CHAPTER-III

GENESIS, GROWTH AND DEVELOPMENT OF TECHNICAL EDUCATION IN INDIA: AN OVERVIEW
Introduction

In this introductory chapter an attempt is made to highlight the emerging need, historical perspective of the origin, growth and development of engineering education in the country. It also presents the need of the most equitable, sustainable and effective system of engineering education in India on par with the rest of the world.

India has emerged as a major player in the world in the field of Engineering Education. Indian engineers have contributed significantly to the economic and technological development of many foreign lands, not only in the Information Technology sector but also in general engineering services solid-state electronics, communications etc.,

In India the Buddhists developed University institutions several hundred years before similar institutions of higher learning (Studium Generate) appeared in the 12th Century in Europe. The Buddhist Viharas in India developed into bigger institutions such as Nalanda, Vallabhi, Vikramshik, Odantapuri, Jagaddala, Mithik, Ranchi, etc. However, these Universities disappeared due to decline of Buddhism in India.¹

The excellence of manufactured articles in medieval India, e.g., fabrics of cotton and silk, embroideries, painted and enameled wares, steel guns, swords, knives and scissors, gold and silver ornaments and white paper, is well known. This excellence was achieved and maintained for centuries with dependable technical education practices comprising hereditary learning, pupilage training and training schools attached to
workshops. The manufacturing establishments called *Karkhanas*, imparted technical education in their areas of specialization. The early Sultans and Mughals supported such Karkhanas and their technical/vocational education. Both Hindus and Muslims took great interest in vocational education as a result of which trained workers of every trade were available in abundance.

1.1. Technical Education in India during British period

The impulse for creation of centres of technical training came from the British rulers of India. The emerging need for technical education arose out of the necessity for the training of overseers for construction and maintenance of public buildings, roads, canals, ports, training of artisans and craftsmen. The superintending engineers were mostly recruited from Britain from the Cooper's Hill College, and this applied as well to foremen and officers; but this could not be done in the case of lower grades- craftsmen, artisans and sub-overseers who were recruited locally. As they were mostly illiterate, efficiency was low. The necessity to make them more efficient by giving them elementary lessons in reading, writing, arithmetic, geometry, and mechanics led to the establishment of industrial schools attached to Ordnance Factories and other engineering establishments.

Meanwhile in Europe and America, Colleges of Engineering were growing up, which drew to them men having good education, and special proficiency in mathematical subjects. This led to discussions in Government circles in India, and similar institutions were sought to be established in the Presidency Towns.\(^2\)
The British Government in India established the first Survey School in Madras in 1794 with eight students from English schools. The British policy' at that time was against teaching surveying to native Indians because of military and political implications of survey work, as a precaution against reliable maps falling into the hands of the French, the Dutch and the Portuguese. The Court of Directors of the Kasi India Company insisted on the secrecy of survey maps and restricted the art and science of surveying to English boys. However, civil surveying for revenue purposes remained outside the ambit of the restrictions of the East India Company because it was an ancient branch of knowledge in India and a class of people, the 'Amins' or 'Mirdhas' specialized in preparing land revenue maps. The Madras Survey School went through several ups and downs, was on the brink of closure in 1810 but was revived in 1819, admitting some apprentices directly called from England in addition to boys from the local English schools. The Survey School was later expanded in 1857 and renamed as the ‘Civil Engineering School’.

1.2. Developments in Bengal

The General Committee of Public Instruction, comprising mostly English officers constituted in Bengal in 1823, remained for about twenty years the only agency of Bengal Government concerned with education, until it was replaced by a Council of Education in 1842. The Committee and its successor Council in their reports frequently mentioned the branches of study which was useful to students to earn their livelihood. Apart from reading, writing, and arithmetic, surveying was recommended for Indians
required in judicial and revenue departments and by courts. At that time Surveying was taught in Bengal in two colleges, namely the Mohammedan College (1781) and the Hindu College (1817).

On the occasion of the establishment of the Sanskrit College in Calcutta, Raja Ram Mohan Roy wrote to Lord Amherst in 1823 and urged the Government to "employ European gentlemen of talent and education to interest the natives of India in Mathematics, Natural Philosophy, Chemistry, Anatomy, and other useful sciences, which the natives of Europe have carried to a degree of perfection that has raised them above the inhabitants of the other parts of the world." The importance of civil engineering, as a branch of instruction for Indians, began to attract attention of authorities in 1843. At this time the idea forming a University was gaining ground. The Council in its report in 1844-45 suggested for the establishment of a central university for "granting degrees in arts, science, law, medicine and civil engineering".

1.3. Developments in Bombay and North Western Province

Elphinstone Institution in Bombay started engineering classes in 1844 to impart training to the Surveyors and builders. The programme had a short life of just three years. It closed because it did not attract students of sufficient, merit to qualify as scientific civil engineers fully groomed in the theory of their art.

In early 19th century, after the conquest of the northern region by the British, the North Western Province (NWP) was created in 1836 with Agra as its headquarters. In
1843 the subject of education in NWP was transferred from the Bengal Government to the Government in Agra. The renovation work on old Yamuna Canals and construction of some roads, and an initial work on the Ganga Canal were undertaken. Appointment of James Thomason as the Lieutenant Governor of NWP at that time proved to be very significant. While the Governors of Presidencies, appointed from the British aristocracy and political heavy weights, responded slowly through proper channels to the proposals coming from lower levels, Thomason rising from the ranks of civil servants, made the proposal himself followed them up for acceptance by higher authorities and implemented them vigorously.

Thomason submitted a detailed proposal for setting up a college to train Indians as Civil Engineers. He made a strong case to form a nucleus at Roorkee for training Civil Engineers, which led to establishment of the Civil Engineering College at Roorkee in 1847 with Lieutenant Maclagan as the Principal and four teachers, two of whom were Indians. The College began with three courses, one for engineers, one for upper subordinates (overseers) and the third for lower subordinates (sub-overseers and draughtsman).

The Roorkee College was named Thomason College of Civil Engineering in 1854 in honour of its founder. Therefore, the subjects engineering, when Roorkee College was established, were not properly classified from the point of view of teaching. The teachers of Roorkee College, within first twenty five years of its existence did pioneering work in
systemizing the teaching of engineering, formally writing lecture notes, developing examples making drawings, writing books and manuals and updating them periodically. The Roorkee College Manuals and Treatise on Civil Engineering became standard texts not only in Roorkee but at other colleges in India.\(^7\)

### 1.4. Wood’s Dispatch

The famous Wood's Dispatch of July 1854 from the Court of the Directors of the East India Company envisaged an enlarged system of education to be pursued in India in view of the need of suitably trained persons for PWD in all the three Presidencies. In response, the Governor General Lord Dalhousie recommended to the Court for establishment of an engineering class at each of the three Presidencies of Calcutta, Madras and Bombay.

