

4. ENGINEERING AND TECHNOLOGY UNIVERSITIES IN INDIA : PRESENT STATUS AND FUTURE PROSPECTS

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Abstract

The Paper discusses the useful and important role of Engineering and Technology education in the Indian University system, the 21st century challenges being faced by the technical professionals in the country leading to demands for special attention to these and brings out the need for Universities exclusively devoted to Engineering and Technology disciplines. The present status of Engineering and Technology Universities in the country is then covered, followed by the future prospects in this sector.

1. Introduction

For a long time, Universities have been established in different parts of the world as institutions useful for providing higher educational and research opportunities to the youth for shaping their future. They have also been recognized as the most important indicators of a nation's progress and accomplishments. More recently, the UNESCO World Conference on Higher Education (Paris, 1998) has observed that higher education and research act as essential components of culture, socio-economic and environmentally sustainable development of individuals, communities and nations, since the society is now becoming increasingly knowledge-based. As Engineering and Technology education (including research) at the University level plays a significant role in enhancing national capabilities, strengths and competitiveness, the developed nations have been attaching considerable importance to this sector. This is no exception in India, which has prepared a time table to become a developed nation by the year 2020 and already launched a strategy

for this. Thus, for past some time, India has been laying much emphasis on Engineering and Technology disciplines at the Universities and also on the setting up of Universities exclusively to cover these disciplines. As a result, many Universities having the Faculty of Engineering and Technology as well as the Engineering and Technology Universities themselves have become common in the Indian higher education system. These Universities are either unitary, with their academic activities (Departments/Constituent Colleges) restricted to their campuses or affiliating, having their Affiliated/Autonomous/Constituent Colleges spread far and wide in their jurisdiction areas. Besides, India has established many elitist institutions of national importance in different parts of the country, such as, Indian Institutes of Technology (IITs) and National Institutes of Technology (NITs) performing University level functions in the Engineering and Technology disciplines. These initiatives can be seen from Table 1, which portrays the diversities in the present-day University System in India. It is now a matter of satisfaction that the University system in the country has been growing and

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expanding at a remarkable pace, particularly since the 1980s decade, and it is now recognized as one of the largest in the world in absolute terms. The emergence of *Engineering and Technology* as well as other professional programmes as key disciplines in the present-day Indian University system is clearly seen from this Table.

As the University education in Engineering and Technology has to enable the technical professionals in the country to face the 21st century challenges before them, important aspects of these challenges and their influence on their education and training needs are now considered in the following Section. This is followed by a discussion on the status of University education in Engineering and Technology and the need for Universities in the country exclusively devoted to Engineering and Technology. The present status and future prospects of Engineering and Technology Universities are then covered in this Paper. It is hoped that the Paper will be of interest to the planners and implementers of the higher education system in India.

2. 21st Century Challenges

As is well known for a long time, the 21st century is regarded as the *Knowledge Age*. In this period, several challenges are being faced by engineers, technologists and other professionals in the country, who are broadly categorized as *technical professionals*. These challenges, which have considerable influence on *Engineering and Technology* education and research, include:

- 1) Rapidly changing technological scene worldwide, with a shrinking time scale for new developments and for obsolescence of old practices, leading to:
 - Increase in investment on R&D in industry and other sectors;
 - Innovative products and services, based on contemporary technologies; and,
 - Enhancement of abilities to manage change,

so frequent now a days.

- 2) Globalization and liberalization of Indian industry, leading to:
 - Comprehensive restructuring of industry sector for enhancing efficiency;
 - Increase in world-wide mobility of technical professionals; and,
 - Growth of competitive environment globally and also in the country;
- 3) Emergence of new career opportunities for technical professionals, leading to:
 - Demand for broad-based, flexible education in multi-/inter- disciplinary subjects;
 - Emphasis on PG courses, research training and institute-industry interaction; and,
 - Advances in learner-centric programmes and life-long learning opportunities;
- 4) Penetration of IT in all sectors of the technical profession, leading to:
 - Increased demand for IT-based solutions to industrial and related problems;
 - Expertise in emerging IT developments to solve complex, technical problems; and,
 - Improved access to world wide information/ data bases and *knowledge* centres.
- 5) Increased social/environmental concerns in the technical context, leading to:
 - Protection of endangered environment and depleting energy sources;
 - Seeking environment- and energy- friendly solutions to technical problems; and,
 - Wealth generation using environmentally benign and energy efficient techniques;

