically conscious, the store set by an engineer or technician increases and the aspirations of the people assume new dimensions. In such a situation, all legitimate demands for provision of technical education facilities have to be met irrespective of other considerations. The aim of the Central Government in this direction is two-fold. A total view of technical education is taken in relation to the five-year plans and at the same time no region or area is left without opportunities of advancement to its people.

Simultaneous with the establishment of higher technological institutes, and other all-India institutions, a wider geographical dispersal of engineering colleges and polytechnics is being deliberately promoted. The objective is that eventually every one of the districts in the country should have at least one polytechnic and no state is without its own engineering college. As regards the latter the objective has been achieved in the last three to four years. As regards polytechnics, 155 districts still require to have their own institutions. It is hoped that the new institutions to be established in the Third Plan period, will be located in these places.

An important feature of technical education in India is the large role played by private enterprise. Of the 275 institutions in the country at present for first degree and diploma courses, 158 have been established by the Central Government and state governments; 29 by universities and 88 by private agencies. In quantitative terms, the institutions established by private agencies account for nearly 35% of the total number of seats. That is a very substantial part. A definite policy is also followed by the Central Government to encourage and assist private agencies. Where a private institution by itself or in association with the state government raises enough funds to meet 50% of the non-recurring (buildings and equipment) and 50% of the recurring expenditure for a technical institution, the Central Government provides the balance of the amounts required, as grant-in-aid. The Central Government also gives interest-free loans for the construction of hostels. As a result of this policy, nine engineering colleges and 25 polytechnics have been established by private agencies during the second plan period as against nine colleges and 45 polytechnics established by state governments and universities. Private enterprise therefore constitutes a very important element of technical education in India and supplements in a large measure the efforts of the state. In order to ensure that the private institutions are run on the right lines and maintain proper standards, governing bodies that include representatives of the Central Government and state governments and the All India Council for Technical Education, have been set up for the administration and management of the affairs and finances of the institutions.

Does the present system of a four-year or five-year under-graduate course after the Intermediate or Higher Secondary train adequately the type of engineers who could go in for post-graduate studies and research? Would it not be better to design specially a first degree course that aims at a higher standard of scientific and technological content and in which an adequate foundation is laid for advanced studies later on? Should not the pattern of Technical education be flexible enough to permit of the training of different types of graduate engineers and particularly of those who can become 'Scientist-engineer'? These are some important questions raised in the context of post-graduate studies and research.

Most people agree that a University would not be doing its duty unless it gave its technological students an education in scientific principles; that a graduate course in technology requires a knowledge of fundamental mathematics and science and that unless this knowledge is acquired up to a high level the student will not be able to turn his practical experience to effect. In addition, the technologist must have enough instruction in his speciality to qualify for entrance to the profession which, with increasingly rapid advances in modern science and technology implies courses in electronics, ultrasonics, servo-mechanisms, nuclear energy and other new material that was unknown up to ten to 20 years ago. Above all, there is a plea in many quarters that the courses should be devoted to teaching the future technologist to be a leader of men, to live a broader life and have an understanding of the arts and sciences which make life more pleasant and the world a better place to live in.

It is a hard enough job for any University with fully developed faculties of the liberal arts and sciences and technology to live up to the objective of cooperation between those cultures and also to meet the challenges of new situations that arise out of the ever-widening frontiers of knowledge. In a normal engineering college which is only affiliated to a University and has limited resources in teaching staff, the task is more difficult.

It has also to be realised that the pattern of employment of technical personnel is changing fast. The old concept of an all-purpose engineer is vanishing and job specifications are becoming more specific. Of course, the function of a technical institute is not to train a student for a particular job but to give him a broad-based education on which he may build later on a truly professional career in his chosen field. The education should enable him to fit into his field of engineering as a whole. Nevertheless, the pattern of education should be flexible enough to suit students of varying interests and abilities. It should also be responsive to the stimulus of change in industry & in research.

A majority of engineers required for industry and other activities are of a uniform type and can be trained in the present four or five-year course . The standard and content of the course will be just sufficient to enable them to enter the profession. With experience gained in the field, they advance to higher levels of employment and professional competence. A limited number of engineers, however, is necessary for research, design and other kinds of original work. They constitute the sheet-anchor for all future technological progress. It is for the training of this small group, both at under-graduate and at post-graduate levels, that special provision has to be made in the existing pattern of Technical education.

An important suggestion is to organise at selected centres a special three-year under-graduate course in engineering, admission to which should be restricted to graduates in Physics, Mathematics and Chemistry. The course should be of an honours degree standard and lay special emphasis on advanced scientific principles as applied to engineering. The selectivity of candidates for the course and their high initial educational level would enable us to get a type of engineers who are well equipped for post-graduate studies and research.

V. POST-GRADUATE STUDIES AND HIGHER TECHNOLOGICAL INSTITUTES.

An impressive range of scientific discoveries and technological development characterises the present times.

Television and radar; electronic computers for the solution of complex mathematical problems and for business accounting; semi-conductor devices, known as Transistors as a replacement for the thermionic valves; electron microscopes with magnification exceeding 100,000; nuclear fission and fusion processes for power generation and for the production of radioactive materials that are of importance in agriculture, medicine & industry; new synthetic materials like polythene, terylene, silicones etc. that have a wide range of application in industry and in our daily life; gas turbines and jet propulsion. These are only a few examples of scientific and technological achievements of the modern world. These as also many others in practically every field are the result of the creative effort of scientists and technologists working in many countries and as partners in a common enterprise, namely, to extend the frontiers of scientific knowledge and to apply scientific discoveries to practical technological problems. They emphasize the inter-dependence among the various branches of technology as well as the ever-increasing dependence of technology on the fundamental sciences. They have further demonstrated the increasing need for technologists to acquaint themselves with, and to interpret and apply, the work of chemists, physicists, metallurgists and mathematicians and for the representatives of the various scientific and technological disciplines to collaborate in team effort.

India cannot remain unaffected by these advances. We may not attempt space travel and rocketry, but scientific and technological discoveries that touch upon the utilisation of material and energy resources of the country are of great significance to us. We have not only to adapt and apply known knowledge and techniques to different situations in the country, but also to make our own contribution to scientific and technological progress. As the Scientific Policy Resolution approved by the Parliament rightly points out, the key to national prosperity lies in the effective combination of the spirit of the people with technology, raw material and capital. Technology is more important than either raw material or capital, for the discovery and the use of new techniques can make up for deficiencies in natural resources and reduce the requirements of capital. Education is even more important, for "it is the function of education both to develop technology and to build up morale". India therefore needs quality scientists and technologists, who are not only specialists but are capable of looking well beyond their own fields; who can understand the inter-relationships of different disciplines and co-ordinate a diversity of skills, techniques, materials and experience in the solution of engineering problems; who can co-operate as a team and cross-fertilise each other.

The training of a technologist is not just a course; it is a complex process that extends over a number of years. Part of the process takes place in an institution and part in industry or in the professional field. The undergraduate studies are only the first cycle in which the young student is introduced to fundamental scientific and technological principles and given a general and broad education. Specialised training in a particular branch of technology to acquire depth of knowledge; practice in rigorous theoretical and experimental analysis; ability to think independently and judge in a scientific way; an understanding of the inter-relationships between different branches of science and technology; and what is more important, an adequate preparation in mathematical & physical sciences that is necessary for advanced technological work. These are the other cycles in the training of a technologist. Organised post-graduate studies at institutions specially meant for the purpose are therefore a necessity.

An important step taken by the Central Government to develop facilities within the country for advanced technological training is to establish four higher technological institutes, one in each region, east, west, south and north. A plan for the institutes was first drawn up in 1946 by a Special Committee under the Chairmanship of the late Mr. N.R. Sarkar. The concept behind the institutes is that for the training of the highest possible grades of technologists, who are required in large numbers, national institutions provided with all the necessary resources and full freedom to adapt themselves to the fast changing situations are necessary. In addition to the training of technical personnel, the institutions should be fountain-heads of scientific and technical knowledge and should contribute through research and other activities to the industrial advancement of the country.

The Indian Institute of Technology, Kharagpur, is the first higher technological institute to be established and started functioning in 1951. Equipped with all the faculties viz. liberal arts, fundamental sciences and the various technologies, that are necessary for the realisation of the highest ideals of technological education, the institute provides facilities for the education and training of over 1500 students in the undergraduate courses and 500 students for post-graduate courses and research work. The subjects offered cover a wide range some of which, as for instance, Naval Architecture and Marine Engineering, Fuel and Combustion Engineering, Production Technology, Geophysics, Advanced Electrical Communication Engineering, Foundry Engineering, Concrete Technology, are designed to meet the special requirements of industrial and other developmental projects for high grade technologists. The Institute has been incorporated by an Act of Parliament as an Institution of National Importance.

The other three higher technological institutes are in process of establishment at Bombay, Madras & Kanpur. The Bombay Institute started functioning in 1958 and Madras Institute in 1959, when admissions were made to first degree courses. The Kanpur Institute also started this year. All these institutes are also being planned on the same comprehensive scale as the Kharagpur Institute, and when completed will take the technological education of the country several steps further. Each will be a fully residential institution designed to promote corporate life among students and teachers, and will provide facilities for about 1500 students in the Undergraduate Courses and 500 students for post-graduate courses and research. While the nature and level of work of all the institutes is the same, each will pay particular attention to certain special fields of technology that are of importance to the industrial development of the country. Dead Uniformity and duplication will be avoided as far as possible, and each institute will be allowed to develop in directions best suited to its own resources and genius.

In this, the foreign technical assistance that the Institutes are receiving will be of great value. The Bombay Institute is being assisted by the Soviet Union and the Madras Institute by West Germany. The assistance given by these countries comprises scientific & technical equipment, services of expert professors for a period of five years and facilities for the training of Indian teachers at Universities and Institutions in the Soviet Union and West Germany. These two countries are famous for the technological and industrial advancements that has been achieved in their own ways. The

Bombay and Madras Institutes will, it is hoped, bear the imprint of the progress of the countries that assist them in their establishment and development. Similarly, the Kanpur Institute is expected to receive assistance from the U.S.A. The Kharagpur Institute has received assistance from many countries through the Unesco, Colombo Plan, Point-four Programme etc. All the higher technological institutes, therefore, represeat a venture in international co-operation and understanding in scientific & technological fields.

Another important centre of post-graduate studies in engineering is the Indian Institute of Science, Bangalore. Established in 1911 due to the foresight and magnanimity of Jamshedjee Tata, the institute has built up a high reputation in scientific research. In 1946, the Central Government decided to develop the Institute for advanced studies and research in technology and promote thereby the interaction of pure and applied sciences. In the last ten years the Institute has beoome a centre of advanced technology with particular reference to Power Engineering, Aeronautical Engineering, Metallurgy, Internal Combustion Engineering and Electrical Communication Engineering. The Power Engineering Department of the Institute is the only one of its kind in the country and provides facilities for advanced training and research in the various aspects of electrical power generation, transmission and distribution. This is a provision of great significance in the context of the big power projects undertaken in the country. Similarly, the Aeronautical Engineering Department is also the only centre for advanced training and research in aeronautics and related fields. The department has research, design & testing facilities that are of great value to aircraft industry. The other subjects offered by the Institute include Soil Mechanics & Foundation Engineering; Automobile Engineering; [illegible]ial Engineering & Foundry Engineering. The Institute provides facilities for over 400 post-graduate students & research scholars.

In an expanding system of education institutions should have a capacity for growth that has the essential quality of maturity; to project themselves into the future and anticipate changes; to prepare their products to meet the challenge of new situations. This is all the more necessary for technical institutions that are constantly exposed to the powerful influence of industrial development and scientific progress. How far 253 institutions in the country that are conducting first degree and diploma courses will ultimately answer to this description depends on the opportunity provided to them to grow out of themselves and strive for higher levels of academic and technical performance. To confine the facilities for advanced work to the higher technological institutions or a few selected institutions specially set up for the purpose is to deny them the much-needed opportunity of advancement. Therefore, on the recommendations of the All India Council for Technical Education, a deliberate policy has been adopted to encourage as many institutions as possible, depending upon their resources & abilities, to conduct advanced courses in engineering, or to establish research units. A number of institutions, as for instance, Bengal Engineering College, Sibpur, Roorkee University, Guindy Engineering College, Madras, Poone Engineering College etc. that were till recently engaged only in undergraduate work are now offering facilities for advanced studies in engineering. The fields of study include, Dam Construction & Irrigational Engineering, Structural Engineering & Concrete Technology, Public Health Engineering; Electrical Machines Design; Mechanical Engineering; Metallurgy; Electronics.

A list of institutions for post-graduate studies, subjects offered by each and other details is given at Annexure II.

VI. FACILITIES FOR STUDY IN SPECIAL SUBJECTS.

Diversification of the field of training is an important aspect of technical education. As industrial development progresses, the need for personnel trained in different fields and possessing diverse skills is felt. As the areas of application of science enlarge new technical disciplines are established which in turn create a demand for entirely different types of trained personnel. For instance, the application of nuclear science has established the new field of nuclear engineering and made it necessary for nuclear engineers to be specially trained. The application of electronics, transistors and circuitry to computors, servo-mechanisms and automatic controls has opened up new fields in which engineers are being trained in large numbers. It is, therefore, a primary function of technical education continually to respond to new developments in science and technology, identify new technical discipines and provide training facilities in them.

In India, the full impact of scientific and technological advances on technical education has yet to come. Nevertheless, a marked diversification of the field of training is noticeable and new faculties are being added in institutions whose activities were till recently restricted. For instance, Mining, Metallurgy, Chemical Engineering, Petroleum Technology, Geophysics, Industrial Engineering are some of the subjects in which several institutions are today offering courses. This is largely due to a definite demand felt at present for technical personnel in these fields for various development projects under the five-year plans.

Among the facilities created for training in special fields, may be mentioned the School of Town & Country Planning, Delhi. The school has been established as a Central institution for the post-graduate training of architects, engineers & sociologists in civic design & planning, an activity of great importance to the country. The school also conducts a special course in Housing to provide the much-needed personnel for the housing projects undertaken by the Central & State Governments. A Department of Architecture is proposed to be added to the school, that will conduct a full-fledged degree course in the subject.

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Scientific Management is another field that has attracted considerable attention. Rightly so, since for the success of the numerous industrial and commercial enterprises that have been undertaken both in the public and private sectors, good management is a sine quo non. The rapid changes that are taking place in the social, political and technological environment, are making it increasingly necessary for the modern manager to be specially trained for his profession rather than to come up the 'hard way' through the school of experience. His training is both a rigorous academic discipline, essentially educational in chεracter and a practical down-to-earth mastery of tools, techniques and processes. Therefore, on the recommendations of the Board of Management Studies, specialised courses in Business Management have been organised at four selected centres in the country and in Industrial Administration at three centres. The courses are essentially for persons who are engaged in management and have to be equipped suitably so that they may become better managers and for those who possess a minimum amount of practical experience and wish to enter the management field. In order that they may best serve this purpose, the courses are generally organised on a part-time basis. The question of the lines on which Management education in the country should be further developed is under the consideration of the All India Council for Technical Education.

The Administrative Staff College, Hyderabad established in 1957 as a joint and cooperative enterprise of the Central Government and private industry and commerce offers a three-month course to young administrators from all walks of national life in the principles and techniques of organisation, administration and leadership in civil life. It lays emphasis on team work, and upon the basic fact that those who are called upon to work together will be drawn from different apprenticeships. The task is to make a co-ordinated group out of individual specialists. It is one that grows with each further step in technological development. What the Staff College hopes to do is to bring together young administrators from all walks of national life at an age when their views are formed but not fixed, to provide for the exchange of ideas to the common advantage and to promote better understanding between those

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in charge in different spheres of activities. The resulting cross-fertilisation of ideas and techniques will be of advantage to all who participate and to the community as a whole.

The different centres of Management Studies and the Administrative Staff College are complimentary to one another. The Staff College is not concerned with preparatory training. Its constituency is among men and women already expert but needing the opportunity to reflect, to compare notes and to equip themselves more fully for their services.

For the training of technicians of the supervisory cadre for printing industry, four Regional Schools of Printing have been established at Calcutta, Bombay, Madras and Allahabad. The schools, working in close association with the industry offer National Certificate courses in the various branches of Printing and each serves the States in the region in which it is located. It is proposed to establish one more regional school at Delhi and a Central institute for advanced training and research in Printing technology and allied fields.

In developing facilities for new or special fields, keeping pace with current advances alone is not enough. To anticipate the future and be ahead of the times constitutes the mainspring of technical education.

VII. JUNIOR TECHNICAL SCHOOLS.

The Indian Constitution makes it essential for the state to seek to provide free compulsory education for all children up to the age of 14 i.e. up to three classes below the new higher secondary course that is in process of being introduced. The question is, how to provide diversified opportunities for education and training to a majority of students after 14, for gainful occupation in life. The issue arises partly due to the fact that secondary education is an end in itself to a majority of students and so, has to be a self-sufficient and practical preparation for entry to life. And partly due to the fact that the present spectre of large numbers of students crowding aimlessly into universities and other higher institutions has to be eliminated. University education should be open only to those who can profit by it and have the necessary academic merit. For the rest, secondary education of diversified types that suit individual ability and aptitude should be provided. Therefore, technical education and training at secondary level is of special importance.

The Junior Technical School which is a special type of secondary technical school, provides an answer to this question. Designed specifically for students who wish to enter industry and other technical occupations, the school offers a three-year integrated course in General education, Technical education and Technical Training in various engineering trades. It accepts fully the concept of 'Double Finality' within its curriculum - of educational development of the student from 14 to 17 and of his effective preparation for a definite technical occupation in life. In each year of the course, general education, technical studies and workshop training are so integrated that all these three elements together constitute the base for the total development of the young student. The work load is also so designed that the technical school functions as a cross between a factory and a school. It will generally observe a larger number of hours of work per day than an ordinary school which facilitates the disciplining of the students in gradual stages to the conditions of industrial occupation. A total of 4560 hours of instruction is provided over the three-year period comprising: 1280 hours of general education including science; 760 hours of technical studies including engineering drawing and 2520 hours of workshop training in a particular technical trade.

The workshop training which constitutes over 55% of the total course, when conducted in well-equipped shops provides a good foundation for the development of the student as a skilled worker of a high order in due course. The development of technical skill is facilitated by training in engineering drawing and in elementary Mechanical and electrical engineering included in the course. The curriculum of the final year provides for about two-third of the total time being spent on workshop training. It should, therefore, be possible to organise this training in cooperation with industry in such a way that the students work four days a week in industry and attend the school the rest two days. This type of sandwich course will train a product that is readily useful to industry.

Some critics of junior technical schools have asked the question, Is not 14 too early an age for a student to decide his future occupation in life? The answer is simple. A postponement of the decision till after he has completed the normal secondary schooling leaves him with only one choice i.e. university education for which he may or may not be fit. He has also not had an education and training that prepares him for any gainful occupation in life. To undertake such a preparation for industrial occupation at 17, it is too late and wasteful. Further, in our present economic circumstances, a boy should become a productive member of the community at 17-18. That is possible only if his education at the secondary stage is made purposeful not only from a general standpoint of education per se but also from the point of view of occupational requirements, or to put it plainly, from the standpoint of earning his bread. Therefore, whether one likes it or not, most boys have to make the decision at 14. In many European countries that are industrially advanced, the age of entry to technical schools is 11-12. There is no evidence that the boys have been handicapped in later life.