In 1854, Lord Dalhousie proposed that on the principle of Thomason College at Roorkee, a complete system of instruction should be provided at Madras for every class belonging to Europeans of PWD and natives, whether artificers, foremen, overseers, surveyors or civil engineers. The Court of Directors conveyed their concurrence in 1855. The Director of Public Instructions (DPI) submitted a detailed scheme of an institution at three levels just as at Roorkee College, with provision of military students along with civilians. The Madras Government approved the scheme with the provision that every student of the college be required to master some craft or trade and the school at the Gun Carriage Factor" in Madras be extended to supply the PWD with officers. The Supreme Government eventually accepted the proposal of Madras Government with some-
stipulations. The Civil Engineering College came into being in Madras in 1859 but functioned on a very modest scale because Madras Government gave no grams in addition to what was given to the Survey School.\textsuperscript{8}

1.5. Fluid State in Bengal

In 1854, the Council of Education Bengal recommended the establishment of a separate engineering department in the proposed Presidency College, which was to function in the following year by incorporating the Hindu College. The Chief Engineer of Bengal, Col. Goodwyn, however, recommended the constitution of a separate engineering college for general improvement of the Department of Public Works. The Bengal Government concurred with the Chief Engineer, but took two years to prepare its detailed scheme to obtain the sanction of the Court of Directors. In November 1856, the Civil Engineering College Calcutta started functioning with 10 students and two teachers. The Government gave a guarantee of employment in PWD to the students after passing the two year course. The College was affiliated to Calcutta University when it was established in 1857 and the course was raised to three years with one year training at the end of which the candidates got the degree of Licentiate in Civil Engineering (LCE).\textsuperscript{9}

1.6. The Poona College

On the proposal of the Bombay Government, the Supreme Government \textsuperscript{IE} 1855 approved the establishment of a college for the instruction of civil engineers, surveyors, overseers, foremen and artisans. The project started in a low key with an Engineering Class and a Mechanical School at Poona. Later Sir Cowasjee Jehangir made a
magnificent donation of Rs. 50,000 which helped in converting the School into Poona Civil Engineering College in 1864 and affiliation to University of Bombay in 1868 for the degree of Licentiate in Civil Engineering. The scope of instruction of the college was expanded in 1879 to include a forestry country for forest rangers and a diploma course in agriculture. The name of the College of Engineering was changed to the College of Science. General courses in Science were started leading to B.Sc. degree by Bombay University.

In 1886, the course of civil engineering was revised and upgraded and the minimum qualification for admission was raised from matriculation to what was then called Previous Examination. The trend towards opening new courses was reversed. The Rangers Class was closed in 1904. By 1911 all other non-engineering courses were also abolished. The B.Sc. classes were transferred to the Science Institute in Bombay and the College was given back its original name, the Poona College of Engineering.10

1.7. Military Hegemony over the Engineering Colleges

The Royal Engineers in the army in British India played a major role in influencing the fortunes and also the misfortunes of the four engineering colleges. They were the only type of engineers that came to India with the East India Company. As the Company took more and more responsibility of governance of the country, all technical jobs of engineering and scientific nature were entrusted to the military engineers. PWD was almost entirely officered by them. Engineering education fell naturally in their sphere. The original proposal for each of the four engineering colleges was to place them
under the education departments of the respective Presidency or Province to fulfill the
civilian objectives of the colleges to train engineering personnel for civilian work.

The other three colleges successfully remained under the control of this
department of education. However, in matters of admission and courses, Madras-College
had similarity with Roorkee College. Its last Royal Engineer Principal retired in 1907.
The Calcutta College too showed military bias but its life was short. The engineering
classes of the Presidency College and later Sibpur College had no military connection.
The first Principal of Poona College BH Close was very keen to make the College serve
military needs by providing instruction to European sappers posted in Bombay
Presidency. The Education Department did not allow too much importance to train
military officers at Poona. On the first two Principals were from the military.
Subsequently, the military connection ceased.11

1.8. Stanley Engineers and Cooper's Hill College

By 1858, it was clear that the ambitious objectives of the Roorkee College
envisioned by its founder did not quite fit in with the imperial interests perceived by Her
Majesty's Government in England, which had taken the responsibility of direct
governing India matter the 1857 war of independence. A scheme of directive recruiting
young Civil Engineers in England for service in the public works in India was initiated
by the Secretary of State Lord Stanley in 1859. Engineers recruited under the scheme
were dubbed as Stanley Engineers. From 1859 to 1868, 165 'Stanley Engineers were
appointed against only 45 from Roorkee College.12
While the military engineers nurtured all the four engineering colleges in their infancy, within a few years they also initiated policies which adversely affected growth of the colleges. In 1870, as a modification of the Stanley Scheme, college of civil engineering, Royal Indian Engineering College, popularly call Cooper's Hill College, on the pattern of Roorkee College, was established if England to train engineers for PWD in India. Later due to fall in demand for engineers in PWD, the recruitment to PWD from Cooper's Hill was reduced in 1892 and thereafter the Cooper's Hill Collars-limped for another 17 years and was finally closed in 1907.13

1.9. Establishment of Universities

In July 1854, the Court of Directors of the East India Company sent a Dispatch to the Governor General of India in the Council suggesting the establishment of Universities in the three Presidencies. Consequently, the Universities of Calcutta, Madras and Bombay were founded in 1857. Their scope covered all branches of learning involving intellectual efforts worthy of recognition by a University. These Universities established faculties and instituted degrees to traditional areas like arts, science, law, etc. and also in medicine and engineering.

It was left to colleges to enroll students, organize teaching and seek affiliation with the university degrees. For engineering, Calcutta and Bombay University aimed higher and instituted Master of Civil Engineering (M.C.E) degree for which a B. A. degree was prerequisite. Madras University more relationally instituted, in addition to M.C.E., a
lower degree called Graduate in Civil Engineering (GGE; for which prerequisite qualification was matriculation. The three engineering colleges at Calcutta, Madras and Poona were duly affiliated to the Universities of their Presidencies.14

1.10. Status of Technical Education (1884-85)

Sir MacDonnell's Memorandum prepared in 1886 on the existing state and future prospects of technical education had nothing much to notice except the four engineering colleges, three schools of industrial art and about forty five lower grade industrial schools. Sir MacDonnell reported that a few more Survey Schools were functioning during the period in Hyderabad (Sind). The total enrollment in the four engineering colleges during 1884-85 was reported to be 608, that in Survey Schools 465 and in industrial schools, 1379.15

1.11. Golden Jubilee of Queen's Reign

The golden jubilee celebration of Queen Victoria's reign in 1887 provided rise occasion to collect large sums of money from the public for commemorating the event suitably. In Bombay and Madras opening of technical schools was considered an appropriate way of utilizing the funds. Viceroy Dufferin in a public address in Lucknow in 1888 said bare always taken the deepest interest in technical education. The latter responsibility devolves on the local government to a certain degree, but still more largely on the Indian community. Even the local governments, unassisted by the label; and counsels of those who are in a position to support their efforts, can but do little”.16
The Victoria Jubilee Technical institute, founded in 1887, which led to the formation of Indian National Congress, were also responsible for the origin of the Institute.

1.12. At The End of 19th Century

The facilities of technical education at the end of 19th Century consisted of four engineering colleges at degree level, about 20 survey and technical institutions any some 50 industrial schools. The standard of education was good except the industrial schools. The diplomas/ degrees of the colleges were recognized by the Institution of Civil Engineers, London. However, there was stagnation in the growth of engineering education and a decline in the number of students passed out of the four engineering colleges during the last almost four decades of the 19th Century. The reason for non-utilization of the capacity was not the non-availability of suitable candidates but the then prevailing employment policy of the Government. Government support for the development of technical education had come to a standstill by 1875. The national sentiment for technical education found its greatest expression in the endowment of Rs.30 Lakh created by Jamshedji Nusserwam; Tata in 1898 to promote technical education, which finally led to the creation of Indian Institute of Sciences in Bangalore.

1.13. Emergence of Public Opinion

In 1880s, a new class of educated Indians was growing who had exposure to education, literature and political thoughts of the West. This class wanted to emulate the West and progress in respect of technical education and industrial development. This new class began to impress on the Government the need to start and accelerate the pace
of such development. It did have the support of some Englishmen but the Englishmen on
the official side said that the Indians were trying to move too fast. The newspapers with
national leanings were continually faulting the Government for not making enough
provisions for technical education unemployment was on the increase and technical
education was viewed not only as the basic need for industrialization but also as a means
to ameliorate unemployment.