These challenges require appropriate orientation of *Engineering and Technology* education and research in the country as outlined below, so that technical professionals of the 21st century are equipped to face them with determination and they become ready to contribute to national development in a significant way. Laying of special emphasis on

Table - 1

University	Established By	Important Features
General	Central/State Governments	(i) <u>Unitary</u>: Teaching (UG/PG) & research on campus (main/sub); (ii) <u>Affiliating</u>: Teaching (PG) & research on campus (main/sub); Mostly Affiliated (UG) Colleges; In some cases, Autonomous (UG/PG) Colleges in its jurisdiction; <i>Most Universities belong to these categories, with each having many faculties, like Arts, Science, Commerce, Engineering & Technology.</i>
Specialized	State Governments	(iii) Teaching (UG/PG) and research in chosen disciplines on campus (main/sub); Both the types viz., unitary and affiliating, functioning now a days; <u>Professional</u> areas like <i>Engineering & Technology, Health Sciences, Law</i>, exclusively covered here; <i>Many States have established Universities in this category, each having faculties in the chosen professional and associate disciplines.</i>
Agricultural	State Governments	(iv) <u>Agricultural</u> studies (UG/PG), including forestry, horticulture, veterinary science, research and extension; Mostly unitary; <i>Many States have established these Universities, each having faculties in the chosen and associate disciplines.</i>
Deemed	Central/State Government Private/Joint Sector	(v) <u>University status</u> given to institutions engaged in PG teaching and research, with close interaction between both the functions; Few faculties; Unitary only; <i>Few Institutions in this category, like IISc, IITs.</i> (vi) <u>University status</u> given to institutions of long standing (or even <i>de novo</i>) & high academic reputation; UG/PG teaching and research; Single/ Multiple faculties; Unitary only; <i>Many Institutions in this category already, numbers increasing rapidly.</i>
Open	Central/State Governments	(vii) <u>Open and flexible</u> education offered through the distance learning mode using correspondence courses/modern educational technologies like interactive TV, internet, etc.; Wide variety of programmes-UG/PG/Research; <i>Many Universities functioning now; their numbers steadily increasing.</i>
Other	Central Government Private/Joint Sector	(viii) <u>Unitary</u>: Teaching/Research in close contact between students/teachers - classroom lectures, tutorials, seminars etc; <i>Very few Universities of this type; JNU an example.</i> (ix) <u>Elitist</u>: Institutions offering professional (UG/PG) teaching /research on campus, to talented and carefully selected students; <i>Institutions of national importance, like IITs/NITs/ IIMs/AIIMS/PGIMS/Law Institutes etc., fall in this category;</i> (x) <u>Private (mostly under State Act)</u>: Teaching(UG/PG)/Research on campus ; Mostly Unitary ; Single/Many faculties; <i>Already in few States, numbers increasing.</i> (xi) <u>Virtual</u>: Institutions using multimedia & providing intra/inter net based <i>any-time, any-where, any-discipline</i> learning in professional subjects like Engineering * Technology, Management; <i>Already in some States, numbers increasing;</i> (xii) <u>Foreign</u>: Universities singly or jointly with local partners, offering UG/PG Teaching/Research programmes on campus, <i>Rapidly upcoming type.</i>

educational and training programmes of engineers and technologists, for preparing them well to demonstrate the following abilities are crucial in this endeavour:

- (a) Effective application of *knowledge* of mathematics, science and technical subjects;
- (b) Planning and design to conduct scientific and technical experiments;
- (c) Analysis and interpretation of scientific, technical and economic data collected;
- (d) Design of parts, subsystems, systems and/or processes to meet specific needs;
- (e) Identification, formulation and solving of problems using simulation or otherwise;
- (f) Use of techniques/tools including software, as required in modern practice;
- (g) Effective communication skills and leadership/participation in team work;
- (h) Fulfillment of professional, social and ethical responsibilities;
- (i) Sensitivity to environmental and energy issues and concerns;
- (j) Planning; development and implementation of strategies for life- long learning.

The development of these attributes and the intellectual skills and *knowledge* as required have to be provided to the students by the present-day *Engineering and Technology* education and research programmes, so that the technical professionals in the country are equipped to contribute to the society through productive and satisfying careers as *innovators, decision makers and leaders* in the global economy of the 21st century. These expectations clearly set the goal for *Engineering and Technology* education and research at the University level in the country. This is covered

in the following Section.