Another question asked is, What are the opportunities of further education open after the Junior Technical School? The suggestion implied in such a question viz. that the junior technical school should be a stage towards higher education is totally unjustified.

Otherwise, the very concept of education at the secondary stage as a preparation for life and an end in itself has to be rejected and it has to be subordinated to the requirements of university education. The junior technical school is a self-contained course and an end in itself. Its aims and objectives are not laid down in relation to university or any other kind of higher education. Nevertheless, students who have completed the junior technical school course can, if they wish to, do higher studies in several ways. While working in industry as skilled workers, they can attend the diploma courses in engineering on a part-time basis and complete them in a period of three to four years. That will not only better their prospects in their chosen profession but will improve them for supervisory positions in industry. Alternatively, immediately after the school studies, they can join a polytechnic for a full-time diploma course. In that case, in view of the extensive workshop training they have had as also training in engineering drawing and basic sciences, the duration of the diploma course will be only two years as against the normal three years. A third alternative that is open to brilliant students is, one more year's study in a normal higher secondary school which could prepare them for the secondary school examination. On passing that examination they could join the integrated five-year degree courses in engineering.

These are the various aspects of the Junior Technical School scheme. The schools are, however, in process of establishment and as, in the case of the new system of secondary education, more experience has to be gained with the curriculum, standard and content of general education and level of technical training that could be reached in the crucial three-year period. With that experience, the junior technical school could play a vital role in the educational reconstruction of the country and serve usefully a majority of students.

A proposal that is currently engaging attention is to establish Junior Technical Schools as adjuncts to Polytechnics. This will not only make for considerable economy in buildings, equipment and staff but also establish a rationale between secondary technical education and professional education at polytechnic level. The two educational cycles can be integrated into one unified system that takes off immediately after the compulsory schooling age of 14.

VIII. PLANNING FOR TECHNICAL MANPOWER

In planned economy, the demand and supply of manpower is of prime importance. Unless an adequate supply of the necessary trained personnel is ensured, the progress of development projects in any field suffers. Unless the projects throw up a sufficient number of jobs to absorb the available manpower and provide employment opportunities in an increasing measure, the economic system becomes stagnant. Therefore, a right balance between demand and supply of manpower has to be maintained at all times. That calls for an integrated and statistical approach to the problem of technical education and training.

The first ever attempt made to assess the requirements for technical personnel over a given period and plan for the necessary training facilities was by the Scientific Manpower Committee in 1947-48 soon after Independence. At that time, however, no five-year plans had been formulated. Nevertheless, the Committee visualised a certain level of economic development to be reached by the country over a ten-year period, 1947-57 and estimated the requirements for technical personnel for industry, agriculture, transport and communication, defence and other fields. Qualitatively, it also classified the personnel required into different categories of engineers, scientists, technicians etc. and indicated the level of their training in terms of post-graduate and specialist qualifications, degrees & diplomas. On the supply side, it carried out a comprehensive survey of the state of scientific & technical education in the country, the available training capacity of the institutions, the shortages existing in the instructional facilities and the scope of development of the institutions. The Committee estimated that the requirements for technical personnel over the ten-year period 1947-57 would be of the order of 30,000 persons possessing post-graduate qualifications & first degrees in various fields of technology (including engineering) and 33,000 persons possessing diplomas. In order to meet this demand and also to improve the quality of technical education, the Committee recommended a number of schemes that included development of existing institutions and establishment of new institutions. A scheme

was also formulated ....

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for the institution of research scholarships for the training of research workers in science and technology and of practical training stipends to enable fresh graduates and diploma-holders to undergo a stated period of practical training in industry. Some of the schemes were accepted by the Central Government and were implemented. They were the forerunners of more vigorous efforts made in subsequent years particularly during the Second Plan period to develop technical education.

Curiously enough, doubts were raised in certain quarters about the estimates of manpower requirements, prepared by the Scientific Manpower Committee. The critics said the estimates were rather on the high side and the country did not need as many as 30,000 graduate engineers and 33,000 diploma-holders over a period of ten years. According to them, the economic development of the country was not likely to proceed on such a comprehensive scale as envisaged by the Committee nor as speedily. Subsequent events, however, proved that the fears were unfounded.

In 1955 i.e. at the end of the First Five-Year Plan, technical institutions in the country produced 4020 graduates and 4500 diploma-holders. The number of institutions increased to 65 for degree courses and to 114 for diploma courses. Their admission capacity also increased to 5890 students for degree courses and to 10,480 for diploma courses. When the Second Five Year Plan was formulated, a target of nine additional institutions for degree courses and 21 additional polytechnics for diploma courses was proposed in the Plan that would have increased the admission capacity to 7390 students for degree courses and to 13,080 students for diploma courses. This was the order of development visualised by the Scientific Manpower Committee. There was no noticeable unemployment among engineering graduates and diploma-holders. Quite the contrary. Doubts were expressed and rightly so, that the training of manpower was not being geared to the needs of the Five-Year Plan and difficulties were likely to be encountered in pressing on with the development projects. In fact, an acute shortage of personnel was reported in certain sectors. The Planning Commission therefore appointed in 1955 an Engineering Personnel Committee to make an estimate of the requirements for manpower for the Second Five-Year Plan, and to suggest measures to meet the shortage, if any. In its report submitted in May, 1956, the Committee estimated that for the various development projects included in the Second Plan, about 26,500 graduates and 50,500 diploma-holders in engineering would be required by 1960-61. The supply from the institutions during that period would not meet the demand in full and the shortage in 1960-61 would be of the order of 1800 graduates and 8000 diploma-holders. According to the programme of expansion of technical education then contemplated, the admission capacity of the institutions would reach only 7390 students for degree courses and 13,080 students for diploma courses by the end of the Plan period. The Committee emphasised that unless efforts were made towards a much larger expansion of technical education than then contemplated, and the gap between the demand and supply of technical manpower was bridged, the economic development of the country would not make the necessary progress. The Committee recommended that the targets of technical education should be increased by 2790 seats for degree courses and 8,220 seats for diploma courses by the end of the Plan period. To that end, a number of new engineering colleges and polytechnics should be established in the country.

In consultation with the Planning Commission the Central Government decided in 1957 to increase immediately the training capacity of existing institutions by providing additional buildings, equipment and staff. An 'Open door' policy of assisting private agencies in the establishment of technical institutions was adopted. This gave a great impetus to the development of technical education as nine colleges and 25 polytechnics were established by private agencies. The plans of State Governments were revised in stages and provision was made for the establishment of eight new colleges and 49 polytechnics. Finally, it was decided in 1958 to expand technical education on a much larger scale so as to meet the demand for technical personnel not only for the Second Plan but for the Third and subsequent plans. For that purpose a special scheme of establishment of eight large-sized regional engineering colleges and 27 additional polytechnics was formulated and steps were taken to implement it.

The targets of technical education have had to be revised thrice in the course of the current plan period. The original targets correspond to an annual admission of 7390 students for degree courses and 13,080 students for diploma courses by 1961. The revised targets are 13,500 students for degree courses and 27,000 students for diploma courses. We are pretty near these new targets. In 1960, the admission capacity reached 13,500 students for degree courses and 25,290 students for diploma courses. When all these new schemes are implemented, our institutions will produce about 10,500 graduates and 18,000 diploma holders per year during the Third Plan period, which is more than double the present (1959) output of 4500 graduates & 7250 diploma holders. The important thing is that with this advance preparation, no serious shortage of technical personnel is anticipated for the successful execution of the Third Five-Year Plan. In fact, the supply will keep in step with the demand.

If our experience in the Second Five-Year Plan has taught us anything, it is that an integrative and statistical approach to the problem of manpower is essential. A certain measure of audacious planning for technical education & training yields rich dividends.

While on the question of supply and demand, the right proportion in which graduate engineers and diploma-holders should be trained, is an important issue. The proportion in which graduates and diploma-holders are required varies from project to project and depends on a number of complex factors viz. the nature of technical operations involved, extent of supervisory and executive responsibilities to be discharged by personnel at different levels, degree of mechanisation, instrumentation and automatic controls adopted etc. Nevertheless, on an overall basis for the entire field of engineering, a proportion of 1:3 of graduates and diploma-holders is generally accepted. Our institutions however, produced in 1947 graduates and diploma-holders in almost equal numbers. That was very unsatisfactory. The position improved gradually in subsequent years and in 1959, the proportion was 1:1.6. When the new institutions now being established start functioning and train additional graduates and diploma holders, the proportion will reach 1:1.8 during the third plan period. Even so, that will not be wholly satisfactory. Therefore, one of the major problems of further planning for technical education is, how to bring about a balanced development of facilities for degree and diploma courses.

This is not an educational matter only, but is related to the pattern of employment of technical personnel in industry, departments of government and other organisations. The present imbalance is in no small measure due to the employing organisations demanding graduate engineers for positions that can be filled by diploma-holders, adequately or entrusting to graduate engineers work and responsibilities that can be discharged by personnel with lower qualifications. In several organisations, higher positions are filled exclusively by promoting persons from lower levels on the basis of length of service. Since the higher positions require personnel with better academic qualifications, the tendency is also to prescribe the same qualifications for initial recruitment to the services, irrespective of the actual requirements of the different job levels. Therefore, unless the pattern of employment of technical personnel in many organisations is re-organised and the available technical personnel is carefully husbanded, the present imbalance will continue. A disturbing situation may well develop in which the value of technical education and training will be at a discount.

Another important measure is to create special facilities of further education for persons in service, so that when they wish to advance in their profession on the basis of experience, they could be equipped with the necessary higher training. For instance, a part-time degree course for diploma-holders, who are in service and possess a certain minimum amount of practical experience should benefit many organisations and also reduce the demand for fresh graduates from universities. Further, it will give a great incentive to the diploma-holders for better technical performance. The fresh graduates could be absorbed in positions where they are really required. The University of Jadavpur has organised successfully such a part-time degree course in engineering. Enormous scope exists for extending it to other centres where the demand for graduates is increasing.

IX. THE ADMINISTRATION OF TECHNICAL EDUCATION.

The organisation of technical education in India reflects characteristic features of the Indian Constitution and a strong bias in favour of central planning and co-ordination. India is a union of states that are autonomous in certain subjects that include education. The Union comprises 15 states, each with its own legislature and a government formed on the basis of universal adult franchise. It is, therefore, the primary responsibility of the states to organise, develop and administer technical education and training within their respective areas.

This constitutional position, notwithstanding, the organisational and administrative set up in many states were till recently unsatisfactory. There was no single department in the state government fully responsible for technical education and a variety of arrangements existed. In some states technical institutions were under the administrative control of Industries Departments; in some under the Public Works Departments; and in others under the Education Departments. In a few states, Industries Departments and Public Works Departments performed overlapping functions. In the same state, the Industries Department was in charge of certain technical institutions and the Public Works Department in charge of others. Each department laid down its own standards for the courses conducted by institutions under its control, held examinations departmentally and awarded diplomas and certificates.

As schemes for the expansion of technical education on a large scale were formulated under the Five-year plans, it was realised that a unified approach to the problems of organisation and administration of institutions was necessary at the state level. More important, when a large number of institutions, especially polytechnics were established in all states, it became necessary to ensure that the institutions maintained high standards of instruction, and their examinations were conducted by an independent body on a uniform basis. The All India Council for Technical Education, therefore, recommended that in each state there should be set up a Directorate of Technical Education in the Government and a State Board of Technical Education. The State Board should include _inter alia_ representatives of industry, commerce, universities, technical institutions and other interests concerned with technical education. It should prescribe courses of study for institutions not affiliated to universities, inspect institutions from time to time to ensure maintenance of standards, hold examinations and award diplomas and certificates. The Directorate, as the administrative agency of the government, should be in charge of the organisational & management aspects of the institutions. The recommendations of the Council have been accepted generally by all states, which have set up their own State Boards of Technical Education. In most states one single government department is now in administrative charge of technical institutions. The establishment of this new organisational set-up for technical education in the states is of great importance. It has not only helped in ensuring uniform standards on an all-india basis, but in associating various interests with the development of technical education and co-ordinating their efforts.

The concept of central planning and co-ordination has resulted in the Central Government's playing an active role in the development of technical education and training in the country as a whole. That the concept itself is justified, is because of several important considerations. First, in any system of planned economic development a clear perspective of the different sectors is an essential pre-requisite to action, whether at local or regional or central level. Second, when the programmes of economic development include large-sized projects for key industry, power, fuel, transport and communications etc. in the public sector, it is the primary responsibility of the Centre to ensure that the manpower required for the projects is made available. Third, on a national level, facilities for advanced technological studies and research can be organised satisfactorily only by the Centre, which has also to ensure that the institutions established for the purpose play their due role in the development of the country as a whole. Fourth, the expansion of technical education in a developing country like India involves a heavy financial outlay that is beyond the resources of the states and therefore the Centre has to bear a major part of the expenditure both directly and as grants to the states. Fifth, the Seventh Schedule of the Constitution places upon the Centre the responsibility to co-ordinate & determine standards in institutions for higher education or research and scientific and technical institutions.

In view of the above considerations, the role of the Centre in the field of technical education has a four-fold objective viz.

(a) to prepare an integrated plan of development of technical education for the country as a whole;

(b) to establish higher technological institutions, institutions for specialised courses and other institutions of all-India importance;

(c) to assist financially & otherwise state governments, universities and other agencies in the establishment of technical institutions;

(d) to watch over the progress of technical education and to ensure the maintenance of high standards.

These are essentially in the nature of educational leadership which the Centre has to provide.

The most important machinery set-up by the Central Government to provide this leadership is the All India Council for Technical Education, that consists of representatives of all State Governments, Ministries of the Central Government, Industry, Commerce, Labour, Professional and Learned Societies, Universities, Technical Institutions, Parliament and various other interests concerned with technical education. As a national body the All India Council advises the Centre, the states, University Grants Commission and other authorities on all aspects of improvement and development of technical education. Its functions include <u>inter alia</u>, the preparation of plans for the development of technical education on an All-India basis; to assess the requirements for technical manpower of different types and to suggest measures required to meet them; to suggest improvements in the pattern of technical education from time to time to suit changing conditions; to establish liaison between industry, government departments and other organisations on the one hand and technical institutions on another; to co-ordinate the activities of State Boards of Technical Education; to recommend grants and other forms of assistance that might be given by the Centre to the states, universities and other organisations in the development of technical education. Presided over by the Minister of Scientific Research & Cultural Affairs and with the Ministry of Scientific Research & Cultural Affairs as its secretariat, the Council functions with fewer handicaps than most other advisory bodies, whose relations with the administrative authorities are vague and whose recommendations are subject to further examination. As a matter of convention the recommendations of the Council are accepted by the Central & State Governments. The fact that technical education is not a controversial subject has also facilitated the work of the Council.

For the correct discharge of its functions the All India Council for Technical Education has set up a Co-ordinating Committee, four Regional Committees and seven Boards of Technical Studies. The Co-ordinating Committee is the Executive Committee of the Council and co-ordinates the work of the Regional Committees and Boards of Studies.

The importance of Regional Committees in promoting a co-ordinated development of technical education in the different parts of the country cannot be overemphasised. The very vastness of the country raises many & varied problems of development that require to be examined in the light of the conditions prevailing in and the needs of each region. Schemes for the establishment of new and for the improvement and development of existing institutions have to be formulated and implemented on a regional basis. A constant watch over the progress of the institutions which are spread over the whole country has to be maintained and expert advice and assistance to institutions that are in need, have to be provided. These and many other tasks can be performed satisfactorily only through appropriate regional agencies, specially set up for the purpose and working in close co-operation with local authorities.

The four Regional Committees of the All India Council for Technical Education deal with the following areas:-

<u>Northern Region:</u> Jammu & Kashmir; Himachal Pradesh; Punjab; Rajasthan; Delhi; Uttar Pradesh.

<u>Eastern Region</u> : Assam; Manipur; Tripura; West Bengal; Bihar; Orissa; Andaman & [illegible].

<u>Western Region:</u> Maharashtra; [illegible]dhya Pradesh; Gujerat.

<u>Southern Region:</u> Mysore; Madras; Andhra Pradesh; Kerala & Pondichery; Laccadive, Minicoy & Aminidevi islands.

Each Regional Committee consists *inter alia* of representatives of the state governments within its area, representatives of industry, commerce & labour, technical institutions, State Boards, universities and experts. Constituted in this manner the Committees are fully representative of all authorities & interests concerned with technical education in their respective areas. Their main functions are:-

(a) to survey facilities for technical education at all stages and to make recommendations on the development of technical education, including the establishment of new institutions wherever necessary.

(b) to make a preliminary examination of any institution seeking recognition.

(c) to tender advice and guidance to technical institutions within the region.

(d) to promote liaison between technical institutions and industry.

(e) to assist the states & institutions in securing practical training facilities.