The Indian National Congress in its third Session held at Madras in 1887 passed a
resolution that"— baring regard for poverty of the people, it is desirable that the
Government be moved to elaborate a system of technical education".\textsuperscript{17} A mention of the
need to have technical education became a regular feature of the Presidential address at
Congress sessions and its resolutions. In particular, the subject was emphasized by the
Congress Presidents, W.C. Banerjee in 1892, Ananda Mohan Bose in 1898.
Chandavarkar in 1900 and Madan Mohan Malviya in 1909. Earlier in the 1905 session
the Congress passed a resolution expressing its opinion that a Government: College of
Mining Engineering be established at some suitable places on the model of the Royal
School of Mines in England and the Mining colleges of Japan and Europe.

1.14. Lord Curzon's Dispensation

In 1900 Viceroy Lord Curzon appointed Sir Edward Buck to advise him on
technical and industrial schools. Buck recommended that technical education be
separated from the general education at all levels in terms of separate schools and
separate administrative set-ups. His views, however, were ignored. In 1901, Curzon
appointed a committee under the chairmanship of Col John Clibborn, to examine the subject of technical education. Curzon did not favour spreading higher level technical education in India. Curzon was the opinion that India did not have the necessary educational base to profit from higher technical education. Fresh Government resolutions resulted only in opening a few more technical and industrial schools. There were few industries in India and most of them were owned by Europeans. They preferred to employ Europeans in all technical positions. In 1902, Indian Universities Commission was appointed, which made its recommendations on technical education: "As the Colleges of Engineering trains a large number of students for the lower branches of the profession and only a small number for the higher branch, of which alone, the University takes cognizance, we do not think it desirable that the University should itself undertake instruction in Engineering"  

1.15. Provinces Invited To Make Suggestions

In 1903 the Government of India sent out a circular to provincial Governments asking for suggestions on utilization of an additional grant for technical education. United Provinces, as advised by the Upper Indian Chamber of Commerce, considered technical schools unnecessary and that the industrial schools served no useful purpose. Madras wanted no grants for expansion. Bombay wanted to reorganize the Victoria Jubilee Technical Institute (VJTI) and to start three or four new technical schools. Bengal wanted a weaving school at Serampore. These negative replies further convinced Curzon that technical education was not needed.
The Indian public opinion was, however, different. When Curxon fund was exceeding Rs.1.5 Crore for setting up a Memorial for the Queen was collected, the public opinion was strongly in favour of utilizing it to advance the cause of technical education. It was suggested that the fund be added to Tata\textquotesingle-gift for a science institute. But Curzon preferred a monument in stone. The Swadeshi Movement of the first decade of the 20th Century led to the urge of Swadeshi education also. During this period, many national educational institutions, free from the Government control, were established.\textsuperscript{19}

1.16. Post World-War 1

After the World War I, the Government became a little more responsive to public demand of technical education. The situation, which was stagnant during the War period, began to improve. Several institutions were established during the War and in the decades thereafter. They include Banaras (then Benares) \textit{Hindu University} (1916), Harcourt Butler Technology Institute, Kanpur (1920), Calcutta University College of Science and Technology (1920), Bihar Engineering College, Patna (1924), Indian School of Mines, Dhanbad (1926), Maclagan College of Engineering, Lahore (1930), Andhra University, Visakapatnam (1933), University Department of Chemical Technology, Bombay (1934), and Aligarh Muslim University (1935). Some Colleges were started in the Princely States of India in 1937; Many other colleges in the four regions of the country were started in subsequent years.\textsuperscript{20}
There was a lack of coordination at the all India level and to some extent at the provincial level on the issues of contents and durations of the educational programmes. The nomenclatures, 'Engineering', 'Technical', 'Technological', or 'School', 'College', and 'Institute' were arbitrarily used and did not indicate the level of the programmes. Later for coordination and standardization of courses, the All India Association of Principals of Technical Institution was formed in 1941. Several technical institutions were established in different parts of the country during this period. As recommended by the Abbot-Wood Committee, a Polytechnic was established in Delhi in 1941.

1.17. Pre-Independence initiatives

The number of engineering colleges during the years before the Independence was 46 with a total intake capacity of 2500 students. These colleges catered predominantly to the needs of the various Government departments such as Public Works, Railways, Electricity, Tele-communications, Irrigation, etc. A very small proportion of engineers found opportunities in private sector companies engaged in engineering operations and productions.

In 1944, the Central Advisory Board of Education was asked by the Reconstruction Committee of Viceroy's Executive Council to give a Report on the post-war education development in India. In the light of the Report, the Council appointed a committee in 1945 under the chairmanship of N.R. Sarkar to consider the development of higher technical institutions in India. In its interim report submitted in 1945, the
Sarkar Committee recommended the establishment of not less than four Higher Technical Institutions one each in the North, East, South and the West. The objectives of these institutions were expected to be similar to those pursued by the Massachusetts Institute of Technology in the USA. The key features of the proposed programme were non-specialized orientation and integrated curricula supported by institutional processes that would encourage Indian students to think creatively. The products of these institutions were expected to be "creative scientist-engineers" and technical leaders with a broad human outlook and individuals with "creative initiative in future situations". All students were expected to have strong core knowledge of basic sciences, engineering sciences, humanities, and technical arts besides the professional courses in their chosen disciplines.21

On the recommendations of the Sarkar Committee, a national agency, All India Council for Technical Education (AICTE, then not a Statutory body), was established in 1945 for planned and coordinated growth of technical education in India.

The action on the other recommendations of the Sarkar Committee, led to establishment of IITs, was taken by the Government of India. The visionary report of the Sarkar Committee led to the birth of the first Indian Institute of Technology at Kharagpur in 1951 followed by four other IITs at Bombay, Madras, Delhi and Kanpur in the late fifties and early; sixties. The Abid Hussain Committee, which was constituted to review the IITs, clearly recommended that more IITs be not established and the intake of the existing IITs be increased to meet the demand of quality technical institutions, In
view of Rajiv Gandhi’s Assam Accord and due to political considerations, the IIT at Guwahati, Assam was established which started functioning since 1992. On the historic occasion of reorganization of three States in 2001, when the new state of Uttaranchal was born, circumstances became favourable to convert University.” of Roorkee into an IIT, an event which was soon made an election plank by many.\textsuperscript{22}

1.2.1. Growth of Technical Education after Independence

The Government of India, after Independence, recognized the importance of quality technical education for the economic and industrial growth of the country, which required the future generation of engineers to be competent, innovative, good designers and excellent product manufacturers, The Radhakrishna Commission Report (1949) made several recommendations on technical education emphasizing the need of new types of engineering and technical institutions in India. As a consequence of these recommendations, several new developments took place in the subsequent years.

On the recommendation of the Engineering Personnel Committee, which was appointed by the Planning Commission in 1955, the Government of India initially decided to establish eight Regional Engineering Colleges (RECs). In order to provide each State with a Regional Engineering College, seven more were approved for establishment during the Third Plan period, bringing the total number of RECs to fifteen
by 1972. Two more were added later, one in Jullandhar (1985) and the other in Hamirpur (1989).\footnote{23}

The Technical Teacher Training (TTT) programme, which was started in the late fifties, resulted in the creation of a large pool of dedicated teachers. After the TTT programme was phased out, the Quality Improvement Programme (QIP) for improving the quality of technical education and developing the faculty of engineering institutions was launched by the Government of India in 1970. This programme is operated in 25 engineering/technical institutions; seven of their, are major QIP centres and eighteen are minor centres. This programme provided an opportunity for continuous upgrading of knowledge and skills of persons who were already in the teaching profession. Over the years a large number of teachers acquired higher degrees from leading institutions in the country under the programme.\footnote{24}

In order to assess the impact of foreign technical assistance on the development of technical education in India and to determine the areas need to be developed and supported through the foreign technical assistance programme’. The Government of India appointed a Committee under the Chairmanship of Nayudamma (1978) to review the postgraduate education research in engineering and technology and made recommendation for further development.