2. University Education in Engineering and Technology

The *Engineering and Technology* education has a long standing of over fifteen decades in the Indian University system. As can be seen from Table 1, UG/PG and research programmes in *Engineering and Technology* disciplines are now available from a wide variety of Universities in the country, like, *General, Specialized, Deemed, Private and Institutions of National Importance*. All these Universities and University-level Institutions are in the expansion mode for past some time, on account of the increasing emphasis being laid by the Government of India on *access, equity, quality, standard, relevance* and *excellence* of *Engineering and Technology* education in the successive national Five-Year Plans. But, each of these University types has its own *strengths* and *weaknesses* for imparting *Engineering and Technology* education, which are now briefly discussed.

1) General Universities:

The *General* Universities (largely in the State sector), mostly of the affiliating type have been the backbone of *Engineering and Technology* education in the country for a long time. Many Universities of this type have the Faculties of *Engineering and Technology* for facilitating the conduct of academic programmes in their respective campuses (at Departments/Constituent Colleges) and/or in their areas of jurisdiction (at Affiliated Colleges). Some reputed Affiliated Colleges have also been conferred the Autonomous status to enhance their academic capabilities, by following the well established national practice in this connection. In some cases, these Colleges have gained the confidence and admiration of their stakeholders in a short time, by achieving excellence in their academic activities. All these institutions have enabled the conduct of UG/PG and

research programmes for their students to specialize in the chosen branches of *Engineering and Technology* and earn Degrees from the Universities to which they belong. In addition, a few unitary Universities in this category have also set up their Faculties of *Engineering and Technology* and are engaged in UG/PG and research programmes in these disciplines on their campuses (at Departments/Constituent Colleges).

The major areas of *strength* of these Universities include:

- *Engineering and Technology* institutions benefitting from the traditions, cultures and values of all the institutions under the same University;
- Opportunities for inter- and multi-disciplinary studies and better interaction among students belonging to many Faculties under a single University;
- Easy possibilities for students' overall development, through many co- and extra-curricular activities, superposed on *core* courses in the chosen disciplines;

The major areas of *weakness* of these Universities cover:

- *Engineering and Technology* being one among many Faculties at the University, unable to attract full attention of the University Bodies, leading to stunted growth;
- Experts in *Engineering and Technology* for membership in University Bodies being limited, their low influence on quality, standard and relevance of courses;
- Students of *Engineering and Technology* being only a small fraction of the overall strength of the University, their needs to meet 21st century challenges not fulfilled;

However, in spite of the various areas of strength, the *General* Universities (unitary/affiliating types) engaged in *Engineering and*

Technology disciplines are found to have several academic weaknesses. These factors seem to be limiting their future potential for growth, now a days.

2) *Specialized Universities:*

The *Engineering and Technology* Universities (popularly known as *Technological/Technical* Universities) set up by the State Governments in many parts of the country fall in this category. These Universities are oriented exclusively to provide *Engineering and Technology* education and research opportunities to students in their areas of jurisdiction. However, each *such* University has the Faculty of *Engineering and Technology* as well as a few other Faculties covering associate disciplines, like Architecture, Basic Sciences, Humanities and Management. Here also, both unitary and affiliating types of Universities have been established and they are engaged in UG/PG and research programmes for the students to specialize in their chosen branches. While such programmes form part of academic activities of the University Departments/Constituent Colleges located in the campuses of both the unitary and affiliating Universities, they are also organized at the Affiliated Colleges in the jurisdiction areas of affiliating Universities. Some good Affiliated Colleges of these Universities have also been conferred the Autonomous status to enhance their academic capabilities, by following the well established national practice in this connection. Some of the Autonomous Colleges have performed exceedingly well, achieved excellence in their academic activities in a short time and gained the confidence/admiration of their stakeholders. However, the affiliating *Engineering and Technology* Universities (in the State sector), appear to be more common in India now a days. This can be seen from the present status of affiliating *Engineering and Technology* Universities in the country listed in Table 2.

The major areas of *strength* of these Universities include:

- Full attention possible to *Engineering and Technology* and related disciplines from the University Bodies, because of their exclusivity at the University;
- Experts in *Engineering and Technology* and related disciplines being dominant in the University Bodies, ensure the quality, standard and relevance of courses;
- Well coordinated growth of *Engineering and Technology* education in the State/Jurisdiction, to meet the 21st century challenges and better placement successes;

The major areas of *weakness* of these Universities cover:

- Limited exposure/interaction of students in multi-disciplinary environment as in *General Universities* and consequent limitations in their overall development;
- Area of focus of the programmes being limited, the students not able to benefit from the traditions, cultures and values of other institutions in the State;
- Low level of competition among the students in co- and extra-curricular activities, due to limited size of the competitive environment;

As *Specialized Universities* (affiliating type) have jurisdiction over their respective States, they are able to provide high level of access and equity, so necessary for increased opportunities for students' enrollment and their inclusive growth in the *Engineering and Technology* programmes. Besides, these Universities have the potential to enhance the quality, standard and relevance of their programmes and maintain academic excellence, on account of their several areas of strength listed above. Hence, *Specialized Universities* of the affiliating type seem to have a high potential for future growth all over the country.