The Boards of Technical Studies advise the All India Council on all academic aspects viz. the pattern of technical education, duration, standard & contents of courses, admission requirements etc. They also lay down the minimum standards of instructional facilities required for the conduct of various courses by technical institutions. The seven boards that have been set up deal with the following fields:

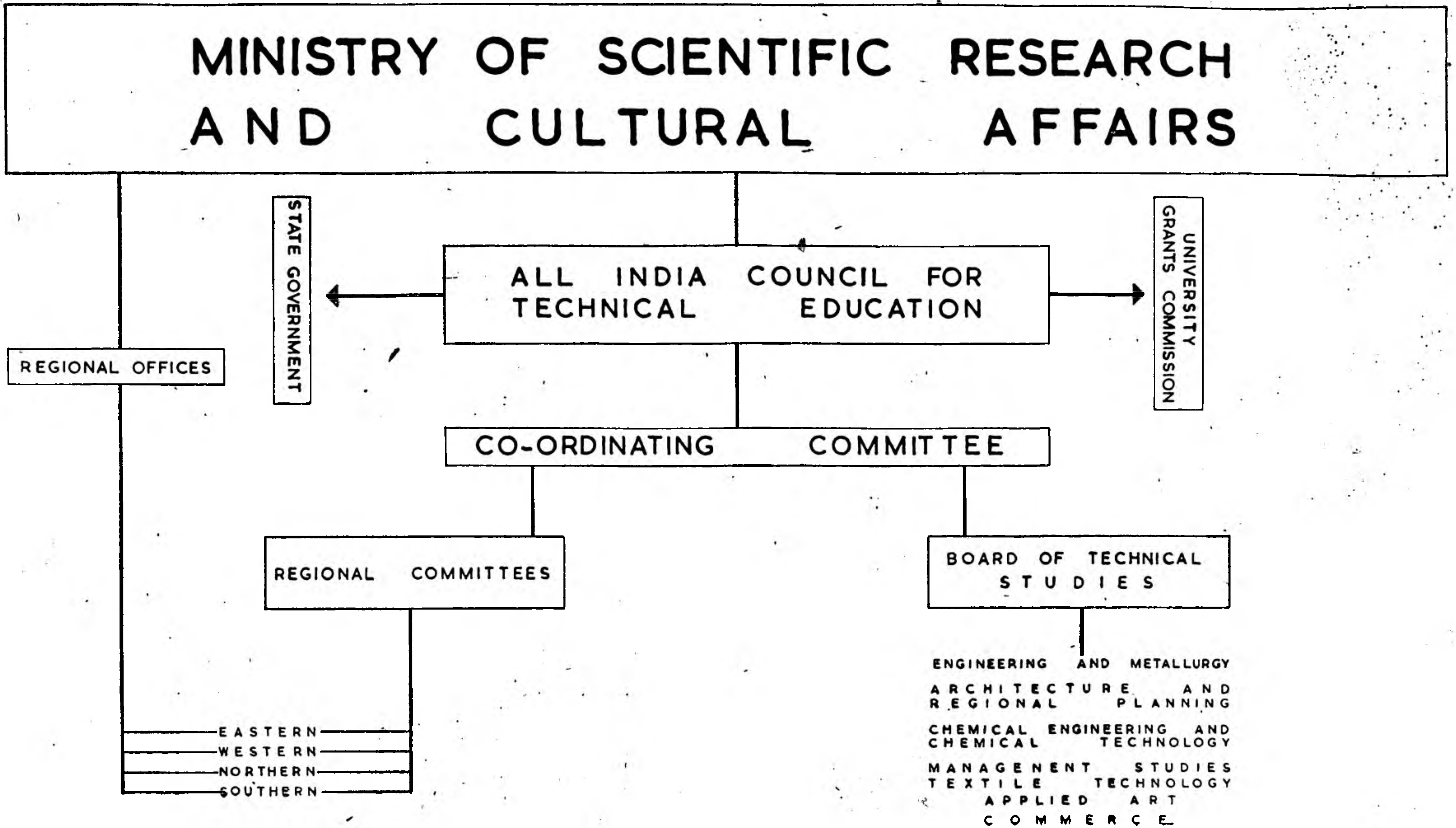
Engineering & Metallurgy
Chemical Engineering & Chemical Technology
Textiles Technology
Architecture & Town Planning
Commerce
Management
Applied Art & Crafts

In addition to representatives of technical institutions, universities, industry & commerce, each Board consists of experts who are appointed by the All India Council in order to bring to bear on the work of the Boards expert knowledge and guidance in the concerned fields. In the last 14 years that the boards have been functioning, much valuable work has been done in formulating courses of study for degree & diploma in various branches, on an all-India basis that have served as a guide to technical institutions. The standards of instructional facilities like buildings, equipment and staff suggested by the Boards have formed the basis on which the Regional Committees assess the requirements of institutions and recommend grants. The Boards have also advised the Council from time to time on specialised courses to meet the needs of industry and commerce and formulated various schemes for the purpose.

Thus, with a Co-ordinating Committee, four Regional Committees and seven Boards of Technical Studies, the All India Council for Technical Education has become a most effective national body for technical education in the country.

In the Ministry of Scientific Research & Cultural Affairs, there is a separate Division for technical education to assist in the formulation of and to carry out policies and programmes. The duality of advisory and administrative functions in the same organisation is a characteristic feature of the Ministry that has made for much progress in technical education. The Division has also four Regional Offices, at Calcutta, Bombay, Kanpur and Madras whose respective territorial coverage corresponds to that of the Regional Committees of the All India Council. Working in close association with the state governments and as the secretariat of the Regional Committees, the offices are concerned with actual field work and provide the much-needed link between the Centre and the states. Among their important functions are, arrangements for the practical training of graduates and diploma holders; keeping a close watch over the progress of development schemes approved by the All India Council for Technical Education; providing assistance to technical institutions in various matters; ensuring correct utilisation of funds provided by the Centre, by institutions.

CHART IV



MINISTRY OF SCIENTIFIC RESEARCH AND CULTURAL AFFAIRS
STATE GOVERNMENT
ALL INDIA COUNCIL FOR TECHNICAL EDUCATION
UNIVERSITY GRANTS COMMISSION
REGIONAL OFFICES
CO-ORDINATING COMMITTEE
REGIONAL COMMITTEES
BOARD OF TECHNICAL STUDIES
EASTERN
WESTERN
NORTHERN
SOUTHERN
ENGINEERING AND METALLURGY
ARCHITECTURE AND REGIONAL PLANNING
CHEMICAL ENGINEERING AND CHEMICAL TECHNOLOGY
MANAGEMENT STUDIES
TEXTILE TECHNOLOGY
APPLIED ART
COMMERCE

FINANCING OF TECHNICAL EDUCATION AND FOREIGN ASSISTANCE

The expenditure on technical education reflects not only the progress achieved in the field but also the organisational structure. Prior to independence, the expenditure of the Central Government on technical education was practically nil and the bulk of the finances required was provided by the States, however, meagre that was. The contribution of private agencies was negligible. As the initiative of the Centre in the development of technical education grew, the Central Government has been provided funds in an increasing measure every year, not only for its own institutions but as assistance to state government and private institutions. There was a corresponding increase in the expenditure on the part of the state governments and private agencies. Today, the finances for technical education as a whole are derived mainly from these three sources viz. the Central Government, State Governments and private agencies.

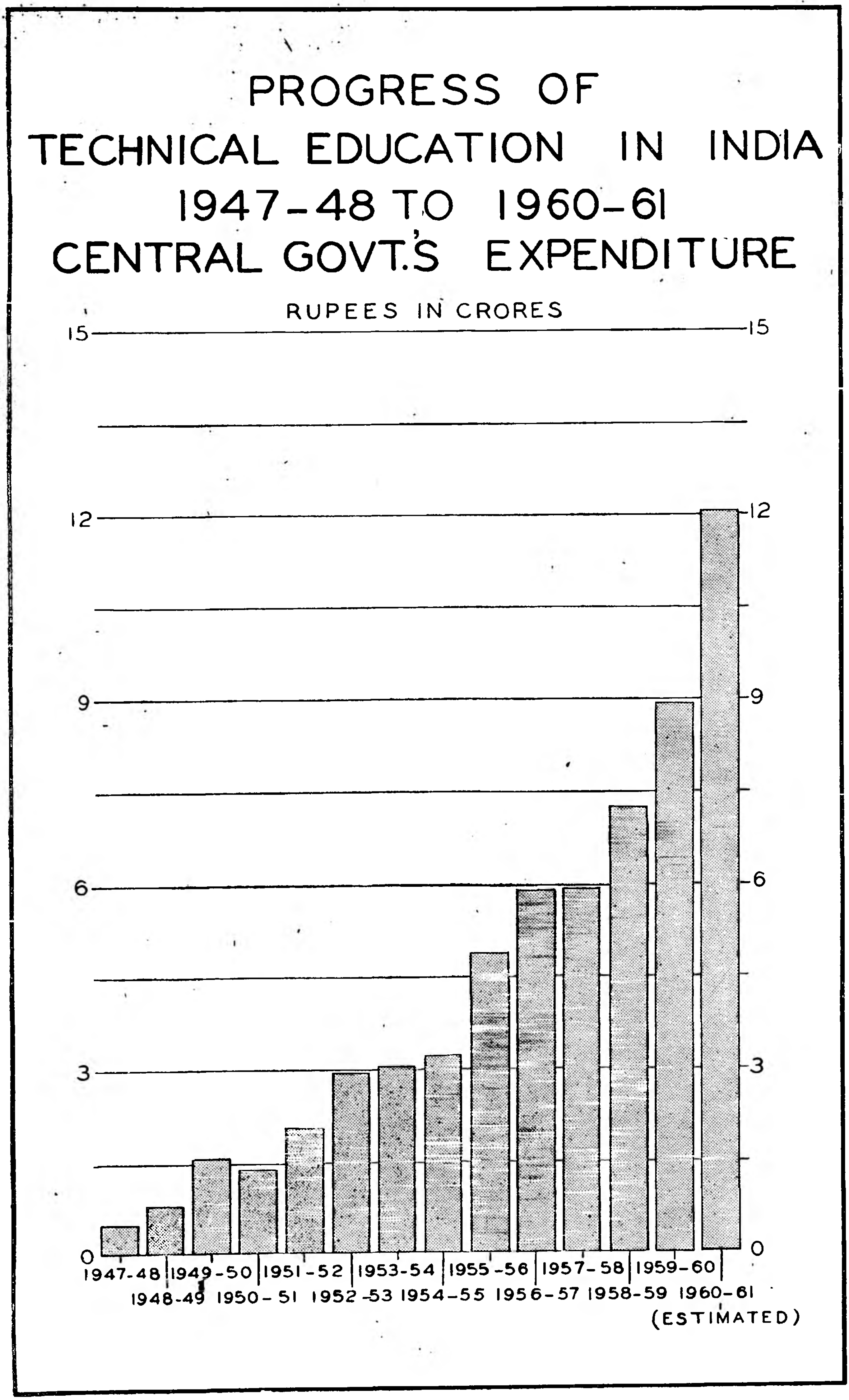
The progressive increase of the Central expenditure on technical education over the period 1947-48 to 1960-61 is given in chart V. The first great fillip came with the First Five year Plan. During that Plan period the Centre provided about Rs.18.33 crores for technical education. A much larger outlay, viz. Rs.40.1 crores which is more than twice that in first plan has been provided for the Second Five Year Plan. These amounts include both developmental and normal expenditure. So far as the States are concerned, the outlay during the first plan was of the order of Rs.7.0 crores. In the Second Plan they are expected to spend about Rs.28.66 crores, exclusive of the assistance received from the Centre.

Exact figures of the expenditure incurred by private agencies are not readily available, but it is estimated that this sector has contributed on an average about Rs.40-45 lacs per year in the last three to four years.

The importance of technical education in the national plan is further underlined by the fact that a much larger outlay is proposed in the Third Five Year Plan. According to the present estimates, an amount of about Rs.176 crores is required to press on with the expansion of technical education at all levels, as recommended by the Planning Commission.

The increasing outlay on technical education is not entirely due to the establishment of an increasing number of institutions and a similar quantitative expansion of the facilities. It is in part due to the fact that the cost of technical education itself is rising sharply. No reliable data are available regarding the cost of establishment of an engineering college or polytechnic prior to 1950, since few, if any, new institutions, were then established. Also, no standards of instructional facilities required for degree or diploma courses in various subjects had been laid down. On the basis of the standards now laid down by the All India Council, an engineering college with an annual admission capacity of 120 students for Civil, Mechanical and Electrical engineering costs today about Rs.40 lacs for buildings and equipment alone. The cost of land and its development for the establishment of the college, providing essential services, hostels, staff quarters, etc. are all extra. The running expenses of the college are of the order of Rs.8 lacs per year, if the salary scales recommended by the All India Council are offered to the staff. Not more than 25% of the running expenditure is met by the income from tuition fees. Similarly, the cost of polytechnic also has gone up and is of the order of Rs.18 lacs for buildings and equipment and Rs.3 lacs per year for recurring expenditure. When courses in special fields as, for instance, Mining, Metallurgy, Chemical Engineering etc. are added to a college, the cost goes up further.

CHART V


PROGRESS OF
TECHNICAL EDUCATION IN INDIA
1947-48 TO 1960-61
CENTRAL GOVT.'S EXPENDITURE
RUPEES IN CRORES
15
12
9
6
3
0
1947-48
1948-49
1949-50
1950-51
1951-52
1952-53
1953-54
1954-55
1955-56
1956-57
1957-58
1958-59
1959-60
1960-61
(ESTIMATED)

A major financial and organisational problem confronting planners therefore, is how to bring down the cost without sacrificing standards? The problem has two aspects. The first involves a consideration of the per capita expenditure. If the per capita expenditure is brought down by making an institution work longer hours and train a larger number of students, a quantitative expansion of the facilities can be secured at less cost than is otherwise possible. An attempt in this direction has already been made in the current Plan period and the training capacity of a number of institutions has been expanded in preference to new institutions being established for the additional number of students. Whether the same principle should not be extended to new programmes has to be examined in detail in the light of the actual experience gained in the last two-three years.

The second aspect involves the development of indigenous scientific instruments industry. According to the present estimates, at least 50% of the equipment required by an engineering college and 30% of the equipment required by a polytechnic have to be imported. The prices of imported equipment are rising steeply and in the last three years alone, the prices of many items have gone up by about 50% on an average. Apart from foreign exchange difficulties, such a large increase in the prices can upset completely the targets of a plan. The institutions will be hard put to it to equip themselves fully within the allotted funds. The solution to the problem lies in the development of indigenous industry and making the country self sufficient in respect of essential scientific equipment of quality and precision. The institutions themselves should be encouraged to make in their own workshops as many items of equipment required by them as possible. An expert committee of the All India Council for Technical Education has gone into this question and suggested various measures for securing economy in respect of equipment for technical institutions.

There is also the question of buildings that account for about 50% of the Capital cost of a technical institution. The practice so far has been to construct buildings in the traditional styles and on a gradiose scale with an eye to architectural embellishments rather than purely functional and economically designed buildings. Unless a radical departure from the current practice is made, technical education will remain an unnecessarily expensive proposition for India. Grand and expensive buildings are not synonymous with good institutions and many great engineers have risen from humble beginnings. We should revise our order of priority; give the first place to staff, the second to equipment and the last to buildings.

No report on Technical Education in India would be complete without a reference to Foreign Aid, that has played no small part in the recent developments in this field. The aid has been given by many countries generously and in a spirit of cooperation and has been readily accepted by us. It comprises scientific and technical equipment; the services of expert professors in various branches of technology; and facilities for the training of the teachrers of our institutions abroad. These are the three essential things that we are much short of for the establishment and development of institutions of advanced technological studies.

The first Foreign Aid to come was under the Unesco Programme. Since 1951 this aid has been extended every year for developing facilities for advanced studies and research at selected centres. Aid under other programmes, as for instance T.C.M. of the U.S.A., Colombo Plan etc. followed in increasing measure. Recently, under bi-lateral and other arrangements, very large assistance has been provided by certain countries in the establishment and development of entire technological institutions. Special mention must be made of the assistance provided by the U.S.S.R. for the

Western Higher Technological Institute at Bombay; by the Federal Republic of Germany for the Southern Higher Technological Institute at Madras; by the United Kingdom for the College of Engineering & Technology at Delhi; and by the U.S.A. for the Higher Technological Institute at Kanpur. It is the valuable aid of these countries that will accelerate the establishment and development of these important institutions.

The extent of Foreign Aid provided or promised for Technical Education in India is given in Table -IV.

TABLE-IV

Aid Programme/Country	Technical Aid Promised or Received upto 1960		
	No. of experts	Value of equipment in Rs. lacs	No. of Fellowships for training of Indian staff:
1. T.C.M. of the U.S.A.	88	163.27*	106
2. Colombo Plan.	37	52.08	24
3. UNESCO & UNTAA	18	13.47	30
4. U.S.S.R. Aid for Indian Institute of Technology, Bombay under UNESCO Programme.	18	166.80	20
5. U.S.S.R. (For Indian Institute of Technology, Bombay).	-	36.00	-
6. West Germany.	24	170.00	20
TOTAL:-	185	601.62	200

(*) Exclusive of aid of Rs.107.5 lacs provided by the U.S.A. out of the Rupee Fund for Indian Institute of Technology, Kanpur, for buildings and indigenous equipment.

(In addition a large number of teachers of technical institutions have been sent abroad for training on fellowships offered by various countries. So far over 500 teachers have been trained or are under training notably in the U.S.A., U.S.R.R., U.K., West Germany and France)

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XI. PRACTICAL TRAINING

The practical work done by students of technical institutions is an integral part of their training in becoming engineers and just as important a pre-requisite to successful technical studies. It serves many purposes. It is to acquaint students in practice (depending upon their field of study) with the production of materials, their moulding and processing, as well as with the finished products in composition, structure and mode of action. In addition, it is to familiarise them with the testing of a finished workpiece and with the assembly of machines and apparatus installation on the site, and control. In Civil Engineering, the training has to deal with the actual construction methods and techniques, the stability and strength of structures and various other aspects relevant to that field. This is also true of other engineering fields in which appropriate to each of them the training has to deal broadly with the processes and techniques, operations and controls, the functioning and capacity of machines, all geared to the attainment of a pre-determined objective.

According to this, the practical training has to fulfil three tasks. First, to acquaint the student with the production or construction methods. The training, for which only a limited time is available (contrary to conditions in the training of specialist skilled workers) has to be systematic so that the trainee may become acquainted with a whole range of methods and thus gain a wider experience. The trainee should also try to understand the principles underlying the various methods of production and extend his knowledge in that field. The training of specialist skilled workers and the practical training of students of engineering are quite different things. The purpose in training the former is to impart to them the manual skill that is required in their occupation and that is acquired by repeatedly practising on the same workpiece. The training of an engineering student, on the other hand, is intended to show him how the same final shape of a workpiece can be produced by means of different methods in accordance with constructional requirements. The workers training is intensive; the students practical training is more extensive, although the latter cannot dispense with a certain degree of man-ual skill. The knowledge and experience which he gains during his practical training are essential later on, to his professional work.

Next, the prospective engineering must become acquainted with works organisation which governs the structure and functioning of a factory. Third, the trainee should get to know the Works Community; the sociological problems of that community; the worker as an individual his strivings, his urges and his psychology; and the relationships between labour and management.

Only when an engineer student has gone through a definite programme of practical training on these lines, can he be regarded as possessing the minimum experience required for entry to the profession. It is the same as with the young medico who has to 'walk the wards' and serve a minimum period of internship in a hospital before he is qualified to enter the medical profession.

The way in which practical training is given to engineering students varies from country to country. In Germany every student has to serve as an apprentice in industry for a minimum period of six months before he is admitted to a technical university. While at the University, he works as an apprentice in industry during his vacations. Apprenticeship after graduation is also a common feature. The University has no workshops of its own for the preliminary practical training of students, which is looked after by industry. In the U.K. and U.S.A., although a preliminary practical training of six months is not prescribed generally as an essential requirement for entry to technical institutions, the institutions assume no responsibility for giving such training during the course in their workshops. The students have to undergo the necessary training in industry during the vacation or as graduate apprentices after their studies. The institutions, however, assist students in obtaining the necessary training facilities in industry. This system has worked well since, in these countries, organised facilities exist for practical training and Apprenticeship Schemes are an important feature of industrial organisations. The time spent by a student at the institution is devoted entirely to his course of studies which comprises theoretical and laboratory work and drawing.

A typical schedule of workshop training prescribed by Technical Universities in Germany prior to admission is as follows:-

(a)	Fundamental work at the Vice and in the Smithy(training workshop)	4 weeks.
(b)	Model joinery. -- --	4 "
(c)	Moulding shop and foundry. --	4 "
(d)	Machine Forging and drop forging. --	3 "
(e)	Welding shop (autogenous and electrical). --	3 "
(f)	Turning, plating shop, milling. --	6 "
(g)	Marking plate. -- --	2 "
		26 Weeks.

In India, the situation is very different. For a number of reasons, particularly the absence of organised practical training and apprenticeship facilities in industry, technical institutions have had to establish their own workshops where the students could be given necessary preliminary training during the course itself. The degree and diploma courses have therefore been so designed that their curriculum includes workshop practice. Depending upon the particular branch of engineering chosen by him, a student spends from 20 % to 35 % of the course time on workshop practice.