The National Policy on Education (NPE 1986) was a major development in the field of education. NPE came out at a time when the role and impact of private institutions
imparting technical education were not known or even perceived. NPE was, therefore silent on this aspect and so was the resulting Programme of Action (POA 1992).

1.2.2. Postgraduate Education in Engineering and Technology

The intake capacity for Post Graduate education in engineering was a mere 30 students in 1947. Most had to go abroad to obtain postgraduate education in engineering. The postgraduate education in engineering and technology in independent India had a late start. It started in a few institutions in early 1950's but the doctoral programmes were not common until early 1960's. The recommendations of the Thacker Committee (1959-61) and of the Nayudamma Committee (1978-79) played a role in the development of the postgraduate education in engineering education. These Committees were constituted by the then Ministry of Education and their reports were submitted directly to the Ministry for perusal and action. Later a Review Committee on Postgraduate Education in Engineering was constituted by AICTE in 1995 under the Chairmanship of P.Rama Rao, which submitted its Report to AICTE in 1999, The actions on this Report have been slow and sporadic. The postgraduate education in India remains weak and need urgent attention. With a weak postgraduate education in engineering, the technology base will be weak and India will not be able to become a front runner in the field of technology, industrial productivity and the service sector, which determine the growth and development of the country.25

1.2.3. Rama Rao Committee Report
Rama Rao Committee supported the ‘GATE’ system of admission, recommended the increase of the duration of M.E./M.Tech programme from 18 months to 25 months, and enhancing the scholarship to postgraduate students, with a provision of its periodic review. The duration of the programme was, however increased to 24 months. The Rama Rao Committee recommended strengthening the one, year postgraduate diploma programmes in suitable disciplines with industrial/ application orientation. These programmes were aimed at key industry personnel and the concerned industries should be expected to invest in setting up links with selected institutions. The Diploma programme could be offered both on-campus and in Distance Education mode. The Rama Rao Committee recommended enrolling foreign students to post graduate programmes, particularly in engineering areas since many countries did not have the facilities in those areas. The Committee emphasized an assured placement through active linkages with potential employers, recommended that programmes in new areas be started after careful considerations of all aspects and with due care and listed 35 representative areas. The Committee recommended restructuring and at the same time even phasing out of the outdated programmes.²⁶

1.2.4. Expansion of Technical Education in the Private Sector

The technical education in India gradually expanded enormously. A major portion of this expansion is in the private sector, with an annual intake of more than 700,000 in AICTE approved institutions. The quality of education however, is a major concern. More IITs were planned to provide quality technical education. Joshi Committee was
constituted to identify the institutions which could be converted into IIT, since converting an existing institution into IIT would be much less expensive than establishing new IITs. Joshi Committee had two Ex-Directors of IIT and the Committee apparently did not want proliferation of IITs. It shortlisted seven institutions but recommended that they be raised to the level of IITs and further recommended that another Committee be constituted to visit the seven institutions and prepare a road map for raising them to a higher level. Consequently, the Anandakrishnan Committee did a detailed exercise which included visits to the seven institutions and submitted its report to MHRD in February 2006. The Committee stressed that these institutions should constitute a new group with a design and profile which is in the context of the world milieu to 2006 and should be distinct from IITs, which were established more than five decades ago. The Committee also made bold and far reaching recommendations to enable the new group of Institutions to attain very high standards. The response of MHRD on the implementation of the Anandakrishnan Committee report was initially ad-hoc in terms of a lump sum grant to the seven institutions towards the end of the financial year suggested to name them” Indian Institute of Engineering Science and Technology (IIEST).

In the mean time MHRD announced the establishment of eight new IITs and conversion of IT BHU into IIT. Six of the new IITs were started in 2008 under the mentorship of the existing IITs, IIT Punjab being mentored by IIT Delhi; IIT Rajasthan by IIT Kanpur, IIT Madhya Pradesh by IIT Bombay, IIT Orissa by IIT Kharagpur, IIT
Patna by IIT Guwahati and IIT Andhra Pradesh by IIT Madras. In 2009, IIT Himachal is functioning under the mentorship of IIT Roorkee and IIT Gujarat under IIT Bombay. IT BHU is converted into IIT in 2009. To begin with the Director and the Chairman of the Board of Governors of each mentoring IIT were respectively appointed as the Director and the Chairman of its mentored IIT. Recently, the Directors have been appointed for the new IITs which are functioning in make shift/temporary premises. Teaching is largely being done by the faculty of mentoring IITs who commute from one campus to other. Time has come for policy-makers to look beyond IITs on the lines as was recommended by the Anandakrishnan Committee.  

1.2.5. Growth of Indian Engineering Education

Facilities for education in engineering, technology and management have expanded considerably since Independence. Whereas there were only 44 engineering degree level institutions in the country at the time of Independence with a total intake capacity of 2570, on 31\textsuperscript{st} August 2007 there were 1668 AICTE approved engineering degree level institutions with student annual admission capacity of 653,290. In addition professional education is available annually at the first degree-level in Pharmacy for 52,334 students in 854 institutions, in hotel management and catering technology for 5272 in 81 institutions, in general management for 121,867 students in 1149 institutions, in Master of Computer Applications for 70,513 in 1017 institutions, and in architecture for 4543 students in 116 institutions. At the post-graduate level in engineering, there are 1983 programs in 483 institutions with an enrolment capacity of 36052 students. Much of
the expansion in technical education facilities has occurred during the Ninth and Tenth Plan periods primarily due to government policy support for encouraging private investment in the field. During the Tenth Plan period, the degree level institutions went up from 1057 to 1459 with an annual intake capacity going up from 295,796 to some 550,000 an increase of some 80 per cent in less than five years. The private sector continues to be a major player in technical education with its current share in engineering today being close to 86 per cent. Table 3.1 shows the growth of number of engineering degree institutions in the country during 1997-98 to 2008-2009, annual growth rate of institutions and the sanctioned intake capacity.  

Table 3.1

Growth of Engineering Degree level Institutions

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Engineering degree institutions</th>
<th>Annual Percentage</th>
<th>Sanctioned Intake</th>
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<tr>
<td>1997-98</td>
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<td>134,894</td>
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<td>1998-99</td>
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</tr>
<tr>
<td>2004-05</td>
<td>1358</td>
<td>7.5</td>
<td>459,407</td>
</tr>
<tr>
<td>2005-06</td>
<td>1476</td>
<td>8.7</td>
<td>517,018</td>
</tr>
<tr>
<td>2006-07</td>
<td>1522</td>
<td>3.1</td>
<td>NA</td>
</tr>
<tr>
<td>2007-08</td>
<td>1668</td>
<td>9.6</td>
<td>653,290</td>
</tr>
<tr>
<td>2008-09</td>
<td>2388</td>
<td>43.2</td>
<td>820,000</td>
</tr>
</tbody>
</table>

In the last two years the demand situation appears to have gone berserk (AICTE-approved engineering degree level institutions have gone up in 2008-09 by over 40 per cent to 2388 with the annual sanctioned intake capacity going up by more than 25 per cent to over 820,000 students, while the new request for approval for the 2009-10 session is reported to be another 880 institutions). This sudden jump in growth rate could be attributed to the continuing attractiveness of degree level programs for employment of graduates in the growing economic environment but this could also be clue to increasing confidence of the private, sector in investing resources in engineering education forgetting fairly high returns on investment. While the increase in the number of engineering institutions offering degree programs in the last few years has opened the doors for increasing the trained manpower pool for the economy, challenges of increasing access with equity, reducing regional imbalance, and improving and assuring quality of offering continue to remain areas of major concern. These issues are discussed in some-detail in the following paragraphs.