1) Deemed Universities:

The *Deemed Universities* are institutions

which are conferred the University status by the Government of India under Section 3 of the UGC Act, 1956. They form an important class of Universities devoted to professional subjects. As can be seen from Table 1, many of these Universities set up by Registered Societies/Trusts and similar Bodies are engaged in *Engineering and Technology* education and research on a self-financing basis. Being located in many parts of the country, they are playing a crucial role in enhancing *access* to higher education in a remarkable way, while ensuring its quality, standard and relevance. Each such *Deemed University* is a unitary, autonomous institution with national jurisdiction, providing UG/PG and research programmes in *Engineering and Technology* and/or related disciplines at its campus. In some cases, *Deemed Universities* of long standing have been permitted to conduct its programmes at Off-campus Centres and even at Off-shore campuses. The *Deemed Universities* have gained in popularity since the 1990s decade and their number in the country at present seems to be over 125 and this is steadily increasing. The programmes conducted at the *Deemed Universities* generally follow the norms and standards of the Statutory Regulatory Councils, like the AICTE and their functioning is overseen by the UGC. They are also subjected to periodic assessment and accreditation by Agencies approved by the UGC/AICTE, so as to ensure stake holder confidence and satisfaction. While good campus infrastructure and laboratory facilities generally constitute the *strengths* of *Deemed Universities*, their faculty limitations and high tuition and other fees form their major weaknesses. However, the *Deemed Universities* have carved for themselves a niche in *Engineering and Technology* education and research in the country in a short time.

2) Private Universities:

The *Private Universities* are established by Registered Societies/Trusts and/or Section 25 (not for profit) Companies through suitable

legislation in the State/Union Territory concerned, with majority of them being engaged in *Engineering and Technology* education and research on a self-financing basis. These Universities have jurisdiction over the State/Union Territory, wherein they are established and incorporated. They are located in many parts of the country and are now playing a good role in enhancing access to higher education in a commendable way, while ensuring its quality, standard and relevance. Each such *Private University* is a unitary, autonomous institution, providing UG/PG and research programmes in *Engineering and Technology* and/or related disciplines at its campus. In some cases, *Private Universities* of long standing have been permitted to establish Constituent Colleges in its jurisdiction area for conducting its programmes and this practice has been received well by the stake holders. The *Private Universities* are in vogue in the country since the late 1990s and their number at present seems to be about 50 which is steadily increasing. The programmes conducted at the *Private Universities* generally follow the norms and standards of the Statutory Regulatory Councils, like the AICTE and their functioning is overseen by the UGC and the State/Union Territory Government concerned. They are also subjected to periodic assessment and accreditation by Agencies approved by the UGC/AICTE/State or Union Territory Government concerned, so as to ensure stake holder confidence and satisfaction on a continuing basis. *Private Universities* engaged in the *Engineering and Technology* disciplines are known for their high quality and standard of infrastructure and educational facilities; But, their limitations like in the case of *Deemed Universities* include the faculty strength and capabilities and the high fee structure. However, the *Private Universities* have become popular in *Engineering and Technology* education and research in some parts of the country in a short time.

3) Institutions of National Importance:

The *IITs* and *NITs* are leading, centrally

funded *Engineering and Technology* institutions in the country belonging to the class of University level institutions. Of these, the *IITs* have set an excellent *bench mark* in *Engineering and Technology* education and research, through the long experience of over 50 years of some of them, the high quality of their physical infrastructure and academic facilities and the high level of dedication and creativity of their faculty members. This has resulted in all the *IITs*, which are unitary, autonomous institutions, to be able to attract highly merited and talented students to their UG/PG and research programmes on a continuing basis. Besides, the placement successes and excellent potential for further higher education of their students, have indeed brought them world-wide attention, resulting in increasing demands for students' admissions and also for other services like, continuing education, sponsored R&D and scientific/ industrial consultancy. While, the country had only 5 *IITs* for many decades, this number has now risen to 15 in the XI Five Year Plan Period (2007-12). This has been well received by the society at large. The *NITs* also have progressed at a good pace from their earlier status of *Regional Engineering College (REC)* in the IX Five Year Plan Period (1997-2002) and are now poised to become leading institutions closely following the *IITs* in several respects. The *NITs* have been established in every State/Union Territory of the country and their number is now close to 30. Both together, the *IITs* and *NITs* are good examples of India's national resolve to make available international level *Engineering and Technology* education and research opportunities to the youth in the country at an affordable cost. Hence, they are receiving serious attention for better exploitation of their capabilities in the future.