This position has raised two important issues.

First, how far is it justified that workshop practice, that does not strictly constitute academic studies, should cut into the course work of a student for degree or diploma? Second, is it desirable that a technical institution should spend as much as Rs. 4.0 lacs in the establishment of a training workshop, when that amount could be better utilised for scientific equipment for the laboratories and research work? This amount is about 20% of the outlay on equipment for an engineering college and about 50% that of a polytechnic. This may not seem a big amount for a single institution, but when computed for nearly 80 engineering colleges and 180 polytechnics, the proposition assumes large proportions.

Both questions are valid if only the conditions in India were different, and alternative arrangements could be made for the workshop training of technical students. As explained earlier, such training facilities provided in industry are extremely limited and generally not organised on satisfactory lines. Until the situation improves, and industry not only expands but is made to accept apprenticeship as its own responsibility, existing technical institutions have perforce to continue to provide workshop training within the curriculum of the courses, under their own auspices.

At this stage, a better and more economical way of organising workshop training might be suggested. Instead of each technical institution having its own training workshop, central workshops could be set up at selected places where the students could undergo the necessary training before joining technical institutions, or during their vacations or both. Such central workshops can serve specific areas or specific groups of institutions. The advantages of this arrangement are many. First, a central workshop can be better equipped for the same amount as a single institution. The better the equipment the better the standard and the wider the scope of training. Second, in actual practice, the workshop of an engineering college or polytechnic is utilised effectively in the training of students only up to a maximum of 40-50% the total time for which the workshop could work in a year. That is due to the requirements of the time table of the various courses of study conducted at the institutions, interruptions due to vacations and so on. There are no such limitations in the working of a central workshop and therefore a larger number of students can be trained with the same facilities, than is otherwise possible. Third, experience in Germany, U.K. and elsewhere shows that if students joined technical institutions after or preparatory workshop training they could do their courses better, and the entire time available could be devoted to academic studies.

Educationists also hold the view that workshop training during the course is an undersirable interruption of the academic studies. Fourth, a central Workshop with an organisational set up of different firm institutions and with better facilities could simulate the actual conditions of a factory and thereby impart to students practical training in such aspects, as production, methods and techniques etc. If the principle of preparatory workshop training at a central workshop is accepted, the duration of the actual courses at the institutions for degree or diploma could be reduced. Any additional training required by the students for a successful completion of the studies could be given during the vacations in the Central Workshop.

Workshop training prior to or during technical studies is only one aspect of practical experience. The other and perhaps more important consideration is the actual practical training in the field that every engineer or technologist should have in order to enter his chosen profession. That training is generally taken by a candidate after he has completed his academic studies at the technical institution. The duration of the training varies from subject to subject, but it is generally accepted that a two-year apprenticeship at a factory or similar organisation is necessary if a graduate or diploma holder has to be conditioned for gainful employment in his profession.

Prior to 1949, organised apprenticeship facilities for graduates and diploma holders were available in industry or government departments on an extremely limited scale. Even where such facilities were provided by the organisations at the specific request of the candidates or their institutions, the training was generally not supervised; nor were the trainees paid a stipend. The candidates were left to fend for themselves and that reduced enthusiasm for practical training. There were, of course, several exceptions where a few industrial concerns did offer practical training under proper supervision, but generally the position was far from satisfactory. The Scientific Manpower Committee that examined the matter from the standpoint of supply of trained technical manpower for various development projects recommended that the Central Government should assume a primary responsibility for arranging practical training of graduates and diploma holders. The Central Government accepted the recommendation and in 1949 formulated a scheme of Practical Training Stipends and initiated it.

Under the scheme, practical training places are secured in industrial concerns, technical departments of the Central and State Governments and in other organisations where graduates and diploma holders can learn in practice the application of the general principles and techniques of technology in their chosen fields as also the organisational and human relations aspects of industrial enterprise. The duration of training varies from one to two years depending upon the particular fields and the establishments covered by the scheme. The programme of training is generally drawn up in advance in consultation with the establishment and every effort is made to follow it. During training, a graduate is paid a stipend of Rs.150/- p.m. and a diploma holder Rs.100/- p.m. to enable them to meet expenditure on board and lodging.

In the last ten years, the scheme has been gradually expanded both in the number of training places and the range of fields of training. There are at present over 2000 training places available every year for fresh entrants in about 500 establishments, that include industrial concerns in the public and private sectors, Railway workshops, Defence Organisations, Power Projects, Transport and Communications organisations etc. An important feature of the scheme is that a large number of industrial concerns in the private sector not only provide the necessary training facilities but contribute towards a part of the expenditure on the stipends. The contribution varies from concern to concern, but is generally between 40 and 50% of the expenditure.

Since the training establishments are located at large cities or industrial areas, accommodation for the trainees, who come from every part of the country is a major problem. An attempt is however made to construct hostels, wherever possible. Interest-free loans are being given to industrial concerns and other organisations for the construction of trainees hostels.

The Practical Training Stipends Scheme is not in itself is a complete answer to the problem of professional development of fresh graduates and diploma holders. The maximum number of training places secured so far under the scheme is about 2000 as against the present output of 4480 graduates and 8140 diploma holders from all technical institutions. It is true that a certain number of the graduates and diploma holders as soon as they leave the institutions secure jobs and the employers concerned give them the necessary practical training as a kind of in-service training. It is also true that because of the present unusual demand for technical personnel, fresh graduates and diploma holders without practical experience are able to get jobs and therefore all the training places available are not always fully utilised. Nevertheless, unless a graduate or diploma holder has had a broad-based practical training in his field, he is not developed professionally and he is not fit to be employed in any responsible supervisory or executive position. Therefore, when the demand and supply of technical personnel reaches an even level, a one to two-year practical training has to be made compulsory for all graduates and diploma holders. Then, a national apprenticeship scheme becomes necessary that will compel every industrial organisation to provide facilities for practical training commensurate with its size. A bill for the introduction of such a scheme is, at present, under the consideration of the Central Government.

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XII: THE TECHNICAL TEACHER

The heart of an educational institution is the teacher. It is the quality of staff, that in the final analysis makes for the success of an institution. That is even more so in the case of a technical institution where the nature of studies makes closer contact between the teacher and the taught imperative, and demands of the former both academic excellence and professional competence.

A serious problem confronting all our institutions today is the shortage of teachers that has been variously estimated as ranging from 40% to 50% of the required strength. In certain categories the shortage is said to be as high as 60% in a number of institutions. It is not merely the existing shortage, but the fact that it will increase as new institutions are established and the existing ones are expanded that causes concern. The difficulty in obtaining staff of the right calibre and in the required numbers is a serious limitation to the further development of technical education. If in spite of this new institutions are established in large numbers, we run the risk of lowering standards of education and training. This should be avoided at all costs. It is better to train one competent engineer than five inadequate ones. In fact, several educationists hold the view that all further expansion of technical education should be stopped till the staff position at existing institutions has been improved.

The problem of shortage of staff is a complex of various factors. First, the teaching profession is not financially as attractive as industrial or departmental career, which offers far better opportunities of professional advancement, better salaries and what is erroneously regarded a superior 'social status'. The wide disparity in the salaries of teachers of technical institutions and professional engineers in government departments is not just an accident of history. It is the result of a deliberate view held over a long period that the latter are more important to the economic and social life of the country. The difference is so marked that till recently, the salary of a professor of engineering in a large number of institutions, was half that of a Superintending Engineer in the Public Works Departments; and a lecturer was considered less valuable than an assistant engineer. In these circumstances, it is hardly to be expected that well-qualified and competent engineers would prefer to work as teachers than as professional engineers. Only in rare cases does the compensation of 'academic' life, a nebulous affair to most men as practical engineers, influence the decision of an individual in favour of teaching and research.

The second factor is that no organised effort has been made by the institutions themselves to attract bright young graduates to the teaching profession when their ideas are just being formed, not set, train them further and offer them suitable positions on their staff. Instead, the attitude of many institutions is one of abject dependence on the market supply, which more often than not fails them. Good teachers do not grow on trees. They have to be created through a long process, wisely planned on the same lines as the investment policy of an industrial or commercial organisation. That is essentially a responsibility of the institutions themselves.

The third factor is that few technical institutions are involved continuously with industry, technical departments of governments and other organisations. They function in complete isolation from each other. It is only when an institution builds up a living contact with industry that it is able to attract experts in industry as part-time teachers initially and later on, in full-time teaching positions. The part-time staff not only helps to fill vacant positions that cannot otherwise be filled, but brings to bear on the teaching a quality that only professional experience in the field can supply. To that extent, the standards of education and training are bound to improve. There are always persons in industry who at some time or other in their career show a genuine interest in 'academic' work and could be won over to technical institutions.

There are several other factors, as for instance, lack of housing for staff and other amenities, an overwhelming demand for well-qualified engineers in industry and other organizations, inordinate delays involved in the recruitment procedures, regionalism in appointments etc, that have contributed their share, large or small, to the present serious staff shortage.

The problem has to be solved by the collective effort of all concerned, the Central Government, State Governments, Universities and institutions. A uniform policy for all institutions has also to be adopted. The most important step taken by the Central Government is to accept revised salary scales for teachers of all technical institutions that compare favourably with the salary scales of technical personnel in government departments. It has also agreed to bear the entire additional expenditure involved for a period of five years in the first instance. The revised salary scales provide for a uniform improvement as shown below:

(a) <u>For institutions conducting first degree courses</u>:

(i)	Principal or Head of Institution.	:	The salary scale should be the same as for the Chief Engineer in the State Public Works Department.
(ii)	Professors	:	The salary scale should be the same as for the Superintending Engineer in the State Public Works Deptt.
(iii)	Assistant Professors	:	Rs.600-40-1000-50/2-1150
(iv)	Lecturers	:	Rs.350-350-380-380-30-590-30-770-40-850.

(b) <u>For Polytechnics</u>:

(i)	Principal or Head of Institution.	:	Rs.800-50-1250.
(ii)	Heads of Departments	:	Rs.600-40-1000-50/2-1150
(iii)	Lecturers	:	Rs.350-350-380-380-30-590-30-770-40-850

The salary scales prescribed for Assistant Professors and Lecturers in all degree institutions are uniform. It is in these categories that the largest migration of persons takes place from one institution to another or from institutions to industry and government departments. By making the salary scales uniformally the same, the migration could be minimised. Also, the revised salary scales are the same as Class-I senior and junior scales respectively of the Central Engineering Services. The same general principles govern the sanction of uniform scales for Principals, Heads of Departments and Lecturers of polytechnics.

At the level of Principals and Professors of engineering colleges, parity with Chief Engineers and Superintending Engineers of the concerned Public Works Departments has to be accepted. The migration of Principals and Professors from one region to another takes places only on a very limited scale. Possibly because they are in an advanced age group which implies domestic and other responsibilities greener pastures far from home do not attract them greatly. Therefore, the question of uniform scales for all colleges on an all-India basis does not arise. Parity with the scales of Chief Engineers and Superintending Engineers ensures that the opportunities of advancement that the Principals and Professors would have had, had they joined the departments, are not denied to them. It also offers attractive enough terms to engineers in service to join technical institutions as teachers.

The importance and urgency of adopting the revised scales at all institutions need no underlining. Even if the outlay on equipment and buildings has to be reduced in order to meet the additional expenditure on staff salaries, that is well worth doing, since richer dividends can be expected in the long run.

The revised salary scales proposed for technical teachers are far higher than the scales sanctioned for teachers of Science, the Humanities and other disciplines at universities and other educational institutions. For instance, the salary scale sanctioned by the University Grants Commission for a University Professor in Science or the Humanities is Rs.800-50-1250; for an Assistant Professor or Reader, it is Rs.500-25-800; and for a Lecturer, Rs.250-500. The issue that has been raised in certain quarters is, how far is it justified to single out teachers of technical disciplines and treat them on an entirely different footing? It is also held that apart from this inequity, a Professor of Physics or Mathematics or Literature at an University has to have higher academic qualifications and research experience than a Professor of Engineering at an engineering college. The point acquires added force when at the same University with departments of Science, the Humanities and Engineering, the teachers of the engineering department are distinguished by higher salaries for their posts.

Everyone agrees that it is not right to discriminate between teacher and teacher. Every one also wishes that it were possible to remove existing disparities between the teaching profession and other professions like the administrative services, Engineering service etc. The hard fact, however, is that there is no one to bell the cat. When the resources of the state are limited and economic development is an essential prerequisite to social advancement, priorities have to be accepted, however untenable they may be from a purely moral or ethical point of view. The issue is strictly one of having an 'Operational approach' to a situation that contains many contending claims. As long as the economic progress of the country depends upon an adequate supply of technical manpower, a premium must be set on Technical Education. If the law of demand & supply operates in that field a higher price has to be paid when the situation demands it.

The mere offering of higher salaries is not by itself a complete solution to the problem of staff shortage at technical institutions. The problem has to be tackled from many directions, the most important of which is continuously to train and create a cadre or pool of Technical Teachers. The Central Government initiated in 1959 a scheme of training of technical teachers at five selected centres. About 110 young graduates have been selected and sent for training at the Indian Institute of Technology, Kharagpur, Bengal Engineering College, Sibpur, Roorkee University, Engineering College, Poona and Engineering College, Guindy, Madras. The programme of training that extends over a period of two to three years covers three distinct aspects viz. a course of advanced studies or research in a selected branch; participation in actual teaching work of the college as understudy to a Professor including a course in pedagogy; and practical training in industry. The course of advanced studies or research is intended to give the teacher-trainee a depth of knowledge in his own field, an essential qualification of a good teacher. As an understudy to a Professor the trainee is introduced gradually to actual teaching work for the undergraduate classes and is made to participate in lecturing, supervision of laboratory practicals, tutorials and other aspects of work of a regular teacher. This is a sort of Practice-School method in which the trainee gains actual teaching experience under supervision. This experience is supplemented by a course in pedagogy specially organised for the purpose. Part of the time, especially the vacations, is spent in industry or a technical organisation to acquire the necessary practical experience in the field that makes of an individual a good teacher.

Each teacher-trainee is paid a stipend of Rs.350-25-400 during training and is also assured of a position on the staff of a technical institution after the training.

This integrated programme of Teacher Training will produce a fresh pool of teachers from which both existing and new institutions could draw their future staff. It is necessary to develop the programme in the coming years and train larger numbers of persons as teachers, not only for engineering colleges but for polytechnics. The details of the training for the latter have however, to be adjusted to the requirements of polytechnics.

In addition to training within the country, a large number of persons, who are either working as teachers or are sponsored by technical institutions has been sent to the U.S.A., U.K., U.S.S.R., West Germany and other countries for training under various Foreign Aid Programmes. Over 500 teachers have so far been trained or are under training abroad.

Another measure necessary for the improvement of staff position is that the recruitment policy of technical institutions should be revised and made more flexible. At present institutions generally create only as many posts as are strictly required each year for the teaching work. Rarely do they plan ahead by anticipating their future requirements for staff, create the necessary positions in advance, recruit potentially suitable persons, train them and employ them. The existing arrangement would work all right if there were a steady supply of trained teachers at all times. In the absence of such a supply, the demand as it arises remains unmet and shortage of staff is felt keenly. The institutions should therefore look beyond their immediate requirements and follow a more progressive recruitment policy.

Housing for teachers is becoming a matter of increasing concern to educational administrators and institutions alike, who hold the view that in the absence of this essential amenity the prospects of attracting well qualified persons to teaching positions are very restricted. That apart, the nature of work of technical institutions seems to require that the staff should live on the campus. On several occasions in the past, the All India Council for Technical Education has emphasised the problem of housing and recommended that institutions should be assisted in the construction of staff quarters. Owing to inadequate financial resources, however, the recommendation has so far not been implemented. It is estimated that to provide residential accommodation to 25% of the staff, an amount of Rs.5.0 crores would be required. That is indeed a large amount as compared to the estimates of cost of other aspects of technical education. Nevertheless, if the problem of housing for technical teachers has to be solved in the larger interests of technical education as a whole, some priority must be given to this matter in the allocation of resources in the Third Five-Year Plan.

A last word about teachers of technical institutions. We may offer the most attractive salaries possible; provide residential accommodation and create other amenities of life. No teacher, however, is worth any of these unless he is not only a scholar in his own subject but also a competent engineer. It should be his constant endeavour to improve both his academic scholarship and professional experience. Mere teaching out of the texts that he studied as a student is dead experience. Nothing survives but what is alive and adapts itself to conditions around.

In all first-rate technological institutions elsewhere in the world, a good teacher is engaged constantly in research in industrial or professional consultative work and in many other activities that bring him into close contact with the current developments in his own field. It is this primary activity that keeps him a living force in the institution and also raises the standard and improves the quality of his teaching work. It is said that at technical universities in Germany, professors as a rule work as industrial consultants. Even their selection as professors is made <u>inter-alia</u> on the basis of their standing in the professional field. In fact, it is through the association of their professors with industry that the universities are able to secure large sums for laboratories, special research facilities etc. and not depend upon the State to provide them. Similar arrangements are a common feature of all institutions in other advanced countries.

Unfortunately, in India, the situation is entirely different. Few of our professors have any worthwhile contact with industry or in the professional field. They function in isolation and are exclusively concerned with teaching according to a set curriculum and syllabus and preparing students for external examinations. In the selection of staff, institutions tend to place a high premium on teaching experience rather than on research and professional experience. Strangely, the rules of service in many government and non-government institutions are so restrictive that a teacher is discouraged from doing professional consultative work that is otherwise to his own benefit as also in the best interests of his institution. If this state of affairs continues it will not be long before our institutions are cut off completely from the main currents of engineering developments and their <u>raison d 'etre</u> is called into question.

A deliberate effort should be made by technical institutions to encourage their teachers to work on research projects sponsored by industry and to accept professional consultative work. For its part, industry, including technical departments of government should refer its problems requiring research investigations and design, production and construction problems to institutions and pay for the services rendered by the institutions or the professors concerned. They should also invite the teachers to spend stated periods [illegible] organisations: extend to them the facilities and opportunities whereby they may enrich their professional experience and encourage them to work on and find solutions to their various technical problems.

All these are facilitated by a mutual understanding and cooperation between technical institutions and industry. A mental revolution in both is urgently required.

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XIII. THE TECHNICAL STUDENT

If the pattern of courses, organisational structure, staffing, equipment, buildings etc. are all important aspects of Technical Education, equally important, if not more so, is the student himself. Ultimately, it is he who has to benefit from the educational facilities created at great cost and effort. His selection and admission to the course of his choice, his residence, cost of education, welfare etc. are all important questions. They affect the quality and standard of the future engineers and technicians.

In the last eight to ten years, a revolutionary change has taken place in the attitudes and values of the student community in the country. It is now the ambition of many students going up to university to secure admission to an engineering college and become engineers. The reasons are not far to seek. The attraction of a technical career in life with the higher economic status or earning power implied, as also the higher store set by the engineering profession are the main reasons. The ambitions of parents, the more pronounced for age and experience, set a high premium on engineering education for their children. The prayers sent up by them at the time of college admission if counted, and the frantic efforts made by tens of thousands of young students each year to secure admission, bear ample testimony to the importance given to technical education in present-day Indian society.