1.2.6. Access to Engineering Education

The accelerating growth of the Indian economy, between 8-9 per cent p.a., has generated increased annual demand of qualified engineers in construction, manufacturing and service sectors, so much so that employers are already reporting shortages both in the core industries as well as the IT sector. The Nasscom-Mckinscy Report (2005) made a forecast of a shortage of some 500000 engineers in the IT and ITES sector alone by 2010. When this is coupled with the demand of Indian engineers in
other parts of the world, even the present high rate of expansion (average of some 14 per cent per year during the last ten years) may prove to be inadequate. The reported decision of the Government to raise the Gross Enrolment Ratio (GER) of higher education from the present 10 per cent to 15 per cent by the end of the 11th Plan and 22 per cent by the end of the 12th Plan. It shows that there is a need for higher rate of growth of engineering education in the country during the next decade, since engineering and medicine are the preferred disciplines for admission to higher education in the country. Although the proposed expansion and the rate of growth in higher education facilities are most welcome as they would help meeting the growing demands of an economy which is poised to reach the double digit rate of growth. India is still lagging far behind in the production of S&T manpower when compared to those of other countries: India having 3.5 S&T personnel per 1000 population against China having 8.1, South Korea 45.9, USA 55, Germany 76, Israel 76 and Japan 110. If India has to emerge as a developed industrialized nation, it has to expand access to professional education many fold. Compared to China, India presents a much poorer picture. In 2004, for instance, there were 4,376,167 engineering students studying in various Universities and colleges in China, which constituted about 34 per cent of the total number of University students, i.e., 13,334,969.

At the post-graduate level, there were 302,296 graduate students (Master's and Doctoral candidates; studying engineering at Universities in China, which is 38.84 per cent of the total number of graduate students in that country (779,408), compared to this
India had some 28,000 students studying post-graduate programs in engineering which is only about 3-4 per cent of all post-graduate students (872,161). This dichotomy shows the low emphasis placed on engineering education both at the degree and postgraduate levels in India compared to that in China. If the Indian economy has to catch up with the Chinese economy, the percentage of students entering engineering education must increase substantially.  

1.2.7. Equity

In addition to the need for increasing access to engineering education to a larger number of students graduating from senior secondary schools (+2 schools), there is also a major question of equity, most of the engineering students come from affluent urban families and equal opportunities for seeking professional education are denied to those coming from rural homes, from low-income families, or to those who come from disadvantage groups like women, Scheduled Castes, Scheduled Tribes and other Backward Classes. Although there have been reservations few seats in public institutions for SC/ST candidates for a long time and scholarships are awarded to all students to this category admitted to these institutions to meet their educational and living expenses, the participation of this group in engineering is still very limited when the whole of the engineering education system is considered (there is presently no reservation in private institutions which control 86 per cent of the enrolment) The recent decision of the Government to extend the reservation benefits to other backward classes in central institutions is intended to improve equity. However the question of assisting eligible
students from poorer families who do not have access to support through grant of soft loans to be recovered after their employment continues to be a problem to be tackled much more purposefully than being done at present. Some selected data from SES2005 given in table 3.2 illustrate the equity issue. The data in Table 1.2 refer to the entire Higher Education Sector in the absence of similar data for the engineering sector alone).

### Table 3.2

**Gender Wise and Caste Wise Enrollments in Engineering Education**

<table>
<thead>
<tr>
<th>Category</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
<th>Scheduled Caste</th>
<th>Scheduled Tribe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total enrolment in engineering 2004-05</td>
<td>696609</td>
<td>531207 (76.3%)</td>
<td>165402 (23.7%)</td>
<td>59299 (I) (8.5%)</td>
<td>47076(M) 12223(F)</td>
</tr>
<tr>
<td>GBR in Higher Education 2004-05</td>
<td>10.0</td>
<td>11.6</td>
<td>8.2</td>
<td>6.7(1) 8.1(M) 5.2(F)</td>
<td>4.9(1) 6.3(M) 3.5(F)</td>
</tr>
<tr>
<td>Gender Parity in Higher Education</td>
<td>0.71</td>
<td></td>
<td></td>
<td>0.64</td>
<td>0.55</td>
</tr>
<tr>
<td>Number of Engineering students Who Graduated in 2003</td>
<td>127610</td>
<td>101143 (79.3%)</td>
<td>26467 (20.7%)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Number of Engineering Post-graduates in 2003</td>
<td>12370</td>
<td>10205 (82.5%)</td>
<td>2165 (17.5%)</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Source: AICTE, Annual Report, 2005-06

The gender parity in engineering education (0.31) is much worse than in total higher education (0.71). This is true not only for all students but also for the SC (0.26 as against 0.64) and ST students (0.24 against 0.55). The situation has, however, started
improving in recent years due to a large number of girls entering computer science, information technology, electronics and communication and biotechnology, programs in engineering. Apart from gender disparity, there are differences in access to higher education on the basis of religion, rural/urban divide as well as poor/non-poor divide because of perceived cultural preferences, awareness of employment opportunities, and cost of education. National Sample Survey data (NSS2003) for GER for Higher Production illustrate these variations: Total 13.2, Male 15.3, Female 11.0; SC 7.5, ST 5.0, OBC 11.34, others 24.89; Hindu 12.0, Muslim 8.2, other religions 30.9; Rural 7.8, Urban 27.2; Poor 2.43, Non-poor 12.81. This difference for higher education in engineering could be even more pronounced since the cost of professional education is relatively much higher than general higher education and girls in most communities do not prefer engineering as an attractive career option.

1.2.8. Regional Imbalance

Unfortunately, the recent expansion of facilities has created not only the problem of maintaining high quality of education, it has also increased regional imbalance of educational facilities. The facilities for engineering education is so badly distributed in the country- that 63.6 per cent of the UG seats and 62 per cent of the PG Seats are available in only three of the seven regions of the country namely the Southern, the South Western and the Western (Table 3.3). Further, nearly 60 per cent of engineering graduates and post-graduates come from only 4 states, Tamilnadu, Andhra Pradesh,
Karnataka and Maharashtra (Table 3.3). Table 3.3 shows in detail the regional availability of sanctioned UG and PG seats.
Table 3.3
Regional distribution of sanctioned intake for UG and PG Programs in Engineering Institutions

<table>
<thead>
<tr>
<th>Regions (as per AICTE grouping)</th>
<th>Under Graduate Programs in Engineering as on 31-08-2007</th>
<th>Post-graduate Programs in Engineering as on session 2007-08</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Institution</td>
<td>Sanctioned intake Capacity</td>
</tr>
<tr>
<td>Central (MP, Chattisgraph, Gujarat)</td>
<td>166</td>
<td>66161 (10.13%)</td>
</tr>
<tr>
<td>Eastern (Mizoram, Sikkim, Orissa, West Bengal, Tripura, Meghalaya, Aunachal Pradesh, A &amp; N, Assam, Manipur, Nagaland, Jharkhand).</td>
<td>128</td>
<td>40613 (06.22%)</td>
</tr>
<tr>
<td>Northern (Bihar, UP, Utaranchal)</td>
<td>155</td>
<td>57988 (08.88%)</td>
</tr>
<tr>
<td>North West (Chandigarh, Haryana, J&amp;K, Delhi, Punjab, Rajasthan, HP)</td>
<td>206</td>
<td>73251 (11.21%)</td>
</tr>
<tr>
<td>Southern (Andhra Pradesh, Pondicherry, Tamilnadu)</td>
<td>593</td>
<td>256572 (39.26%)</td>
</tr>
<tr>
<td>South-West (Karnataka, Kerala)</td>
<td>234</td>
<td>91939 (14.07%)</td>
</tr>
<tr>
<td>Western (Maharashtra, Goa, Daman &amp; Diu, Dadar NH)</td>
<td>186</td>
<td>66767 (10.22%)</td>
</tr>
<tr>
<td><strong>INDIA</strong></td>
<td><strong>1668</strong></td>
<td><strong>653290</strong> (10.22%)</td>
</tr>
</tbody>
</table>
Table 3.3 gives the sanctioned seats for degree and post-graduate education in engineering per lakh of population of the 28 States and Union Territories. The variation is very large: no engineering degree education is available in the north eastern states of Nagaland, and Mizoram, and no post graduate engineering education facilities in these States and in Meghalaya, Manipur and Tripura; the range, for UG seats per lakh of population in the remaining States and Union Territories vary from the lowest of 1.86 for Bihar to 189.20 for Tamilnadu. Twenty States/UTs have below the national average of 58.74 UG seats per lakh of population and only 10 are ahead with Karnataka, Andhra Pradesh and UTs of Chandigarh/Pondicherry having more than twice the national average. The status of PG facilities is similar, varying from a low of 0.2 for Bihar to a high of 10.94 for Tamilnadu and 17.51 for the UTs of Chandigarh/Pondicherry.
### Table 3.4
State-wise Sanctioned seats per Lakh of Population in Degree & PG Level courses in Engineering