Future Prospects

Considering the diversity of Indian higher education system, the 21st century challenges being faced by the technical professionals and the present status of University education and

Table 2 : AFFILIATING ENGINEERING AND TECHNOLOGY UNIVERSITIES*(As in April 2010)*

S. No.	State University	Jurisdiction State(Region)	Year of Establishment
1(a)	Jawaharlal Nehru Technological University, Hyderabad	Andhra Pradesh (Specified Region)	1972
1(b)	Jawaharlal Nehru Technological University, Kakinada	Andhra Pradesh (Specified Region)	2008
1(c)	Jawaharlal Nehru Technological University, Anantpur	Andhra Pradesh (Specified Region)	2008
2	Gujarat Technological University, Ahmedabad	Gujarat	2007
3	Visvesvaraya Technological University, Belgaum	Karnataka	1999
4	Rajiv Gandhi Prodyogiki Vish wavidyalaya, Bhopal	Madhya Pradesh	2004
5	Biju Patnaik University of Technology, Rourkela	Orissa	2003
6	Punjab Technical University, Jalandhar	Punjab	1998
7	Rajasthan Technical University, Kota	Rajasthan	2006
8(a)	Anna University, Guindy, Chennai	Tamil Nadu (Specified Region)	1970
8(b)	Anna University, Tiruchirapalli	Tamil Nadu (Specified Region)	2006
8(c)	Anna University, Coimbatore	Tamil Nadu (Specified Region)	2006
8(d)	Anna University, Tirunelveli	Tamil Nadu (Specified Region)	2006
9	Uttar Pradesh Technical University, Lucknow	Uttar Pradesh	2001
10	Uttarakhand Technical University, Dehradun	Uttarakhand	2008
11	West Bengal University of Technology, Kolkata	West Bengal	2001
12	Guru Gobind Singh Indraprastha Vishwavidyalaya, New Delhi	Delhi (NCT)	1998

research in the *Engineering and Technology* disciplines in India, it is clear that Universities/ University level institutions exclusively devoted to *Engineering and Technology* have a crucial role in national development. As a result, such Universities of different categories, viz., *Specialized, Deemed, Private and Institutions of National Importance* are now receiving much attention in the country. However, the *Specialized Engineering and Technology* Universities of the affiliating type are now available in 12 States of the country and they have emerged as the institutions having a high potential for future growth in India. In particular, these Universities are now able to take care of the following requirements so necessary in *Engineering and Technology* education across a State:

- Uniformity in education all over the State with least diversities, e.g., in respect of location and development, like: urban/rural and developed/backward, respectively;
- High quality, standard, relevance, breadth and depth of programmes at all the institutions, due to advice/close monitoring by technical experts in University Bodies;
- Well balanced/focussed UG/PG/research programmes, life-long/continuing education in emerging areas & cutting edge technologies at the University, to benefit students;
- Better training and preparation of students for further higher education in India and abroad, for high quality placement and related support services for them;
- Fulfillment of most of the expectations of

21st century technical professionals listed earlier, in particular, pursuit of a high level of achievement in technical disciplines;

It is expected that the establishment of *Specialized Engineering and Technology Universities* of the affiliated type in the remaining States and Union Territories at an early date would be helpful in bridging the various gaps and accelerating the growth of the technical education system in the country as a whole, covering both lateral (*size*) and vertical (*stature*) dimensions, thereby facilitating India to reach a leadership position in a short time. This would be particularly helpful in enabling the country to fulfill its dream of becoming a developed nation by the year 2020.

Concluding Remarks

The usefulness and importance of *Engineering and Technology Universities* in the country for providing higher educational and research opportunities to the youth for shaping their future, and in turn, for enhancing their contribution to national development have been highlighted in this Paper. As discussed in detail, *Specialized Universities* of the affiliating type, exclusively devoted to the *Engineering and Technology* disciplines are highly useful in this connection. Although only 12 States have established such Universities, they have a good potential of being set up in the remaining States and Union Territories of the country in a short time. This is expected to be of considerable help to the country in its march to become a developed nation by the year 2020, based on the strengths and the capabilities of its technical professionals.