It is said that for every seat at an engineering college, there are at least ten qualified applicants. In this great rush for admission, how are the institutions to select the best students?

The methods followed in the selection of students vary from institution to institution. Some institutions select candidates on the basis entirely of the marks secured by them at the qualifying examination viz. Intermediate in Science or Higher Secondary. Some throw in an interview or viva-voce which lasts about ten minutes for each candidate, but otherwise depend on the performance at the qualifying examination. Others again hold an admission examination of their own both written and viva and select on the basis of the performance of candidates at this examination. The reason advanced for a separate admission examination is that the standards of the qualifying examinations of Universities or State Boards of Secondary Education vary widely and when students who have passed these examinations apply to the same institution, the institution is hard put to it to adopt a uniform standard of assessment of the applicants. A separate admission examination at which the inter se merit of the applicants could be judged on a uniform basis is therefore necessary.

There is not much to be said either in favour of or against any particular method. The question is one of each institution selecting as many candidates as the seats available out of a group of eligible applicants. Until a few years ago, this did not present a serious problem either to the institutions or to the candidates. The number of engineering colleges was small and the attempts of the applicants were confined mostly to institutions in their own states. Recently, with a large increase in the number of institutions, some of which are making admissions on an all-India basis, and a great rush for seats, the problem has assumed different dimensions. The position today is that a candidate for admission to an engineering course generally takes many tests and many interviews. He can avoid such multiple tests and interviews only if he decides to take his chance at only one institution. Such a decision requires not only great self-confidence but also a knowledge of the possibilities regarding admission to various institutions which a young student cannot generally be expected to have.

So far as the institutions are concerned, their difficulties have increased. Their main concern should be to admit students of the right calibre according to certain definite and uniform standards. If each one of them conducts its own admission examination, it has to make the necessary arrangements at a number of centres to suit the convenience of the candidates. Its programme of examinations may clash with those of other institutions and this may lead to various complications. Even after making a first selection of candidates, the institution is not always sure that all of them will join since some candidates delay till the results of selection at other institutions where they have tried to obtain are known. The institution is therefore forced to extend the last date of joining in order to ensure that all the seats are filled.

In order to remove these various difficulties of both students and institutions and to ensure some uniformity in the standards of admission, the All-India Council for Technical Education recommended some time back that a common admission examination should be held for all institutions which could be taken by any eligible student. The examination should be held on a regional basis through regional boards set up for the purpose and the standards should be co-ordinated on an all-India basis by a Central Coordination Board. On the basis of the results of this common examination, individual institutions should select candidates from among those who have applied for admission to them.

Unfortunately, this important recommendation has not found much favour with institutions under the control of State Governments, Universities and other authorities. Efforts, however, continue to be made by the Central Government to secure general acceptance. Pending such acceptance, the Central Government has decided to hold a common admission examination for all higher technological institutions and other institutions that will agree to join in the scheme. That at least represents some progress made towards ensuring uniformity of the standards of admission to these important all-India Institutions. It is hoped that in the larger interests of students and technical education all institutions accept the scheme of common examinations ere long.

The question of an 'Aptitude Test' for admission to technical institutions has often been discussed by various committees, and individuals, but opinion remains sharply divided. Those in favour of it suggest that if in addition to academic suitability, the candidates are proved to have an aptitude for engineering studies, the wastage during the course could be minimised. Those who do not favour it question not the principle but the practicability of conducting such a test in the present circumstances. They point out that at least for higher engineering studies no reliable and objective aptitude tests have been designed so far and if tests on an <u>ad hoc</u> basis that involve several subjective factors are conducted, the results may be to the detriment of students who are otherwise potentially good. According to them the results of the tests conducted as an experimental measure at certain institutions at different times contradict one another.

There is much force in these arguments. Some kind of objective tests can perhaps be designed to test the aptitude of a student for purely mechanical skills as for instance, machining, turning, welding, carepentry etc., in which he wishes to be trained as a skilled worker. Such a test may even be necessary in the selection of a candidate for training at this level. For higher engineering studies, however, the term 'aptitude' has an entirely different significance. Here it is not so much the so-called 'mechanical aptitude' of a candidate as his intellectual capacity to understand the basic principles of physics, mathematics and other fundamental sciences and their application to problems of engineering design, construction and production that is important. That intellectual capacity is best determined as at present, by his academic career or performance at a separate admission examination held for the purpose. An interview of candidates by a competent committee will ensure that only those who are potentially capable of undergoing engineering studies are selected. These considerations apart, the so-called 'mechanical aptitude' of a student depends largely on his environment and other external factors. If he has had opportunities of fiddling with his father's car or his mother's electric iron, he may impress others with his so called 'technical bent' of mind. But, that does not necessarily mean he will make a good engineer. On the other hand, if he is born of poor parents and has few opportunities of coming into contact with things mechanical he may fail to measure up to the usual aptitude tests. That does not mean he will fail to become a good engineer given the necessary education and training. The intellectual ability of a prospective engineering student cannot and should not be subordinated to an aptitude test that is at best purely arbitrary at present. Until more reliable tests are designed that take fully into account the actual requirements of engineering studies, the present methods of selecting candidates on the basis of their academic record will have to continue. There is, however, no gainsaying the fact that ample opportunities should be provided to young students in their early years to develop an interest in science and technology.

The next important point is the expenditure incurred by a student on his engineering education. This expenditure as compared to other fields of education, has always been high and is increasing every year. It is estimated that a student of an engineering degree course has to spend to-day about Rs.100 p.m. on his fees, lodging and boarding at a college hostel and other items. He has also to spend at least about Rs.500/- on books, instruments, tours etc. for the entire course. For the diploma course, the average expenditure varies from Rs.60 to 75 p.m. In our present economic position, that is undoubtedly beyond the resources of a large number of our students, Many a deserving student in indigent circumstances therefore is either unable to continue technical studies or does so with extreme difficulty. State aid to him in the form of scholarships, stipends etc. is therefore necessary.

Till 1959, the number of scholarships and stipends available at a majority of our technical isntitutions was extremely small. It covered barely 5% of the students studying at institutions. Their value too was inadequate to meet the full expenses of the students. In order to improve the position, the Central Government in 1959 formulated and implemented a scheme of Merit-cum-Means Scholarships for students of all technical institutions. Under the scheme 1040 Scholarships have been instituted for the students of degree and diploma courses. Each scholarships is tenable for the full course of studies of the students concerned and is of the value of Rs.75 p.m. for degree students and Rs.50 p.m. for diploma students. The scholarships holders are either exempted from the tuition fees by their own institutions or have their scholarships increased by an amount equal to the fees payable by them. It is proposed to institute another 1040 scholarships in 1960-61 for fresh entrants.

In addition, all four Higher Technological Institutes as also the eight Regional Engineering Colleges that have been sponsored by the Central Government, have made provision for the award of scholarships of an adequate value to 20-25% of their students.

Nevertheless, even with these Merit cum Means Scholarships and the provision made at the Higher Technological Institutes and Regional Colleges, only 5% of the new entrants to technical institutions are covered by scholarships. The rest have to depend upon their own meagre resources to finance their technical studies. It is therefore unnecessary to emphasise the urgent need to increase the number of scholarships and stipends for meritorious poor students. A minimum coverage of 25% has to be aimed at at all institutions in the course of next five years.

So far as post graduate studies and research are concerned the position is more satisfactory. From the very beginning, the All India Council for Technical Education insisted that at least 50% of the places in post-graduate courses should carry scholarships of the value of Rs.150 p.m. This was accepted by the Central Government and a provision was accordingly made at all centres of post-graduate studies. After a further review of the matter, the All India Council recommended recently that cent per cent of the places should carry scholarships and the value of the scholarships should be increased to Rs.250 p.m., in view of the high cost of education at this level and the need to attract really first rate students to post-graduate studies who will otherwise seek attractive professional appointments after graduation. This has also been accepted by the Central Government. As a result nearly 500 Scholarships of a reasonably good value are or will shortly be available for post-graduate studies in various branches of technology.

On the recommendations of the Scientific Manpower Committee the Central Government in 1949 implemented a scheme of Research Training Scholarships to encourage bright young students to do research in basic sciences after M.Sc. or in Technology after graduation in that field, at Universities and other educational centres. Initially 200 scholarships were sanctioned. In the course of the last ten years, the number has been increased to 800. Each research scholarship is of the value of Rs.200 p.m. and is tenable for a period of three years for an individual scholar. A number of these research scholarships have been made available at various technical institutions for research in technology.

It has nevertheless been observed that a good proportion of the research scholarships sanctioned for technology are not being utilised. The main reason is again the relatively greater attraction of professional employment than research. The former offers to a bright young graduate an assured career in industry or in a government department and if it happens to be an engineering service that he joins, the service offers prospects of quick advancement whose temptation is irresistable to most. On the other hand, in the present national situation, research is an uncertain affair, though more challenging intellectually, less rewarding financially. The number of well-paid research positions as compared to occupation in other fields is extremely limited. Therefore, if research has to be promoted in the larger interests of the country's advancement, greater inducements have to be offered to young bright graduates to come for research. The All India Council for Technical Education has recommended that research fellowships of the value of Rs.400/- should be instituted for post-graduate research in technology. Other expert Committees have recommended various measures to make research career more attractive and to raise its level to that of other professional services. It is to be hoped that when these measures are implemented and research is organised and developed as an essential activity of major industrial concerns in the private and in the public sector, technical departments of government and other organisations, there will be an increasing flow of research students to technological institutions.

The next question is the provision of adequate facilities for the students of technical institutions. With a large increase in the number of institutions and the student enrolment nearing the 100,000 marks, the demand for hostel accommodation is increasing correspondingly. When a large number of students have to leave their homes to join technical institutions located far away, their residence, their healthy and corporate life, their discipline are all serious matters that concern educational authorities and parents alike. It is only when an institution has its own hostel to provide the necessary residential facilities to its students that it can ensure their care and welfare. The establishment of a hostel is therefore an integral part of a technical institution.

Fortunately, due to the enlightened policy followed by the Central Government since 1947, the present position in respect of hostels for technical students is satisfactory. The Government has assisted institutions in building hostels by advancing interest-free loans repayable in easy instalments. Definite standards of hostel accommodation to be provided at an institution, the cost of the hostel etc. have been worked out. On the basis of these standards is determined the loan to be given for the construction of hostels. For example, it has been accepted that for a residential institution, the hostel facilities should cover the entire student body and in the case of a non-residential institution, they should be for 50% of the students. In the later case, the remaining 50% of the students are expected to live with their parents or guardians or find suitable lodgings elsewhere. However, if the institution is located in a large town or city where outside students are unable to find suitable lodgings, the scale of hostel accommodation is increased to meet the requirements. Similar standards have also been laid down for the type of hostel to be constructed and the various amenities to be provided.

So far, loans amounting to Rs.4.51 crores have been sanctioned for the construction of hostels. This will rise to 6.81 crores by the end of the Second Plan period. In terms of actual hostel seats provided, it covers over 24,000 students. This is in addition to the hostels constructed at all higher technological institutions and other institutions of the Central Government, the entire cost of which is borne by the Centre.

XIV. TECHNICAL EDUCATION AND PROFESSIONAL SOCIETIES.

The function of a professional society of engineering is two-fold. First, to promote and advance the science & practice of engineering. Second, to ensure that only persons of the right type and with the requisite qualifications enter the profession. This two-fold function has a direct bearing on technical education and training and, therefore, professional societies are and should be intimately concerned with former. In the interests of the engineering profession, the societies should constantly strive to raise the standard of technical education. In the light of new developments in the field, they should advise institutions on other improvements necessary to ensure that the future engineers who join the profession are trained along correct lines.

In India, the first professional engineering society to be established is the Institution of Engineers which came into being in 1920. It was organised and developed on the same lines as the Institutions of Civil, Mechanical and Electrical Engineers, (London) and received a Royal Charter in 1935. As the field of engineering widened and new branches were added, separate professional societies were established to promote the new branches. There are today three other professional societies viz. The Indian Institute of Chemical Engineers, The Institution of Tele-Communication Engineers (India) and the Aeronautical Society of India that are concerned respectively with Chemical Engineering, Electrical Communication Engineering and Aeronautical Engineering. There are also other societies as, for instance, the Mining, Metallurgical & Geological Institute of India, and the Institute of Metals which are both scientific and professional bodies.

How far have the Institution of Engineers and other professional bodies helped to advance technical education and training in India? It is hard to answer the question at this stage since it is only in the last five or six years that the business of technical education has been pursued vigorously and that is too short a period in which any professional body could make its impact felt either qualitatively or quantitatively. Nevertheless, these various professional bodies are represented on the All India Council for Technical Education, its Boards of Studies and other

Committees where the benefit of their counsel and advice on various problems is secured. It is to be hoped that the Institution of Engineers and its sister engineering societies will play their rightful part in the future development of technical education along the correct lines and establish close collaboration between technical institutions and the engineering profession.

An important aspect of this activity that is closely related to professional development is the examinations held by the societies to admit candidates to the fraternity of engineers. The Institution of Engineers first instituted the examinations in 1928 to admit candidates to the Associate Membership who have not had the benefit of formal education and training at a university or technical institution but who are nevertheless fit to enter the profession as qualified engineers in virtue of their experience and knowledge in the field gained through apprenticeship or service or in any other way. The Institution of Tele-communication Engineers (India) and the Aeronautical Society followed suit. The Associate Membership Examinations of these three professional bodies are recognised by the Central Government for purposes of appointment to superior posts in the relevant fields. It is understood that nearly 1500 candidates sit for the examinations every year and about 250 of them succeed and join the ranks of full-fledged engineers.

A serious doubt has been raised in certain quarters, about the examinations of professional bodies. In the context of present-day advances in science and technology how far are we justified in admitting a candidate to the profession of engineering merely on the basis of an examination passed by him when he has not gone through a rigorous training in engineering and associated scientific disciplines at a recognised university or institution? Advocates of this view argue that the practical experience gained by a candidate in the field is all right in so far as the particular job held by him is concerned. That, however, does not give him either the extent or the depth of knowledge in the broad field of engineering and the underlying scientific principles, which can only be acquired through a process of academic training at an institution that includes not only theoretical studies but also practical work in laboratories, drawing halls etc. Professional experience itself is a term of varying import and significance and no uniform yardstick can be devised to measure the experience of candidates doing various types of jobs. What is even more difficult to assess is the quality of that experience, and how far that has helped a candidate in his understanding of engineering. If these important considerations notwithstanding, a candidate is declared fit to enter the fast developing and complex field of engineering on the basis of the examinations passed by him, our future engineers will not be of the brightest calibre. That system is only a mill to produce engineers of an indifferent quality.

Perhaps, these views are of an extreme section of the engineering or academic fraternity. Nevertheless, they raise an important issue of standards of training and professional competence, that deserves careful consideration.

To hold examinations by a professional body of engineers is special feature of the British scene. The Institution of Engineers (India) is to follow the British example very closely. The main concept is that the training of an engineer is not exclusively through an organised course conducted at a technical institution for students specially selected and admitted for the purpose. An engineer also comes up the hardway, through apprenticeship and professional experience gained over a number of years in factory or field. He should be given every opportunity to supplement his practical experience with the theoretical knowledge of his subject and to qualify as a professional engineer. His chances of advancement should not be the less because he has not had the good fortune of a formal education at a university provided he has the capacity to become an engineer through self-effort.

The success of this concept in the United Kingdom is largely due to two factors. First, industry and other organisations there have a highly-developed and well organised system of apprenticeship. Second, facilities for part-time courses are organised on a large scale, for the benefit of those who are working in industry. A deliberate policy of encouraging their employees and apprentices to take full advantage of these part-time courses is being followed by industry. It is understood that for every full-time student in engineering, there are over 30 part-time students. The part-time courses are specially designed to complement the practical experience of an individual. The two together equip him to sit for professional examinations and qualify as an engineer.

Our problem in India is that we have yet to organise on correct lines and on an adequate scale a system of apprenticeship training. Facilities for part-time courses also are extremely limited. This difficulty places on our professional bodies a heavy responsibility to evaluate correctly the practical experience of a candidate, the effort made by him to equip himself with the theoretical knowledge of his subject and decide whether or not he is fit to enter the profession as a qualified engineer. Otherwise, the so called engineers coming up the hard way will not enhance the standards of their profession and the institutions will only lay themselves open to severe criticism.

While on this subject, the importance of part-time courses in the expansion of technical education in the country and the urgent need to improve the facilities for such courses have to be emphasised. As against a present enrolment of about 1,15,000 students in full-time courses, the enrolment of part-time students is hardly 1000, somewhat less than one percent of the total student body. This is a most unsatisfactory state of affairs, particularly from two important view points. First, industries and other organisations are leaning heavily on university graduates even for routine engineering activity like construction and production, and operation and maintenance of plant etc. The graduates, however, should be used for other aspects of work like design, research, development etc. where their higher education could be put to correct use. Second, the chances of advancement for persons working within an organisation are limited notwithstanding their actual practical experience. They could only assume higher executive or supervisory responsibilities, if their practical experience were supplemented with adequate theoretical knowledge of their fields.

There are many reasons for the lack of development of part-time courses. The most important are that the general educational level of an average skilled-worker in industry has so far been poor; a general apathy on the part of industrial organisations to encourage their workers to improve themselves through part-time courses; and our technical institutions confining their efforts exclusively to full-time courses. In the interests of the country's development these should change, and the sooner the better. There has to be a mental revolution on the part of the management of industry, workers and technical institutions. All should cooperate to build up the facilities for part-time courses as an integral part of the technical education system in the country.

It would be a half-hearted attempt to suggest that the existing institutions should conduct part-time courses. It is also one way of passing the buck. These institutions are much too pre-occupied with their normal activity of full-time courses and are unable to devote the time and effort required to organising and developing part-time courses. The lack of contact between industry and institutions that exist at present is also a serious handicap. It requires a better understanding of the needs of industrial workers and a capacity to adjust the programmes of education and training to meet those needs. The present institutions, regulated in their thinking and action within a rigid framework of full-time courses prescribed by universities and state boards, are not in a position to voyage into unchartered waters. In these circumstances, the best course is for the government - Central and State, to establish separate institutions for part-time courses at selected centres that command a good catchment area for candidates for whom such courses are intended.

These special institutions should work in close collaboration with industrial concerns and other organisations which are served by them. The collaboration should not be a one-way traffic. Industry should not only advise the institutions on the types of courses to be conducted for the benefit of the workers and similar aspects, but should participate actively in the working of the institutions. It should be an important part of the participation that industry provides the services of its experts as part-time teachers at the institutions. Industry should encourage its promising workers to join the courses and offer them suitable incentives for the purpose in the form of part-day release from work, tuition fees etc. Professional advancement of the workers should follow as a recognition of the successful completion of the courses.

It is also necessary to bring the professional societies into this picture. The societies should advise the institutions on the standards of the courses, and suitable arrangements should be developed whereby candidates completing the prescribed courses satisfactorily are considered as having fulfilled the requirements for the corporate membership of the societies and are thus recognised as professional engineers. To this end, the examinations may be held jointly by the institutions and professional societies or alternatively the examinations held by the institutions are recognised by the societies after due assessment.