<table>
<thead>
<tr>
<th>S. No.</th>
<th>State / UTs</th>
<th>Projected Population, 2006</th>
<th>Degree Level as on 31.8.07</th>
<th>Post guardant Level as on 2007-08 Session</th>
<th>No. per one lakh population UG + PG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nagaland</td>
<td>21.19</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Mozoram</td>
<td>9.46</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Bihar</td>
<td>907.52</td>
<td>1690</td>
<td>1.86</td>
<td>180</td>
</tr>
<tr>
<td>4</td>
<td>Assam</td>
<td>286.65</td>
<td>870</td>
<td>3.03</td>
<td>156</td>
</tr>
<tr>
<td>5</td>
<td>Manipur</td>
<td>23.08</td>
<td>115</td>
<td>4.98</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>Meghalaya</td>
<td>24.70</td>
<td>240</td>
<td>9.71</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>J &amp; K</td>
<td>109.41</td>
<td>1401</td>
<td>12.81</td>
<td>36</td>
</tr>
<tr>
<td>8</td>
<td>Tripura</td>
<td>34.07</td>
<td>490</td>
<td>14.37</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>Jharkhand</td>
<td>292.99</td>
<td>34.38</td>
<td>11.73</td>
<td>888</td>
</tr>
<tr>
<td>10</td>
<td>West Bengal</td>
<td>852.16</td>
<td>16968</td>
<td>19.91</td>
<td>1318</td>
</tr>
<tr>
<td>11</td>
<td>Arunachal Pradesh</td>
<td>11.69</td>
<td>210</td>
<td>17.96</td>
<td>54</td>
</tr>
<tr>
<td>12</td>
<td>Uttar Pradesh</td>
<td>1832.82</td>
<td>51775</td>
<td>28.25</td>
<td>1669</td>
</tr>
<tr>
<td>13</td>
<td>Himhal Pradesh</td>
<td>64.55</td>
<td>1807</td>
<td>27.99</td>
<td>162</td>
</tr>
<tr>
<td>14</td>
<td>Chattisgarh</td>
<td>225.94</td>
<td>7006</td>
<td>31.01</td>
<td>356</td>
</tr>
<tr>
<td>15</td>
<td>Gujarat</td>
<td>549.79</td>
<td>17408</td>
<td>31.66</td>
<td>1515</td>
</tr>
<tr>
<td>16</td>
<td>Rajasthan</td>
<td>622.76</td>
<td>20683</td>
<td>33.21</td>
<td>804</td>
</tr>
<tr>
<td>17</td>
<td>Orissa</td>
<td>388.87</td>
<td>17817</td>
<td>45.82</td>
<td>270</td>
</tr>
<tr>
<td>18</td>
<td>Delhi</td>
<td>160.21</td>
<td>6943</td>
<td>43.34</td>
<td>818</td>
</tr>
<tr>
<td>19</td>
<td>Uttaranchal</td>
<td>92.19</td>
<td>4523</td>
<td>49.06</td>
<td>251</td>
</tr>
<tr>
<td>20</td>
<td>Goa</td>
<td>14.92</td>
<td>809</td>
<td>54.22</td>
<td>69</td>
</tr>
<tr>
<td>21</td>
<td>Maharashtra</td>
<td>1048.04</td>
<td>65958</td>
<td>62.93</td>
<td>3674</td>
</tr>
<tr>
<td>22</td>
<td>Madhya Pradesh</td>
<td>663.90</td>
<td>41747</td>
<td>62.88</td>
<td>2463</td>
</tr>
<tr>
<td>23</td>
<td>Haryana</td>
<td>233.14</td>
<td>22750</td>
<td>68.51</td>
<td>1125</td>
</tr>
<tr>
<td>24</td>
<td>Punjab</td>
<td>260.59</td>
<td>18879</td>
<td>72.45</td>
<td>1325</td>
</tr>
<tr>
<td>25</td>
<td>Sikkim</td>
<td>5.76</td>
<td>465</td>
<td>80.73</td>
<td>0</td>
</tr>
<tr>
<td>26</td>
<td>Kerala</td>
<td>332.65</td>
<td>29790</td>
<td>89.55</td>
<td>1061</td>
</tr>
<tr>
<td>27</td>
<td>Karnataka</td>
<td>562.58</td>
<td>62149</td>
<td>110.47</td>
<td>3484</td>
</tr>
<tr>
<td>28</td>
<td>Other UTs (Chandigarh, Pondicherry)</td>
<td>(788+2670)</td>
<td></td>
<td>(294+263)</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Andhra Pradesh</td>
<td>807.12</td>
<td>130669</td>
<td>161.90</td>
<td>6693</td>
</tr>
<tr>
<td>30</td>
<td>Tamil Nadu</td>
<td>651.35</td>
<td>123232</td>
<td>189.19</td>
<td>7125</td>
</tr>
<tr>
<td>Country</td>
<td>Enrollment</td>
<td>FTE</td>
<td>Graduates</td>
<td>Faculty</td>
<td>Ratio</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>-----</td>
<td>-----------</td>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>INDIA</td>
<td>11121.86</td>
<td>653290</td>
<td>58.74</td>
<td>36052</td>
<td>3.42</td>
</tr>
</tbody>
</table>

Note: Figures above do not include IITs and NITs (not covered under AICTE).
The above regional disparity would not get removed or even lessened if left entirely to market forces and private sector initiatives, since the latter are usually oblivious of social concerns and invest mostly in states where the atmosphere is conducive and return on investment is high. Although regional imbalance hat-been a concern for AICTE and the Government for many years there is no apparent radical redressal. Table 3.6 which exhibits the Zone-wise distribution of institutions and intake capacity over a four year period (2004-2005) shows that is no market forces the regional imbalance would not get reduced significant. Although Central and Northern zones have picked up some steam. Eastern region as expected is still struggling both in the number of institutions and the intake capacity. Even in States where the number of institutions have increased in recent years, most of the new institutions have come up not only in urban areas but in the same cities where adequate facilities for engineering degree level education already exists.

Hence, there is an urgent need for some innovative State interventions not only to reduce this growing disparity but also to promote location of new institutions in educationally deprived areas in the State. The five categories of States mentioned earlier need separate strategies to reduce the imbalance. Category 5 States need no State intervention and increase or decrease in availability can be left to market forces. AICTE should reduce the number of sanctioned seats if seats remain unfilled for two consecutive years, whereas the States can insist that new techniques institutions would be permitted only on the assessed manpower demand. For other categories, AICTE in consultation
with the concerned States should prescribe targets to be reached in the next three Plan periods. It appears reasonable that Category-1 States should reach seat availability of 40 per cent of the current nations; norms in the 11th Plan period, and 60 per cent by the end of the 12th Plan. Category 2 states should reach a target of 60 per cent in the 11th Plan period and 80 Per Cent by the end of the 12th Plan; Category three States should reach 80 of the current national norms by the end of the 11th Plan period, and 100 per cent by the end of the 12th Plan period. Category four States should reach the current national norms by the end of the current plan period. Although during the 11th and 12th Plan periods, the States which are above the national average would continue to start more new institutions and the national norms will change, the planning should be done on present norms and reviewed at the end of the 11th Plan.

The specific interventions would van- from State to State even in the same category and would need detailed discussion between AICTE and the State authorities As already mentioned earlier that even in States/ UTs which have adequate facilities for degree level engineering education, most of the institutions are located in urban areas with very access to rural students. Category 4 and 5 States should in future reduce the district-wise regional imbalance in the States by encouraging starting of new-institutions in so far neglected districts.

While it is not possible to drastically reduce the imbalance of technical education facilities in one plan period, much could be achieved by a declared policy of reducing this imbalance through pro-active State intervention for which a special fund needs to be
created in each plan period for the 10th, 11th and 12th plan, and the programme of implementation reviewed after each plan.

1.2.9. Engineering Education with International Perspective

Engineering Education is currently at crossroads. It can continue to function through face-to-face interaction at University type institutions and campuses or adopt a mixture of alternative knowledge delivery mechanisms using modern information technology tools and permit both synchronous and asynchronous learning through distance- and web-based education mechanisms. It can remain highly discipline/specialization oriented or become more and more a multi- and cross-disciplinary learning endeavour permitting students to recognize the fact that real life professional engineering activity involves tackling multi-disciplinary problems. It can concentrate on developing only technological excellence among its graduates or equipping them also with professional and business skills of quality and competitiveness in the design, fabrication and utilization of engineering products, services and systems. Globalization of economic activities, and mobility of professionals across national borders and the emergence of a knowledge society are putting new insights on the competency requirements of engineers, their role in the emerging international scenario, and their ability to work harmoniously and effectively in multi-disciplinary and multi-cultural teams.32

The 20th Century witnessed a phenomenal rate of growth and advance in technologies. There are no signs that the rate of growth in the present century would be
any less. The half-life of many technologies are already much lower than the time span of conventional 4-year first-degree program. A fixed 4-year curriculum is already becoming obsolete, as changes have to be made frequently during the 4-year period to keep the students abreast of the latest advances in their field of activity. The rapidity of technological obsolescence is compelling the educational system to ensure that students during their stay in the Institutions develop an attitude for life-long learning and acquire self-learning skills and are provided enough opportunities to demonstrate their ability in information search and retrieval and for acquiring new knowledge.\textsuperscript{33}

1.2.10. Impact of Globalization

During the first half of the 20\textsuperscript{th} Century there was a famous dictum that while science is universal, engineering is nation-specific because engineers are required to solve local problems with local, social and economic constraints. With globalization and the gradual integration of the Indian economy with the global economy, this definition is no longer valid. India should produce engineers who are capable of offering engineering expertise and services to any part of the globe, who would work in international teams with team members having multidisciplinary expertise and diverse cultural backgrounds and who would be capable of recognizing diversity of cultural preferences, differing social and economic constraints, and different engineering standards of the client nation and/ or client engineering organization. While membership of WTO and agreement under GATS entitles free mobility of Indian professionals in all member nations of WTO, it also allows professionals from other countries to offer their professional services in India.
This enables healthy competition among professionals and demands that the engineering and management education system should have the quality of its output comparable to the very best in the world. This has in turn brought great responsibility on all our Universities and Colleges to ensure that their graduates possess knowledge, skills, abilities and attitudes, which will give them an edge over professionals of other countries.

1.2.11. **Merits of Internationalization**

Implicit in the system of Globalization is the inevitability of internationalization of the educational system, particularly at the higher education stage. This is not peculiar to India but has become a worldwide phenomenon. The entry of the World Trade Organization (WTO) and the inclusion of educational services under the General Agreement on Trade in Services (GATS) have given a boost to the internationalization of higher education. The merits of internationalization of education are:35

i. Education will improve if it is internationalized and healthy competition takes place;  
ii. It will provide global opportunities and promote international good will; and  
iii. It will encourage exchange of scholars. This can be done by involvement of reputed scholars in the respective countries in curriculum designing and transaction of knowledge.

1.2.12. **Indian Safeguards**

Notwithstanding the merits of internationalization of education, it will be harmful for our country to allow an unregulated entry of foreign institutions in India. Quite a few of these institutions are of dubious quality- some of them have not even been recognized
in their own countries. The following guidelines were suggested by scholars about the entry of foreign institutions in India:\(^\text{36}\)

- While the foreign institutions may be allowed to set up their campuses in India, they should function under the control of the government or specialized bodies like the National Assessment and Accreditation Council (NAAC) set up by the Government;
- The universities which want to function in India should have been accredited in their own countries;
- The foreign institutions should be subjected to pre-entry academic audit and accreditation norms devised by the designated government agencies;
- They should sign Memoranda of Understanding (MOU) with the government or a body designated by it. The Memorandum should give details of the courses of studies, infrastructural facilities, both academic and non-academic and the amount of expected cost recoveries from Indian students;
- The entry of foreign institutions should be allowed on the basis of reciprocity. The countries exporting education to India should also permit the opening of Indian university campuses in their countries. There should be provision for exchange of faculty among the various countries participating in the programme; and
- In the entire process of the entry of foreign institutions, the paramountcy of national interests should be the crucial guiding factor.

### 1.3.1. Technical Education in Andhra Pradesh

Andhra Pradesh is well endowed with a good number of technical institutions. The State is the one of the important state in India which is preparing world class technical
personnel. In Andhra Pradesh technical education received less attention by the colonial rulers. After Independence the State as being a part of the former Madras State received the attention of rulers. After the formation of separate State of Andhra Pradesh the government has given due priority for the establishment of technical education institutions. But the technical institutions are not grown as per the demand in the state. This led to migration of Andhra Pradesh students to neighbouring states, especially to Karnataka and Tamil Nadu in search of technical education. But the situation slowly altered after 1990s. After the liberalization of Indian economy the number of technical educational institutions increased year by year in the state.

1.3.2. Technical Education

The Director of Public Instruction (D.P.I.) used to head the Technical Education also at the time of formation of Andhra Pradesh. To help speed up the process of development of Technical Education, a Board in the name and style of “State Board of Technical Education and Training” was created vide G.O.Ms.No.371 Edn-dated 26.2.1957. The Joint Director (Technical Education) of DPI used to act as secretary of this newly formed Board. The Board is formed as a statutory body under the A.P. Education Act-1982 (act 1 of 1982), an act of assembly, in the present form, vide G.O.Ms.No.140 dated 24.4.1984. In accordance with the powers conferred by Sub-Sections (1) and (2) of Section 6 read with Sub-Section (1) of Section 99 of the said Act, the Government of Andhra Pradesh have established a Board of Technical Education "The State Board of Technical Education & Training, Andhra Pradesh" in

The Department of Technical Education was established in G.O.Ms.No.1166, Education Department dated 5-6-1957 to bring about coordinated efforts for the development of Technical Education by pooling of Engineering Colleges from the Director of Public Instructions and the Polytechnics from the Department of Industries and Technical Examinations from the Commissioner of Government Examinations. The table 3.5 gives the details of district wise engineering colleges.
Table 3.5
District - Wise Engineering Colleges in Andhra Pradesh as on July 2010