The special institutions should offer a wide range of courses to meet the requirements of different groups of workers. Some may be short courses to improve the operational efficiency of workers in their own fields. Some may be to prepare the workers for the state board diploma examinations and others to prepare them for the membership of professional societies. The question of conducting at the institutions university degree or equivalent courses on a part-time basis should also be seriously considered.

It is important that the training at the institutions is not narrowly professional but broad-based. Educationally this will not only advance the technical efficiency of the workers, but will raise their general educational level. The worker of today is the executive of tomorrow. He should be equipped for his new responsibilities, through an educational process specially designed for the purpose. The institutions should, therefore, adopt a comprehensive and integrated approach to the problem, keeping in view at all stages the social implications of technological progress.

XV. TECHNOLOGICAL HUMANISM

"If the humanities cannot be of service to man during his busiest and most critical hours, then assuredly they are merely a frill for the home-spun of life. The Romans understood by the word Humanitas the practical, daily use of great literature, art and philosophy by those men who had learned the moral, intellectual and imaginative power which habitual association with the best minds of civilization confers. The function of the course, then, is to enable students to think somewhat as the masters have thought about divine, human and eternal nature, and to enable them to feel to some extent the wonder, and awe, the spiritual elevation and power that the masters have felt when their insight into the forces of life has compelled them to produce artistic imitations or philosophic or scientific analyses so that lesser men might also penetrate the abstractions of the world."

Grand words - but the truth assumes a more practical form when a broad view is taken of the potential professional character of engineering as well as of the values that are inherent in the Humanities and Social Sciences. In the education of the professional engineer, the function of the Humanities and Social Sciences is not limited to the improvement of communication skills and the emergence of amiable employees. Nor is the primary function to provide a history of the arts, a convenient catalogue of factual information which is quickly consulted and used in conversation with cultured business associates. It is comparatively unimportant whether students know that the theory of flux preceded Plato's ideal of unvarying truth or that Bach was celebrated for polyphonic harmony and 20 children. The engineer is a responsible professional man, whose every professional act has human and social consequences. Whether he is aware of it or not, he is instrumental in the creation of a new society and a new economic order, as well as a new physical environment. One result of his professional accomplishments is that he is called upon to accept an increasingly responsible role as leader of his community. To fulfil his growing responsibilities the engineer needs both professional competence, a sure understanding of himself and of the world in which he lives. He needs 'depth, flexibility and a capacity for growth in directions in which we ourselves can today only dimly visualize'. The business of an engineering education is to provide him with a foundation upon which he may build a career of genuinely professional stature.

With this in view, the Humanities and Social Science can for us take their appropriate place as an integral part of total education. They do not stand apart from the rest of the curriculum; they support the scientific-technical training, and are in turn supported by it. They contribute to professional competence not merely in the narrowly vocational sense but in the broad sense of enabling the engineer to see his own activities in their human and social contexts. Even beyond this broad concept of professional development, the Humanities and Social Sciences represent for the engineer, as for all men, the heart of an inherited human experience.

For well over 20 - 25 years, all advanced countries have given much attention to the crucial problem of how to develop and maintain and effective programme of humanistic-social studies in Technological education. In the U.S.A. alone nearly 80 universities and technical institutions are actively engaged in this work and the American Society for Engineering Education has done much to promote an educational philosophy that is acceptable to the engineering and liberal arts faculties. The large volume of literature that has emerged on the subject bears ample testimony to the importance of the problem.

Unfortunately, both at our universities and our technical institutions little effort has been made so far to integrate humanistic-social studies into technological courses and to realise the full value of the contributions that the liberal arts can make to the training of engineers. The curricula of many institutions are conspicuous by the absence of any reference to the Humanities; in some, only a passing reference has been made but the subjects suggested viz. English Composition and Report Writing are intended only to improve the communication skill of the candidates. Only one university has included the Humanities in its engineering curriculum i.e. 3% of the total time - but the coverage of the subjects has been left vague. At the Higher Technological Institutes, however, a purposeful attempt is being made to profit by the valuable experience of other countries in this respect. A full-fledged department of the Humanities

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and Social Sciences with the same status as any technological department has been established at the Indian Institute of Technology, Kharagpur, and the prospectus of the Institute defines the objectives of the course as follows:-

> "In order to broaden the student's outlook beyond the limits of his immediate academic and professional interest, all undergraduate courses include a certain amount of non-technical, cultural and social studies which are grouped under the general designation of the Humanities".

The time has now come for Indian universities to address themselves to this problem of humanistic social studies and reconstruct their technological curriculum along more enduring and useful lines.

The recommendations of the Hammond Report to the American Society for Engineering Education are of particular value to our universities. The goals of what that report called the "humanistic-social stem" were stated, not in terms of subject-matter, but in terms of competences which the Humanities and Social Sciences could help the student acquire:

1. An understanding of the evolution of the social organization within which we live and of the influence of science and engineering on its development.

2. The ability to recognise and make a critical analysis of a problem involving social and economic elements, to arrive at an intelligent opinion about it, and to read with discrimination and purpose towards these ends.

3. The ability to organise thoughts logically and to express them lucidly and convincingly in oral and written English.

4. An acquaintance with some of the great masterpieces of literature and an understanding of their setting in and influence on civilization.

5. The development of moral, ethical, and social concepts essential to satisfying personal philosophy, to a career consistent with the public welfare and to a sound professional attitude.

6. The attainment of an interest and pleasure in these pursuits and thus of an inspiration to continued study.

ANNEXURE I

TECHNICAL INSTITUTIONS CONDUCTING FIRST DEGREE OR EQUIVALENT COURSES (1960)

(C.G.= Central Government; S.G.=State Government;CSG=Joint Central & State Governments;U=University; P=Private).

Name of Institution	Fields of Study	Annual Admission Capacity
1	2	3
NORTHERN REGION		
DELHI		
1. Delhi Polytechnic,Delhi(CG)	Civil,Mechanical,Electrical,Chemical Engineering; Textiles; Architecture*	200
	(*Since transferred to the School of Town and Country Planning, Delhi)	
PUNJAB		
2. Gurunanak Engineering College,Ludhiana(P)	Civil, Mechanical and Electrical Engineering	120
3. Punjab Engineering College,Chandigarh(SG)	Civil, Mechanical and Electrical Engineering	240
4. Thapar Institute of Engineering & Technology, Patiala (P)	Civil, Mechanical and Electrical Engineering	120

1	2	3
5. Technological Institute of Textiles,Bhiwani (P)	Textiles.	60
6. Department of Pharmacy,Punjab University, Chandigarh (U)	Pharmacy	15
7. Department of Chemical Technology,Punjab University, Chandigarh (U)	Chemical Engineering	30
RAJASTHAN		
8. Birla Engineering College, Pilani (P)	Civil,Mechanical,Electrical and Tele-Communication Engineering	240
9. M.B.M.Engineering College,Jodhpur (SG)	Civil,Mechanical,Electrical and Mining Engineering	175
10. Birla Science College, Pilani (P)	Pharmacy	20
UTTAR PRADESH		
11. College of Engineering and Technology, Muslim University, Aligarh (U)	Civil, Mechanical and Electrical Engineering	120
12. Engineering College,Banaras Hindu University, Varanasi (U)	Civil, Mechanical and Electrical Engineering	270

1	2	3
13. Engineering College, Dayalbagh, Agra (P)	Mechanical and Electrical Engineering	60
14. University of Roorkee, Roorkee (U)	Civil, Mechanical, Electrical and Tele-Communication Engineering; Architecture.	290
15. College of Mining and Metallurgy, Banaras Hindu University, Varanasi (U)	Mining; Fuel Technology; Metallurgy	110
16. College of Technology, Banaras Hindu University, Varasasi (U)	Chemical Engineering; Glass and Ceramics Technology, Pharmacy.	82
17. H.B.Technological Institute, Kanpur (SG)	Chemical Engineering, and Chemical Technology.	30
18. Government Central Textile Institute, Kanpur, (S.G.)	Textile Technology & Textile Chemistry.	30
19. National Institute of Sugar Technology, Kanpur (CG)	Sugar Technology	15
20. Allahabad Agricultural Institute, Allahabad (P)	Agricultural Engineering	25
21. Indian Institute of Technology, Kanpur (CG)	Civil, Mechanical, Electrical, Chemical Engineering and Metallurgy.	120 *

(* The ultimate admission capacity of the Institute is 300 students)

1	2	3
JAMMU & KASHMIR		
22. Regional Engineering College, Srinagar (CSG)	Civil, Mechanical and Electrical Engineering.	120
EASTERN REGION		
ASSAM		
23. Assam Engineering College, Gauhati (SG)	Civil, Mechanical and Electrical Engineering.	120
24. Government Engineering College, Jorhat. (SG)	Civil, Mechanical and Electrical Engineering.	120
BIHAR		
25. Bihar College of Engineering, Patna University, Patna (U)	Civil, Mechanical and Electrical Engineering	120
26. Bihar Institute of Technology, Sindri (S.G)	Civil, Mechanical (including Production) Electrical, Tele-Communication and Chemical Engineering; Metallurgy.	316
27. Birla Institute of Technology, Ranchi (P)	Civil, Mechanical and Electrical Engineering	270
28. Muzaffarpur Institute of Technology, Muzaffarpur (SG)	Civil, Mechanical and Electrical Engineering.	120

1	2	3
29. Indian School of Mines and Applied Geology, Dhanbad (CG)	Mining, Petroleum Technology; Applied Geology; Applied Geophysics.	150
30. Regional Institute of Technology, Jamshedpur (CSG)	Civil, Mechanical and Electrical Engineering; Metallurgy.	250
ORISSA		
31. College of Engineering, Burla (U)	Civil, Mechanical and Electrical Engineering.	120
WEST BENGAL		
32. Bengal Engineering College, Sibpore, Howrah (SG).	Civil, Mechanical, Electrical and Telecommunication Engineering; Mining; Metallurgy; Architecture.	400
33. College of Engineering and Technology, Jadavpur (U).	Civil, Mechanical, Electrical, Telecommunication and Chemical Engineering.	3[illegible]0
34. Department of Applied Physics, Calcutta University, Calcutta (U).	Applied Physics.	25
35. Institute of Radio Physics and Electronics, Calcutta University, Calcutta (U).	Radio Physics and Electronics	20

1	2	3
36. Indian Institute of Technology, Kharagpur (CG).	Civil, Mechanical, Electrical, Mining, Metallurgy, Chemical, Architecture, Naval Architecture, Agricultural Engineering, Applied Geology and Geophysics.	407
37. College of Textile Technology, Serampore (SG)	Textile Technology	30
38. Department of Applied Chemistry, Calcutta University, Calcutta. (U).	Applied Chemistry	36
39. College of Textile Technology, Berhampur (SG)	Textile Technology	30
40. College of Leather Technology, Calcutta (SG)	Leather Technology	10
41. Regional Engineering College, Durgapur (CSG)	Civil, Mechanical and Electrical Engineering; Metallurgy.	250
WESTERN REGION		
MAHARASHTRA		
42. Engineering College, Poona (SG)	Civil, Mechanical, Electrical and Telecommunication Engineering; Metallurgy.	294
43. Government Engineering College, Aurangabad. (SG).	Civil, Mechanical and Electrical Engineering	120
44. Victoria Jubilee Technical Institute, Bombay (P).	Civil, Mechanical and Electrical Engineering; Textile Technology	165

1	2	3
45. Walchand College of Engineering, Sangli (P)	Civil, Mechanical and Electrical Engineering.	120
46. Department of Chemical Technology, Bombay University, Bombay (U)	Chemical Engineering;. Pharmacy, Food Technology, Pharmaceutics, Textile Chemistry; Chemical Technology of Paints and Varnishes; Intermediates, dyes and plastics.	190
47. Laxminarayan Institute of Technology, Nagpur (U).	Chemical Engineering and Chemical Technology	36
48. Indian Institute of Technology, Bombay (CG)	Civil, Mechanical and Electrical Engineering; Metallurgy; Chemical Engineering.	150*
(*The ultimate admission capacity of the Institute is 300 students).		
49. Sir J.J. College of Architecture, Bombay (SG).	Architecture	100
50. Regional Engineering College, Nagpur (CSG).	Civil, Mechanical and Electrical Engineering.	250
GUJARAT		
51. Birla Vishwakarma Mahavidyala, Anand (P).	Civil, Mechanical, Electrical Engineering	240
52. Faculty of Technology, Baroda University, Baroda (U).	Civil, Mechanical and Electrical Engineering; Textiles Technology, Architecture.	340

1	2	3
53. L.D.College of Engineering,Ahmedabad (SG)	Civil,Mechanical & Electrical Engineering.	300
54. Lukhdhirji College of Engineering, Morvi (SG).	Civil, Mechanical and Electrical Engineering.	100
55. L.M.College of Pharmacy, Ahmedabad (P)	Pharmacy	76
MADHYA PRADESH		
56. Government Engineering College,Jabalpur (SG)	Civil,Mechanical,Electrical & Electrical Communication Engineering.	280
57. Madhav Engineering College,Gwalior (P)	Civil,Mechanical and Electrical Engineering.	120
58. Shri Govindram Seksarai Technological Institute,Indore (P)	Civil, Mechanical and Electrical Engineering	120
59. College of Engineering and Technology, Raipur (SG)	Civil, Mechanical and Electrical Engineering,Mining;Metallurgy.	180
60. Department of Pharmacy,Saugar University, Saugar (U).	Pharmacy	15
61. Maulana Azad College of Technology, Bhopal (CSG)	Civil, Mechanical and Electrical Engineering	250

1	2	3
SOUTHERN REGION		
ANDHRA PRADESH		
62. College of Engineering, Anantapur (SG)	Civil, Mechanical and Electrical Engineering	120
63. College of Engineering, Kakinada (SG)	Civil, Mechanical and Electrical Engineering.	120
64. College of Engineering, Osmania University, Hyderabad (U).	Civil, Mechanical; Electrical and Telecommunication Engineering; Mining.	255
65. College of Engineering, Andhra University, Waltair (U).	Civil, Mechanical and Electrical Engineering	120
66. Department of Chemical Technology, Osmania University, Hyderabad (U)	Chemical Engineering and Chemical Technology.	30
67. J.V.D.College of Science & Technology, Waltair (U).	Chemical Engineering; Chemical Technology; Pharmacy.	45
68. Regional Engineering College, Warangal (CSG)	Civil, Mechanical and Electrical Engineering	250
69. College of Engineering, Tirupathi (U)	Civil, Mechanical and Electrical Engineering	120

1	2	3
KERALA		
70. College of Engineering, Trivandrum (SG)	Civil, Mechanical and Electrical Engineering	210
71. Maharaja's College, Ernakulam (SG)	Pharmacy	10
72. Government Engineering College, Trichur (SG)	Civil, Mechanical and Electrical Engineering	120
73. T.K.M. Engineering College, Quilon (P)	Civil, Mechanical and Electrical Engineering	120
74. Nair Service Society Engineering College, Palghat (P).	Civil, Mechanical and Electrical Engineering	120
MADRAS		
75. A.C. College of Engineering and Technology, Karaikudi (P)	Civil, Mechanical and Electrical Engineering	120
76. College of Engineering, Annamalai University, Annamalainagar (U).	Civil, Mechanical, Electrical and Chemical Engineering	150
77. College of Engineering, Guindy (SG)	Civil, Mechanical, Electrical and Telecommunication Engineering; mining.	275
78. Coimbatore Institute of Technology, Coimbatore (P)	Civil, Mechanical and Electrical Engineering	120

1	2	3
79. Government College of Technology, Coimbatore (SG)	Civil, Mechanical and Electrical Engineering	120
80. Madras Institute of Technology, Chrompet, Madras (P)	Electrical Communication Engineering, Aeronautical Engineering, Instrument Technology; Automobile Engineering.	85
81. Thiagarajar Engineering College, Madurai (P)	Civil, Mechanical and Electrical Engineering	120
82. P.S.G. & Son's Charities College of Technology, Coimbatore (P)	Civil, Mechanical and Electrical Engineering	120
83. Department of Architecture, Madras University, Madras (U)	Architecture	20
84. A.C.College of Technology, Guindy (U)	Chemical Engineering; Textile Technology; Leather Technology	52
85. Department of Pharmacy, Medical College, Madras (SG)	Pharmacy	30
86. Indian Institute of Technology, Madras (CG)	Civil, Mechanical, Electrical and Chemical Engineering; Metallurgy	120*

MYSORE

(* The ultimate admission capacity of the Institute is 300 students)

87. B.D.T.Engineering College, Davangere (SG)	Civil, Mechanical and Electrical Engineering	120

1	2	3
88. B.M.S. College of Engineering, Bangalore (P)	Civil, Mechanical and Electrical Engineering	120
89. B.V.B.College of Engineering and Technology, Hubli (P)	Civil, Mechanical and Electrical Engineering	120
90. College of Engineering, Bangalore (U).	Civil, Mechanical and Electrical Engineering	210
91. National Institute of Engineering, Mysore (P)	Civil, Mechanical and Electrical Engineering	120
92. Indian Institute of Science, Bangalore (P)	Electrical Engineering;Tele-communication Engineering; Chemical Engineering;Metallurgy; Aeronautical Engineering.	130
93. S.K.S.J.Technological Institute, Bangalore (SG)	Textiles Technology	25
94. Engineering College, Gulbarga (P)	Civil, Mechanical and Electrical Engineering	120
95. Engineering College, Manipal (P)	Civil, Mechanical and Electrical Engineering	120
96. Regional Engineering College, Mangalore (CSG)	Civil,Mechanical and Electrical Engineering	250

1	2	3
97. Malnad Engineering College, Hassan (P)	Civil, Mechanical and Electrical Engineering	120
		13,498

TECHNICAL INSTITUTIONS CONDUCTING DIPLOMA COURSES (1960)

(C.G. = Central Government; S.G. = State Government; C.S.G. = Joint Central & State Governments; U = University; P = Private).

Name of Institution	Fields of study	Annual Admission Capacity.
1.	2.	3.
NORTHERN REGION		
DELHI		
1. Delhi Polytechnic, Delhi. (CG)	Civil, Mechanical, and Electrical Engineering.	60
PUNJAB		
2. Government Polytechnic, Ambala (S.G.)	Civil, Mechanical and Electrical Engineering.	240
3. Guru Nanak Engineering College, Ludhiana. (P)	Civil, Mechanical and Electrical Engineering.	120
4. Mehr Chand Polytechnic, Jullundur (P)	Civil, Mechanical and Electrical Engineering.	120
5. National Institute of Engineering, Hoshiarpur. (P)	Civil, Mechanical and Electrical Engineering.	120
6. Punjab Polytechnic, Nilokheri. (S.G.)	Civil, Mechanical and Electrical Engineering.	240
7. Ramgarhia Polytechnic, Phagwara. (P)	Civil, Mechanical and Electrical Engineering.	180

1.	2.	3.
8. Tarakaran S.D.Technological Institute, Baijnath (P)	Civil Engineering.	60
9. Thapar Polytechnic, Patiala (P)	Civil, Mechanical & Electrical Engineering.	120
10. Punjab Institute of Textile Technology, Amritsar (S.G.)	Textile Technology.	30
11. Government Tanning Institute, Jullundur. (S.G.)	Leather Technology.	10
12. Central Polytechnic, Chandigarh. (S.G.)	Civil, Mechanical & Electrical Engineering.	240
1.		
<u>RAJASTHAN</u>		
13. Jodhpur Polytechnic, Jodhpur. (S.G.)	Civil, Mechanical & Electrical Engineering.	240
14. Ajmer Polytechnic, Ajmer. (S.G.)	Civil, Mechanical and Electrical Engineering.	120
15. Udaipur Polytechnic, Udaipur (S.G.)	Civil, Mechanical & Electrical Engineering; Mining.	160
16. Government Polytechnic, Kotah (CSG).	Civil, Mechanical & Electrical Engineering.	120
17. Government Polytechnic, Alwar (CSG).	Civil, Mechanical & Electrical Engineering.	120

1.	2.	3.
JAMMU & KASHMIR		
18. Government Polytechnic, Srinagar.(S.G.)	Civil,Mechanical & Electrical Engineering.	120
19. Government Polytechnic, Srinagar.(S.G.)	Civil,Mechanical and Electrical Engineering.	120
UTTAR PRADESH		
20.Civil Engineering School, Lucknow (P)	Civil,Mechanical & Electrical Engineering.	120
21.Hewett Engineering School, Lucknow (P)	Civil,Mechanical & Electrical Engineering.	120
22. Government Tech. Institute,Lucknow (SG)	Civil,Mechanical & Electrical Engineering.	240
23.Government Technical Institute, Gorakhpur (S.G.)	Civil,Mechanical & Electrical Engineering.	240
24.P.M.V.Technical Institute,Mathura (P)	Civil,Mechanical & Electrical Engineering.	120
25.Technical College,Dayalbagh, Agra (P)	Mechanical & Electrical Engineering.	90
26.University Polytechnic, Aligarh (U)	Civil,Mechanical & Electrical Engineering.	240
27.University of Roorkee. (U)	Civil,Mechanical & Electrical Engineering.	240
28.Government Central Textile Institute Kanpur (S.G.)	Textile Technology & Textile Chemistry.	32

1.	2.	3.
29. Government Leather Institute, Kanpur (S.G.).	Leather Technology.	30
30. Northern Regional School of Printing Technology, Allahabad (S.G.)	Printing Technology.	50
31. Civil Engineering School, Chandauli (P)	Civil Engineering	60
32. M.G. Technical Institute, Hathras (P)	Civil, Mechanical & Electrical Engineering.	120
33. Technical Institute, Handia (P)	Civil Engineering.	60
34. Polytechnic, Nainital (P)	Civil Engineering.	60
35. Government Polytechnic, Bareilly (S.G.)	Civil, Mechanical & Electrical Engineering.	120
36. Government Polytechnic, Jhansi. (S.G.)	Civil, Mechanical & Electrical Engineering.	120
37. S.G. Polytechnic, Khurja. (P)	Civil, Mechanical & Electrical Engineering.	120
HIMACHAL PRADESH		
38. Government Polytechnic, Sundernagar (S.G.)	Civil, Mechanical and Electrical Engineering.	120

P.T.O.

1.	2.	3.
EASTERN REGION		
ASSAM		
39. Assam Engineering Institute, Gauhati (S.G.)	Civil, Mechanical & Electrical Engineering.	180
40. H.R.H. Prince of Wales Institute of Engineering & Technology, Jorhat (S.G.)	Civil, Mechanical & Electrical Engineering.	180
41. Government Polytechnic, Silchar ((CSG).	Civil, Mechanical & Electrical Engineering.	120
BIHAR		
42. Bhagalpur School of Engineering & Technology, Bhagalpur (S.G.)	Civil Engineering	180
43. Ranchi School of Engineering, Ranchi (S.G.)	Civil, Mechanical & Electrical Engineering.	180
44. Dhanbad Polytechnic, Dhanbad (S.G.)	Civil, Mechanical & Electrical Engineering.	240
45. Tiruhat School of Engineering, Muzaffarpur (S.G.)	Civil, Mechanical & Electrical Engineering.	180
46. Bhaga Mining School. (S.G.)	Mining.	40
47. Mining Institute, Jharia, P.O. Maithon Dam, Dhanbad. (S.G.)	Mining	40

P.T.O

1.		2.	3.
48.	Mining Institute, Kodarma	Mining.	40
49.	Patna School of Engineering, Patna (S.G.)	Civil, Mechnical & Electrical Engineering.	180
50.	Government Polytechnic, Gaya (S.G.)	Civil, Mechnical & Electrical Engineering.	180
51.	Government Polytechnic, Purnea (CSG)	Civil, Mechnical & Electrical Engineering.	180
52.	Government Polytechnic, Darbhanga (CSG)	Civil, Mechnical & Electrical Engineering.	180
ORISSA			
53.	Jharsaguda School of Engineering Jharsaguda (S.G.)	Civil, Mechanical & Electrical Engineering.	180
54.	Orissa School of Engineering, Cuttack (S.G.)	Civil, Mechanical & Electrical Engineering.	180
55.	Berhampore Engineering School, Berhampore (P)	Civil, Mechnical & Electrical Engineering.	180
56.	Orissa School of Engineering, Keonjhar (S.G.)	Mining.	
57.	School of Engineering Bhadrak (S.G.)	Civil, Mechanical & Electrical Engineering.	180
58.	Polytechnic, Kendrapara (P)	Civil, Mechanical & Electrical Engineering.	120
MANIPUR.			
59.	Adimjati Tech. Institute, Imphal, Manipur (S.G.)	Civil, Mechanical & Electrical Engineering.	60

1.	2.	3.
TRIPURA		
60. Polytechnic Institute, Narsingarh, Tripura (S.G.)	Civil, Mechanical & Electrical Engineering.	120
WEST BENGAL		
61. Asansol Polytechnic, Asansol (S.G.)	Mechanical & Electrical Engineering; Mining.	80
62. Calcutta Technical School, Calcutta (P)	Mechanical & Electrical Engineering.	90
63. B.P.C. Technical Institute, Krishnagar (S.G.)	Civil, Mechanical & Electrical Engineering.	180
64. Hooghly Institute of Technology, Hooghly (S.G.)	Civil, Mechanical & Electrical Engineering.	180
65. Jadavpur Polytechnic, Jadavpur (S.G.)	Civil, Mechanical & Electrical Engineering.	180
66. Jalpaiguri Polytechnic, Jalpaiguri (S.G.)	Civil, Mechanical & Electrical Engineering.	180
67. Jhargram Polytechnic, Jhargram (S.G.)	Civil, Mechanical & Electrical Engineering.	180
68. K.G. Engineering Institute, Bishnupur (S.G.)	Civil, Mechanical & Electrical Engineering.	180
69. M.B.C. Institute of Engineering & Technology, Burdwan (S.G.)	Civil, Mechanical & Electrical Engineering.	180
70. Murshidabad Institute of Technology Berhampur (S.G.)	Civil, Mechanical & Electrical Engineering.	180

1.	2.	3.
71. Purulia Polytechnic, Purulia (S.G.)	Civil, Mechanical & Electrical Engineering.	180
72. R.K. Mission Shilpamandir, Belurmath (P)	Civil, Mechanical & Electrical Engineering.	180
73. Shri Ramakrishna Vidyapeeth, Suri (S.G.)	Civil Engineering	120
74. South-Western Polytechnic, Calcutta (S.G.) (Shri Jnan Chandra Ghosh Polytechnic)	Civil, Mechanical & Electrical Engineering.	120
75. School of Printing Technology, Calcutta (S.G.)	Printing.	80
76. R.K. Mission Shilpa Vidyapeeth, Belghoria (S.G.)	Civil, Mechanical & Electrical Engineering.	180
WESTERN REGION		
MAHARASHTRA		
77. Government Polytechnic, Poona (S.G.)	Civil, Mechanical, Electrical & Tele-Communication Engineering; Metallurgy.	320
78. Government Polytechnic, Aurangabad (S.G.)	Civil, Mechanical & Electrical Engineering.	120
79. Government Polytechnic, Karad (S.G.)	Civil, Mechanical & Electrical Engineering.	120
80. Government Polytechnic, Amravati. (S.G.)	Civil, Mechanical & Electrical Engineering.	120

P.T.O.

1.	2.	3.
81. Government Polytechnic, Nagpur. (S.G.)	Civil, Mechanical, Electrical and Automobile Engineering & Architecture.	210
82. Government Polytechnic, Sholapur (S.G.)	Civil, Mechanical & Electrical Engineering.	120
83. Institute of Engineering & Technology, Dhulia (P)	Civil Engineering.	60
84. Sir Cusrow Wadia Institute of Electrical Technology, Poona (P)	Civil, Electrical, Mechanical and Radio Engineering.	140
85. Government Tanning Institute, Khar, Bombay (S.G.)	Leather Technology.	15
86. Puranmal Lahoti Smarak Technical Institute, Latur (P)	Civil Engineering.	60
87. St. Xavier's Technical Institute, Bombay (P)	Radio Engineering.	60
88. Victoria Jubilee Technical Institute, Bombay (P)	Civil, Mechanical, Electrical & Automobile Engineering, Textiles Technology and Chemical Technology.	220
89. Walchand College of Engineering, Sangli (P)	Civil, Mechanical & Electrical Engineering.	120
90. Regional School of Printing Technology, Bombay (S.G.)	Printing Technology.	50

P.T.O.

1.	2.	3.
91. Government Polytechnic, Bombay (CSG)	Civil, Mechanical & Electrical Engineering.	300
92. Government Polytechnic, Jalagoan. (CSG)	Civil, Mechanical & Electrical Engineering.	120
GUJARAT		
93. Bhailalbhai Bhikhabhai Polytechnic, Anand (P)	Civil, Mechanical & Electrical Engineering.	150
94. Dr. S. & S. S. Ghandhy College of Engineering and Technology, Surat. (S.G.)	Civil, Mechanical, Electrical and Automobile Engineering.	140
95. Polytechnic M.S. University, Baroda (U)	Civil, Mechanical & Electrical Engineering.	300
96. Faculty of Engineering and Technology M.S. University, Baroda (U)	Textile Technology and Textile Chemistry.	,60
97. Government Polytechnic, Ahmedabad. (S.G.)	Civil, Mechanical & Electrical Engineering.	300
98. Lukdhurjee College of Engineering, Morvi (S.G.)	Civil, Mechanical and Electrical Engineering.	100
99. Shri A.V. Parekh Technical Institute, Rajkot (S.G.)	Radio Engineering.	10
100. Shri Bhavsinghji Polytechnic, Bhavnagar (S.G.)	Civil, Mechanical, Electrical and Automobile Engineering.	150

P.T.O.

1.			3.
101	R.C. Technical Institute, Ahmedabad (S.G.)	Textiles Technology.	40
102	Government Polytechnic, Dohad (S.G.)	Civil, Mechanical and Electrical Engineering.	120
103	Government Polytechnic, Patan (S.G.)	Civil, Mechanical & Electrical Engineering.	120
104	Government Polytechnic, Porbander (S.G.)	Civil, Mechanical & Electrical Engineering.	120
	MADHYA PRADESH		
105	Central Technical Institute, Gwalior (S.G.)	Civil, Mechanical & Electrical Engineering.	120
106	Government Polytechnic, Ujjain (S.G.)	Civil, Mechanical, Electrical & Automobile Engineering.	132
107	Government Polytechnic, Jabalpur (S.G.)	Civil, Mechanical & Electrical Engineering.	120
108	Government Polytechnic, Nowgong. (S.G.)	Civil, Mechanical & Electrical Engineering.	120
109	Govindaram Todi Govt. Polytechnic, Jaora (S.G.)	Civil, Mechanical & Electrical Engineering.	90
110	Samarat Ashok Polytechnic, Bhilsa (P)	Civil Engineering.	60
111	Kirodimal Govt. Polytechnic, Raigarh (S.G.)	Civil, Mechanical & Electrical Engineering.	120

P.T.O.

1.	2.	3.
112 .S.V.Patel Polytechnic, Bhopal (S.G.)	Civil, Mechanical & Electrical Engineering.	210
113 .Sri Govindaram Seksaria Technological Institute, Indore (P)	Civil, Mechanical & Electrical Engineering.	150
114 .Leather Technical Institute, Morar (P)	Leather Technology.	30
115 .Mining Institute, Chhindwara. (S.G.)	Mining.	40
116 .Government Polytechnic, Khandwa (S.G.)	Civil, Mechanical & Electrical Engineering.	120
117 .Government Mining Polytechnic, Shahdol (S.G.)	Mining.	40

SOUTHERN REGION

ANDHRA PRADESH

118 .Andhra Polytechnic, Kakinada (S.G.)	Civil, Mechanical, Electrical, Tele-Communication & Automobile Engineering.	240
119 .Attached Polytechnic to the College of Engineering, Anantapur (S.G.)	Civil, Mechanical & Electrical Engineering.	120
120 .Government Polytechnic, Vizagapatnam (S.G.)	Civil, Mechanical & Electrical Engineering.	180

P.T.C.

1.	2.	3.
121 Government Technical College, Hyderabad (S.G.)	Civil, Mechanical, Electrical, Tele Communication and Automobile Engineering.	270
122 Government Polytechnic, Warangal (S.G.)	Civil, Mechanical & Electrical Engineering.	120
123 Government Polytechnic, Tirupathi (S.G.)	Civil, Mechanical & Electrical Engineering.	180
124 Hyderabad Polytechnic, Hyderabad (P)	Civil, Mechanical & Electrical Engineering.	120
125 Vuyyuru Polytechnic, Vuyyuru. (S.G.)	Civil, Mechanical & Electrical Engineering,	180
126 Mining Institute, Kothagudium (S.G.)	Mining.	40
127 Mining Institute, Gudur (S.G.)	Mining.	40
128 Ceramic Institute, Gudur (S.G.)	Glass & Enamel Technology, Pottery & Ceramics	23
129 Government Polytechnic, Proddatur (CSG)	Civil, Mechanical & Electrical Engineering.	120
130 Government Polytechnic, Nizamabad (CSG)	Civil, Mechanical & Electrical Engineering.	120
131 Krishna Devarya Polytechnic, Wanaparthy (P)	Civil, Mechanical & Electrical Engineering.	120
132 M.V.M. Polytechnic, Tanuku. (P)	Civil, Mechanical & Electrical Engineering.	120

P.T.O.

	1.	2.	3.
133	1.Mahbcobnagar Polytechnic, Mahbbobnagar (S.G.)	Civil, Mechanical & Electrical Engineering.	120
134	Government Polytechnic, Guntur (S.G.)	Civil, Mechanical & Electrical Engineering.	120
	KERALA.		
135	10.Algappanagar Polytechnic, Algappanagar (S.G.)	Civil, Mechanical & Electrical Engineering.	120
136	Government Polytechnic, Kalamassery (S.G.)	Civil, Mechanical & Electrical, Automobile Engineering.	170
137	Kerala Polytechnic, Kozhikode. (S.G.)	Civil, Mechanical & Electrical Engineering; Chemical Engineering.	220
138	Maharaja's Technical Institute, Trichur (S.G.)	Civil, Mechanical & Electrical Engineering.	120
139	Shri Narayana Polytechnic, Quilon (P)	Civil, Mechanical & Electrical Engineering.	120
140	Government Polytechnic, Cannanore (S.G.)	Civil, Mechanical & Electrical Engineering; Textile Technology.	144
141	Central Polytechnic, Trivandrum. (S.G.)	Civil, Mechanical & Electrical Engineering.	120
142	Carmel Polytechnic, Alleppy. (P)	Civil, Mechanical & Electrical Engineering.	120
143	N.S.S.Polytechnic, Pandalam (P)	Ciwil, Mechanical & Electrical Engineering.	120.

P.T.O.

1.		2.	3.
144	Sri Ram Polytechnic, Valpad (P)	Civil, Mechanical & Electrical Engineering.	120
145	Government Polytechnic, Kottayam (CSG)	Civil, Mechanical & Electrical Engineering.	120
	MADRAS		
146	Alagappa Polytechnic, Karaikudi (P)	Civil, Mechanical & Electrical Engineering.	120
147	A.M.M.Charities Trust Polytechnic, Avadi (P)	Civil, Mechanical and Electrical Engineering.	120
148	Annamalai Polytechnic, Chettinad (P)	Civil, Mechanical & Electrical Engineering.	120
149	Central Polytechnic, Madras (S.G.)	Civil, Mechanical & Electrical Engineering.	210
150	C.N.T.Institute, Vepery, Madras (P)	Civil, Mechanical & Electrical Engineering.	120
151	Government Polytechnic, Coimbatore.(S.G.)	Civil, Mechanical, Electrical, Tele-Communication. Mining & Automobile Engineering.	230
152	Institute of Leather Technology, Madras (S.G.)	Leather Technology.	30
153	Ramakrishna Mission Technical Institute, Madras (P)	Mechanical Engineering; Automobile Engineering.	60
154	Nachimuthu Polytechnic, Pallachi (P)	Civil, Mechanical & Electrical Engineering.	120

P.T.O.

	1.	2.	3.
155	P.S.G.& Attached Polytechnic, Coimbatore (P)	Civil, Mechanical & Electrical Engineering.	120
156	P.S.G. Industrial Institute, Coimbatore (P)	Textile Technology.	60
157	Seshasayee Institute of Technology, (P) Tiruchirapalli.	Civil, Mechanical & Electrical Engineering.	120
158	Timilnad Polytechnic, Madurai (S.G.)	Civil, Mechanical & Electrical Engineering, and Automobile Engineering.	200
159	Government Polytechnic, Nagercoil (CSG)	Civil, Mechanical & Electrical Engineering.	120
160	Government Polytechnic, Vellore (.)(CSG)	Civil, Mechanical & Electrical Engineering.	120
161	Regional School of Printing Technology, Madras (S.G.)	Printing Technology.	230
162	Desigar Polytechnic, Tanjore (P)	Civil, Mechanical & Electrical Engineering.	120
163	Sankar Polytechnic, Sankarnagar (P)	Civil, Mechanical and & Electrical Engineering.	120
164	Thiagarajar Polytechnic, Salem (P)	Civil, Mechanical & Electrical Engineering, Textile Technology.	150
165	Muthiah Polytechnic, Annamalainagar (U)	Civil, Mechanical & Electrical Engineering.	120

P.T.O.

1.	2.	3.
166 : .S.V.Nadar Polytechnic, Virudhnagar (P)	Civil, Mechanical & Electrical Engineering.	120
167 : .Bhaktavatsalam Polytechnic, Kancheepuram (P) ( )	Civil, Mechanical & Electrical Engineering.	120
168 .Polytechnic, Sirkali (P)	Civil, Mechanical & Electrical Engineering.	120
169 : .Polytechnic, Gudiyatham (P)	Civil, Mechanical & Electrical Engineering	120

MYSORE

170 : 1.S.K.S.J.Technical Institute, Bangalore (S.G.)	Textile Technology.	40
171 : .Silver Jubilee Occupational Institute, Bangalore (S.G.)	Civil, Mechanical, Electrical Tele-communication, and Automobile Engineering; Mining.	285
172 1 .School of Mines, Corgaum (S.G.)	Mining	40
173 : .B.V.B.College of Engineering and Technology, Hubli. (P)	Civil, Mechanical & Electrical Engineering.	120
174 . .D.R.E.Occupational Institute, Davangere (SG)	Civil, Mechanical & Electrical Engineering.	130
175 : .Government Polytechnic, Gulbarga. (S.G.)	Civil, Mechanical & Electrical Engineering.	120
176 .Karnataka Polytechnic, Mangalore (P)	Civil, Mechanical, Electrical & Automobile Engineering.	170

P.T.O.