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the District</th>
<th>Govt. Engineering Colleges</th>
<th>Private Engineering Colleges</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Co-education</td>
<td>Women</td>
<td>Co-education</td>
</tr>
<tr>
<td>1</td>
<td>Anantapur</td>
<td>2</td>
<td>-</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>Kurnool</td>
<td>-</td>
<td>-</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>Kadapa</td>
<td>2</td>
<td>-</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>Chittor</td>
<td>2</td>
<td>-</td>
<td>27</td>
</tr>
<tr>
<td>5</td>
<td>Adilabad</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Nizamabad</td>
<td>-</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Karimnagar</td>
<td>3</td>
<td>-</td>
<td>16</td>
</tr>
<tr>
<td>8</td>
<td>Medak</td>
<td>-</td>
<td>-</td>
<td>21</td>
</tr>
<tr>
<td>9</td>
<td>Hyderabad</td>
<td>3</td>
<td>-</td>
<td>15</td>
</tr>
<tr>
<td>10</td>
<td>Ranga Reddy</td>
<td>-</td>
<td>-</td>
<td>135</td>
</tr>
<tr>
<td>11</td>
<td>Mahabubnagar</td>
<td>1</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>12</td>
<td>Nalgonda</td>
<td>-</td>
<td>-</td>
<td>40</td>
</tr>
<tr>
<td>13</td>
<td>Warangal</td>
<td>1</td>
<td>-</td>
<td>27</td>
</tr>
<tr>
<td>14</td>
<td>Khammam</td>
<td>1</td>
<td>-</td>
<td>22</td>
</tr>
<tr>
<td>15</td>
<td>Srikakulam</td>
<td>-</td>
<td>-</td>
<td>9</td>
</tr>
<tr>
<td>16</td>
<td>Vijayanagaram</td>
<td>1</td>
<td>-</td>
<td>11</td>
</tr>
<tr>
<td>17</td>
<td>Vishakapatnam</td>
<td>2</td>
<td>-</td>
<td>24</td>
</tr>
<tr>
<td>18</td>
<td>East-Godavari</td>
<td>1</td>
<td>-</td>
<td>29</td>
</tr>
<tr>
<td>19</td>
<td>West-Godavari</td>
<td>-</td>
<td>-</td>
<td>30</td>
</tr>
<tr>
<td>20</td>
<td>Krishna</td>
<td>-</td>
<td>-</td>
<td>33</td>
</tr>
<tr>
<td>21</td>
<td>Guntur</td>
<td>1</td>
<td>-</td>
<td>35</td>
</tr>
<tr>
<td>22</td>
<td>Prakasam</td>
<td>-</td>
<td>-</td>
<td>22</td>
</tr>
<tr>
<td>23</td>
<td>Nellore</td>
<td>-</td>
<td>-</td>
<td>24</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>20</td>
<td>-</td>
<td>581</td>
</tr>
</tbody>
</table>

Source: Census of India, 2001
Table 3.5 shows that there are 668 engineering colleges in the State. Out of which, 20 constituting 2.99 per cent were under government management and the remaining under private management. All the government colleges were spread in 12 districts with varying numbers. Under Government management all colleges are co-education colleges. Whereas under private management there are 67 women engineering colleges, which constitute 10.02 per cent of total colleges. Coming various districts there are wide spread disparities. The Ranga Reddy district with 146 colleges tops the list. This can be attributed that major part of the district is merged with Greater Hyderabad Municipal Corporation, which is the capital of the state. On the other hand Adilabad with only two colleges stood at the lowest rung of the ladder. In coastal Andhra Guntur with 45 colleges stood at the top and it is followed by Krishna and West Godavari districts with 38 and 34 colleges respectively. In Rayalaseema region, there are 92 engineering colleges. Out of which, 33 colleges in Chittoor district and it is followed by Kadapa, Kurnool and Anantapur districts in that order.

1.4.1. Engineering College Libraries

The technological advances have made greater impact on information recording storage and retrieval methods and techniques. The modern telecommunication system is a boon to library an information field. This has emphasized Libraries and Information Centres to shift from ownership to access to resources. The modern information storage media need no more bigger buildings. Huge data can be stored in magnetic and optical discs. Apart from higher storage capacity, these media have enabled the use an easy and
faster access to information and thereby saving valuable time. Thus, today shift from Card Catalogues to Online Public Access Catalogue (OPAC) can be visualised as one example. These factors along with increasing financial constraints have forced libraries to adopt technology for information storage and retrieval. With the availability of library automation software packages having good facilities and functionalities at modest price, there is a growing tendency to move towards the integrated library system to manage the in-house operation in the library. It is now possible to make web OPAC with Internet connectivity.³⁷

Libraries, particularly technical college libraries, have to re-examine their traditional functioning adopted for several decades, should now identify new solutions to their problems to achieve better results as well as their survival in the competitive environment. They should make an attempt to come together to share their resources and services by using IT gadgets, so as to facilitate users with easy access to information at low cost and in short time.

The library of an engineering college plays a significant role in the education system. For a student seeking a graduate degree, it is largely an information resource centre that supplements classroom and outside teaching. On the other hand, for someone pursuing higher degree and teachers, the library is expected to identify, acquire, organise, store, retrieve and disseminate information not only on the specific subjects covered by the curriculum, but also on the current directions of technologies advancement.³⁸

### 1.4.2. Engineering College Libraries and Library Professionals
Librarianship is, certainly, an occupation which demands specialized knowledge and skills. It is based on a systematic theory which delineates and supports the skills that characterized the profession. Librarianship has its professional organisations which promote excellence in the work of the members; influence public sentiments; support, values norms and symbols; and endeavour to raise it to a position of dignity and social standing. It has at its centre career concept and from the beginning it is service oriented. Of course, librarianship is a noble and exalted profession but unfortunately it has not taken roots in India. For a layman in India, librarian is one who can read the spins of books and maintain their records.

The library profession as an occupation is not preceded by a vocational growth process which is hypothesized to be the phenomenon behind socially desired professions like medicine, engineering, teaching, etc., in India. Vocational growth refers to the process of developing work values, crystallizing a vocational identity, learning about opportunities, and typing out plans in part time, recreational, and full-time work situations. Vocational growth process amounts to the development of an intrinsic interest in profession. This intrinsic interest may have a high motivational character in enhancing satisfaction, success and moral of the personnel. Because of the lack of this vocational growth, library science as a profession is not highly respected either by the ‘Academic community,’ or by the ‘public’ or even in the ‘family’.
The rising tide of literature, the proliferation of subjects, the explosion of scholarly and informational material in all major languages of the world and the bibliographical apparatus of the many fields and sub-fields becoming enormously difficult along with the introduction of the system of Open Universities, establishment of Advance Centres of Study, and mounting research in the Universities, devolve upon the librarians to assume the role of a subject specialist, documentalist, or information officer, and the media expert as the occasion requires. The developments in Information Technology (IT) have greatly changed the scenario of the libraries and their operations and services. The function of the librarian as a reliable, competent, accurate and cleaner manipulator of library information for the success of teaching and research entitles him to the academic status, and not slogan-shouting.\textsuperscript{39}

In order to perform the functioning of the Libraries of Technical Education, satisfactorily, the library as vital component of the engineering education system needs to be equipped with proper infrastructure, i.e. proper space and furniture to accommodate users; trained staff to provide services to the users for making use of the collection to satisfy most of the information needs of all users; essential technological devices to help in speedy and efficient provision of service; and so on. Above, all the library personnel starting from the Librarian to other technical staff, their commitment and dedication towards profession. This can be ensured only where the library staff work with job satisfaction.
References


3. Indian Institute of Science Bangalore, *Golden Jubilee Souvenir* 1909-1959 and

4. Indian Education Policy, Resolution Issued by the Governor General in Council,
   March, Calcutta. 1904, p.25.


9. Ibid., p.15.


11. Jha, C.S., Higher Education in India-Restructuring for increased innovation,


15. Ibid’ p.16.


30. Ibid, p.58.


34. Ibid, p.221.