1.		2.	3.
177	K.H. Kabbur Institute of Engineering, Dharwar (P)	Civil, Mechanical & Electrical Engineering.	120
178	National Institute of Engineering, Mysore (P)	Civil Engineering.	60
179	Occupational Institute, Chintamani (S.G.)	Civil, Mechanical & Electrical Engineering.	120
180	Government Polytechnic, Bellary (S.G.)	Civil, Mechanical & Electrical Engineering.	120
181	Polytechnic, Tumkur. (S.G.)	Civil, Mechanical & Electrical Engineering.	120
182	Polytechnic, Chennapatna. (S.G.)	Civil, Mechanical & Electrical Engineering.	120
183	Silver Jubilee Technical Institute, Bhadravati. (S.G.)	Civil, Mechanical & Electrical Engineering.	120
184	S.L.V. Occupational Institute, Hasan (S.G.)	Civil, Mechanical & Electrical Engineering.	120
185	M.E. Society's Polytechnic, Bangalore (P)	Civil, Mechanical & Electrical Engineering.	120
186	Acharya Patshala Polytechnic, Bangalore (P)	Civil, Mechanical & Electrical Engineering.	120
187	B.V. & V.S. Polytechnic, Bagalkot (P)	Civil, Mechanical & Electrical Engineering.	120

P.T.O.

	1.	2.	
188	Government Polytechnic, Karwar. (S.G.)	Civil, Mechanical & Electrical Engineering.	120
189	Government Polytechnic, Belgaum (S.G.)	Civil, Mechanical & Electrical Engineering.	120
190	Government Polytechnic, Chickmaglur (S.G.)	Civil, Mechanical & Electrical Engineering.	120
191	C.P.C. Polytechnic, Mysore (S.G.)	Civil, Mechanical & Electrical Engineering.	120
192	Government Polytechnic, Krishnarejapet (CSG)	Civil, Mechanical & Electrical Engineering.	120
193	Government Polytechnic, Bidar (S.G.)	Civil, Mechanical & Electrical Engineering.	120
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ANNEXURE II

INSTITUTIONS OFFERING FACILITIES FOR POST-GRADUATE STUDIES (1960)

Name of Institution	Fields of Study
1	2
1. Engineering College, Banaras Hindu University.	Electrical Machine Design.
2. Roorkee University	i) Dam Design, Irrigation Engineering and Hydraulics
	ii) Structural Engineering including Concrete Technology
	iii) Soil mechanics and Foundation Engineering
	iv) Public Health Engineering
	v) Highway Engineering
	vi) Photogrammetric Engineering
	vii) Electrical Machine Design
	viii) Applied Thermodynamics.
	A) Power Engineering
	B) Refrigeration and Air-Conditioning
3. College of Mining and Metallurgy, Banaras Hindu University.	i) Mining Engineering;
	ii) Advanced Metallurgy.

1	2
4. Department of Chemical Engineering and Technology, College of Technology, Banaras Hindu University.	Chemical Engineering
5. Department of Silicate Technology, College of Technology, Banaras Hindu University.	Glass and Ceramic Technology
6. Department of Pharmaceutics, Banaras Hindu University.	Pharmacy.
7. J.K.Institute of Applied Physics. University of Allahabad, Allahabad.	Electronics and Radio Engineering
8. H.B.Technological Institute, Kanpur.	Chemical Technology of - a) Oils, Fats and Waxes b) Paints and Varnishes c) Applied Microbiology.
9. Department of Chemical Technology, Bombay University.	i) Textile Chemistry ii) Technology of Foods iii) Technology of Intermediates and Dyes iv) Plastics v) Pigments, Paints and Varnishes vi) Oils, Fats and Waxes vii) Pharmaceuticals and Fine Chemicals.

1	2
10. Department of Pharmacy, University of Saugar.	Pharmacy.
11. Victoria Jubilee Technical Institute, Bombay.	i) Electrical, Mechanical and Automobile Engineering ii) Industrial Management.
12. L.M.College of Pharmacy, Ahmedabad	Pharmacy.
13. Government Engineering College, Jabalpur.	i) Advanced Electronics ii) Soil Mechanics iii) High Voltage Engineering iv) Internal Combustion Engineering v) Radio and V.H.F.Engineering.
14. L.D.College of Engineering, Ahmedabad.	Electrical Machine Design.
15. Indian Institute of Technology, Bombay.	i) Industrial Electronics ii) Electro-vacuum Technology iii) Design of Chemical Plant iv) Technology of Fine Organic Chemicals. v) Technology of Silicates. vi) Electro-Chemical Technology vii) Technology of Heavy Inorganic Chemicals. viii) Ferrous Production Metallurgy ix) Soil Engineering.

1	2
16. College of Engineering, Poona	i) Hydraulics and Dam Engineering ii) Advanced Electronics iii) Electrical Engineering
17. Faculty of Technology and Engineering, M.S.University, Baroda.	Civil, Mechanical and Electrical Engineering
18. Andhra University College, Department of Technology, Waltair.	i) Chemical Technology ii) Ore Dressing.
19. Department of Chemical Technology, Osmania University.	Chemical Technology.
20. P.S.G.College of Technology, Coimbatore.	Electrical Machine Design
21. College of Engineering, T Trivandrum.	i) Electrical Machine Design ii) Hydraulics, Irrigation and Flood Control iii) Structural Engineering
22. Punjab University College, Chandigarh.	Highway Engineering
23. Department of Pharmacy, Punjab University, Chhndigarh.	Pharmacy
24. Birla College of Engineering, Pilani.	Electronics.

1	2
25. Indian Institute of Science, Bangalore.	i) Aeronautical Engineering ii) Internal Combustion Engineering iii) Automobile Engineering iv) Power Engineering - Electrical,Mechanical ,Civil,Hydraulics and High Voltage. v) Electrical Communication Engineering; Ultra-short and Microwave Engineering; Line Communication; and Accoustical Engineering. vi) Foundry Engineering vii) Soil Mechanics and Foundation Engineering
26. Department of Applied Chemistry, Calcutta University.	Chemical Engineering and Chemical Technology
27. Indian Institute of Technology, Kharagpur.	i) Agricultural Engineering-Applied Botany, Farm Power and Machinery; Soil and Water Conservation ii) Applied Chemistry-Technology of Gas Reactions at high pressures; High Polymers and Rubber Technology; Synthetic Drugs and Chemicals; iii) Architecture and Regional Planning iv) Chemical Engineering; v) Civil Engineering-Structural Engineering;Water Power and Dam Construction; Soil Mechancis and Foundation Engineering; Highway Engineering;Harbour Engineering;Municipal Engineering. vi) Electrical Engineering-Machine Design;Control Systems. vii) Electronic and Electrical Communication Engineering viii) Geology and Geophysics-Applied Geology;Exploration Geophysics and Geochemistry. ix) Mechanical Engineering-Foundry;Industrial Engineering;Machine Design;Machanical Handling;Production Technology;Refrigeration and Air-Con[illegible] Plant Design;Internal Combust[illegible]ines

1	2
28. Institute of Radio Physics and Electronics, Calcutta University.	Radio Physics and Electronics.
29. Alagappakhettiar College of Technology, Madras University, Madras.	Chemical Engineering.
30. College of Engineering, Guindy, Madras.	i) Public Health Engineering ii) Advanced Hydraulics, Dam Construction and Irrigation Engineering iii) Structural Engineering and Concrete Technology iv) Electrical Machine Design. v) Soil Mechanics and Foundation Engineering vi) Internal Combustion Engineering
31. School of Planning and Architecture, Delhi.	Town and Country Planning; Housing.
32. Bengal Engineering College, Sibpore.	i) Foundation Engineering & Soil Mechanics. ii) Structural Engineering including Concrete Technology. iii) Prime Movers. iv) Electrical Machine Design. v) Advanced Metallurgy.
33. Jadavpur University.	i) Food Technology. ii) Chemical Engineering.
34. Laxminarayan Institute of Technology, Nagpur University.	i) Chemical Engineering.

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ALL INDIA COUNCIL FOR TECHNICAL EDUCATION

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13. Dr. B.D. Kalelkar,
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Ministry of Defence.

15. Financial Adviser,
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Ministry of Finance.

16. Director-General of Resettlement
and Employment,
Ministry of Labour & Employment.

17. Secretary,
Deptt. of Mines & Fuel,
Ministry of Steel, Mines & Fuel.

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Deputy Secretary, Deptt. of Iron & Steel,
Ministry of Steel, Mines & Fuel.

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Ministry of Works, Housing & Supply.

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Mechanical Engineering,
Railway Board.

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Joint Secretary,
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Ministry of Home Affairs.

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Ministry of Food & Agriculture.

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Professor of Sculpture,
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13. Shri S.N. Guha Ray,
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14. Shri Gurcharan Singh,
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Delhi School of Economics,
Delhi University.

Shri S. Velayudham,
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Indian Institute of Social Welfare &
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Managing Director,
General Radio & Appliances (PT.) Ltd.,
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14. Dr. A.R. Mudaliar,
Calcutta.

15. Shri C.S. Tayabjee,
Managing Director,
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16. Shri R.R. Morarka, M.P.,
Delhi.

(F) TEXTILE TECHNOLOGY:

1. Lala Shri Ram, (Chairman)
New Delhi.

2. Shri Shrinagabhushana,
Principal,
S.K.S.J. Technological Institute,
Bangalore.

3. Dr. C. Nanjundayya,
Director,
Bombay Textile Research Association, Bombay-22.

4. Shri B. Rajaram,
Textile Deptt., Tata Industries Private Ltd.,
Bombay.

5. Shri T.N. Sharma,
Textile Adviser,
Delhi Cloth & General Mills, Delhi.

6. Dr. A.T. Das,
Principal,
College of Textile Technology, Berhampore.

7. Prof. R.K. Mody,
Principal,
Victoria Jubilee Technical Institute, Bombay.

8. Shri D.N. Bhattarcharjee,
Bengal Laxmi Cotton Mills, Calcutta.

9. Shri Mohanlal L. Shah,
Calcutta.

10. Shri E.R. Subbaram,
General Superintendent,
Ambica Mills, Ahmedabad.

11. Dr. R.L. Desai,
Head of Textiles Chemistry Deptt.,
M.S. University of Baroda.

12. Shri M.G. Kulkarni,
Bombay Textile Research Association,
Bombay.

13. Shri Shantilal M. Mehta,
Vice-President, Silk & Art Silk Mills Research
Association, Bombay.

14. Shri Surottam Hutheesing,
Ahmedabad.

(G) MANAGEMENT STUDIES:-

1. Shri J.J. Ghandy, (Chairman)
   Director, Tata Iron & Steel Co. Ltd.,
   Jamshedpur.

2. Dr. A.L. Mudaliar,
   Vice-Chancellor,
   University of Madras.

3. Dr. A.R. Mudaliar,
   Calcutta.

   Lala Shri Ram,
   New Delhi.

   Mr. B.F. Goodchild,
   Calcutta.

6. Shri J.M. Shrinagesh,
   Chairman, Hindusthan Steel Co. Ltd.

7. Prof. A. Das Gupta,
   Delhi School of Economics,
   Delhi University.

8. Mr. Y.A. Fazalbhoy,
   Managing Director,
   General Radio & Appliances (Pt) Ltd., Bombay.

9. Mr. J.K. Srivastava,
   Chairman,
   Sir J.P. Srivastava Group of Industries, Kanpur.

10. Shri P.V. Shah,
    Managing Director,
    Metropolitan Spring (Pt) Ltd., Bombay.

11. Shri S.V. Ghatalia,
    Chartered Accountant, Bombay.

12. Prof. V.K.N. Menon,
    Director,
    Indian Institute of Public Administration,
    New Delhi.

13. Mr. S. Nageswaran,
    Labour Officer,
    Indian Jute Mills Association,
    Calcutta.

14. Prof. V.M. Mathur,
    Professor of Economics & Commerce,
    Rajasthan University, Jaipur.

15. Shri B.S. Manchanda,
    Deputy Secretary,
    Deptt. of Company Law Administration,
    Ministry of Commerce & Industry.

16. Dr. V.K.R.V. Rao,
    Director,
    Institute of Economic Growth,
    Delhi University.

Contd...

17. Shri D.K. Sanyal,
Director, Indian Institute of Social Welfare
Business Management, Calcutta.

18. Shri G.V. Krishna Rao,
Professor of Management,
Madras University.

19. Shri R. Misra,
Professor of Industrial Administration,
Indian Institute of Technology,
Kharagpur.

20. Shri V.S.R. Murthy,
Professor of Management,
Bombay University.

REGIONAL COMMITTEES

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3. Director of Training,
   D.G.R.E., Ministry of Labour & Employment.

4. Deputy Chief Mechanical Engineering (Workshops),
   Northern Railway,
   New Delhi.

5. Director of Technical Education,
   Government of Punjab.

6. The Director of Industries,
   Government of Uttar Pradesh.

7. Shri V.G. Garde,
   Director of Technical Education,
   Government of Rajasthan,
   Jodhpur.

8. Mr. G.H. Khan,
   Principal, Government Polytechnic,
   Srinagar.

9. Shri B.D. Bhatt,
   Director of Education,
   Delhi Administration.

10. Shri K.L. Sethi,
    Diredtor of Education,
    Himachal Pradesh.

11. Shri I.P. Anand,
    General Manager,
    Karam Chand Thapar & Brothers,
    New Delhi.

12. Shri Kashi Nath Pande, M.P.,
    President Indian National Trade
    Union Congress (U.P. Branch), Lucknow.

13. Vice-Chancellor,
    Roorkee University.

14. Shri M. Sen Gupta,
    Principal, Engineering College,
    Banaras Hindu University.

15. Shri V. Lakshmi Narayanan,
    Principal, Birla College of Engineering,
    Pilani.

16. Col. B.H. Zaidi,
    Vice-Chancellor,
    Aligarh Muslim University, Aligarh.

17. Shri Tara Singh,
Principal, Gurunanak Engineering
College, Ludhiana.

18. Brig. K.B. Rai,
Chief Technical Examiner of Works,
Army Head Quarters, New Delhi.

19. Dr. B.D. Laroia,
Development Officer,
University Grants Commission.

20. Shri K.C. Gupta,
General Manager, Kanpur Electric
Supply Administration,
Kanpur.

21. Director, Indian Institute of
Technology, Kanpur.

22. Chairman, Board of Technical
Education, Uttar Pradesh,
Lucknow.

23. Chairman,
State Board of Technical Education,
Rajasthan, Jaipur.

24. The Director of Technical Education,
Punjab,
Chandigarh.

(B) WESTERN REGIONAL COMMITTEE:

1. Seth Kasturbhai Lalbhai, (Chairman)
Ahmedabad.

2. The Director,
Indian Institute of Technology,
Bombay.

3. Director of Training,
Directorate General of Resettlement
& Employment,
Ministry of Labour & Employment.

4. Shri J.F. Muncherjee,
Chief Mechanical Engineer,
Western Railway,
Bombay.

5. The Director of Technical Education,
Government of Bombay.

6. The Secretary,
Education Department,
[illegible]ent of Madhya Pradesh.

7. [illegible]ctor of Technical Education,
[illegible]ernment of Gujarat.

8. Dr. (Mrs.) Sita Parmanand, M.P.,
Chindwara.

9. Shri N. Dandekar,
Managing Director,
Associated Cement Companies Ltd.,
Bombay.

10. Dr. G.M. Nabar,
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Department of Chemical Technology,
University of Bombay.

11. Shri G.V. Sapre,
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12. Dr. V.M. Dokras,
Principal,
Government Engineering College,
Jabalpur.

13. Shri S.R. Beedkar,
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S.V. Government Polytechnic,
Bhopal.

14. Prof. N.N. Ghosh Dastidar,
Principal,
Madhav Engineering College,
Gwalior.

15. Shri V.K. Kelkar,
Principal,
Walchand Engineering College,
Sangli.

16. Shri D.P.R. Cassad, M.I.E.,
Nagpur.

17. Shri Pranlal Patel,
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18. Dr. L.A. Bhatt,
Bombay.

19. Secretary,
State Board of Technical Education,
Madhya Pradesh, Bhopal.

(C) EASTERN REGIONAL COMMITTEE:

1. Shri J.J. Ghandy,
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Jamshedpur.

2. Dr. S.R. Sen Gupta,
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Indian Institute of Technology,
Kharagpur.

3. Deputy Chief Mechanical Engineer(Works
Eastern Railway, Calcutta.

4. Director of Training,
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Resettlement & Employment,
Ministry of Labour & Employment.

5. Shri A.C. Sen,
Chief Inspector, Technical Education,
Government of West Bengal.

6. Director of Industries,
Government of Bihar.

7. Shri D.L. Purkayastha,
Additional Secretary,
Industries Department,
Government of Orissa.

8. Shri I.N. Hazarika,
Deputy Director of Public Instruction(Tech.),
Government of Assam.

9. Shri S.D. Bahuguna,
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Ex-officio Education Secretary,
Manipur Administration.

10. Shri G.N. Chatterjee,
Director of Education,
Tripura.

11. Shri M.P. Birla,
Calcutta.

12. Dr. (Mrs.) Maitrayee Bose,
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13. Prof. N. Das Gupta,
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Assam College of Engineering,
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14. Prof. B. Prasad,
Principal,
Engineering College,
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15. Dr. T. Sen,
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College of Engineering & Technology,
Jadavpur University.

16. Prof. M.C. Pande,
Principal, Birla Instt. of Technology,
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17. Shri N.K. Mitra,
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18. Shri B.N. Chaudhury,
Consulting Engineering & Architect,
[illegible]

[illegible] Roy,
[illegible]pal, Bengal Engineering College,
[illegible]h.

20. Shri A.K. Bose,
Calcutta.

21. Shri N. Chakravarty,
Principal, School of Printing Technology,
Calcutta.

. Chairman,
State Board of Technical Education, Assam.

3. Chairman,
State Council for Engineering & Technical Education,
West Bengal.

24. Chairman,
State Board of Technical Education, Bihar.

25. Chairman,
State Board of Technical Education, Orissa.

(D) SOUTHERN REGIONAL COMMITTEE:

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2. Dr. S. Bhagavantam,
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Southern Railways.

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6. Shri C.V.D. Murthy,
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7. Joint Director of Technical Educatio
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18. Shri P.M. Reddy,
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19. Shri A.M.M. Murugappa Chettiar,
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20. Chairman, State Board of
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21. Shri J.C. Hardikar,
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Government of Andhra Pradesh.

22. Chairman, State Board of Technical
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23. Chairman, State Board of Technical
Education, Kerala.
