I– INTRODUCTION

Technical Education is broadly defined as “Education which is mainly to lead participants to acquire the practical skills, know-how and understanding, and necessary for employment in a particular occupation, trade or group of occupations.” In India, Technical Education covers courses and programmes in engineering, technology, management, architecture, town planning, pharmacy and applied arts & crafts, hotel management and catering technology. The formal technical education system operates at three levels.

• Certificate level course through ITIs/ITCs
• Diploma level courses through polytechnics
• Degree level programmes through Engineering Colleges/ NITs/ IITs and such other degree granting institutions.

Engineering is the discipline and profession of applying scientific knowledge and utilizing physical resources in order to design and create materials, structures, machines, devices, systems, and processes that realize a desired objective and meet specified criteria under constraints. Engineering is basically a creative activity that helps in fulfilling demand of engineering goods and services needed by individuals, society and nations. Engineering involves the application of mathematical and natural sciences and a body of engineering knowledge, technology and techniques to design and create solutions to human problems in the context of society, environment, and ethics within the constraint of project management cost, quality and time.

The development of a professional engineer or for that matter any engineering/technical professional consists of two important stages. In the first stage, a set of predominantly educational requirements are satisfied through an accredited engineering education programme. In the second stage, the engineer follows a process of training, experience and further learning required for professional registration. The purpose of undergraduate engineering education is to develop fundamental scientific and engineering knowledge, knowledge specific to a discipline and essential attributes to enable the graduate to continue learning and to develop competencies required for independent practice and licensure.

Several accrediting bodies for various levels of engineering/technical qualifications have developed outcome based criteria for evaluating programmes so as to have mutual recognition of qualifications. Similarly, many engineering associations/registering bodies have developed competency based standards for registration for mutual recognition of competence.

II– INTERNATIONAL ACCORDS

There are six international agreements governing mutual recognition of engineering qualifications and professional competence.

2.1– Agreements covering tertiary qualifications in engineering

There are three agreements covering mutual recognition in respect of tertiary-level qualifications in engineering:

The Washington Accord signed in 1989 was the first, it recognises substantial equivalence in the accreditation of qualifications in professional engineering, normally of four years duration.

The Sydney Accord commenced in 2001 and recognises substantial equivalence in the accreditation of qualifications in engineering technology, normally of three years duration.
The Dublin Accord is an agreement for substantial equivalence in the accreditation of tertiary qualifications in technician engineering, normally of two years duration. It commenced in 2002.

2.2– Agreements covering competence standards for practising engineers
The other three agreements cover recognition of equivalence at the practising engineer level i.e. it is individual people, not qualifications that are seen to meet the benchmark standard. The concept of these agreements is that a person recognised in one country as reaching the agreed international standard of competence should only be minimally assessed (primarily for local knowledge) prior to obtaining registration in another country that is party to the agreement.

The oldest such agreement is the APEC Engineer agreement which commenced in 1999. This has Government support in the participating APEC economies. The representative organization in each economy creates a “register” of those engineers wishing to be recognised as meeting the generic international standard. Other economies should give credit when such an engineer seeks to have his or her competence recognised. The Agreement is largely administered between engineering bodies, but there can be Government representation and substantive changes need to be signed off at governmental APEC Agreement level.

The Engineers Mobility Forum agreement commenced in 2001. It operates the same competence standard as the APEC Engineer agreement but any country/economy may join. The parties to the agreement are largely engineering bodies. There are intentions to draw EMF and APEC closer together.

The Engineering Technologist Mobility Forum agreement was signed by participating economies/countries in 2003. The parties to the Agreement have agreed to commence establishing a mutual recognition scheme for engineering technologists.

III– WASHINGTON ACCORD
The Washington Accord (WA) is concerned with degree programmes that provide the academic foundation for the practice of engineering at the professional level. The signatories to the WA are national accrediting bodies for engineering programmes. The Accord reflects agreement between signatories on several principal matters. First, signatories accept that the criteria, policies and procedures used by fellow signatories are comparable. Second, that the accreditation decisions rendered by one signatory are acceptable to the other signatories. Third, Each signatory will make every reasonable effort to ensure that the bodies responsible for registering or licensing professional engineers to practice in its country or territory accept the substantial equivalence of engineering academic programs accredited by the signatories to this agreement. Fourth, signatories agree to exchange information on their respective criteria, policies and procedures and to encourage the implementation of best practice. For example, observation of other signatories’ accreditation processes is encouraged outside the formal monitoring visits. Comparability of accreditation systems and mutual recognition of graduates is based on the principle of substantial equivalence. Substantially equivalence means achieving outcomes that whilst not individually identical to those of the standard or exemplar of that standard, taken cumulatively achieve the same overall outcome. In other words, Substantial equivalence means that two educational programmes, while not meeting a single set of criteria in detail, are both acceptable as an education base that prepares their respective graduates to enter training and experience toward registration in a jurisdiction. Substantial equivalence relates to the output of degree programmes rather than their detailed internal structures.

3.1– Signatories of Washington Accord
Signatories have full rights of participation in the Accord; qualifications accredited or recognised by other signatories are recognised by each signatory as being substantially equivalent to accredited or recognised qualifications within its own jurisdiction.

Signed in 1989 by:
- United States represented by Accreditation Board for Engineering and Technology (ABET)
- Canada - represented by Engineers Canada
- United Kingdom - represented by Engineering Council UK
- Australia - represented by Institution of Engineers Australia
- Ireland - represented by Engineers Ireland
- New Zealand - represented by Institution of Professional Engineers New Zealand

Signed in 1995 by
- Hong Kong (China) - represented by Hong Kong Institution of Engineers Signed in 1999 by
- South Africa - represented by Engineering Council of South Africa

Signed in 2005 by
- Japan - represented by Japan Accreditation Board for Engineering Education

Signed in 2006 by
- Singapore - represented by Institution of Engineers, Singapore

Signed in 2007 by
- Chinese Taipei - represented by Chinese Taipei: Institute of Engineering Education Taiwan
- Korea - represented by Accreditation Board for Engineering Education of Korea

Signed in 2009 by
- Malaysia - represented by Board of Engineers Malaysia
Signed in 2011 by
- Turkey – represented by MUDEK

Signed in 2012 by
- Russia – represented by Association for Engineering Education of Russia

3.2– Provisional Members
Organisations holding provisional status have been identified as having qualification accreditation or recognition procedures that are potentially suitable for the purposes of the Accord; those organisations are further developing those procedures with the goal of achieving signatory status in due course; qualifications accredited or recognised by organisations holding provisional status are not recognised by the signatories

- Bangladesh - Represented by Board of Accreditation for Engineering and Technical Education
- Germany - Represented by German Accreditation Agency for Study Programs in Engineering and Informatics
- India - Represented by National Board of Accreditation of All India Council for Technical Education
- Pakistan - Represented by Pakistan Engineering Council
- Sri Lanka - Represented by Institution of Engineers Sri Lanka

IV– GRADUATE ATTRIBUTES
(The term graduate does not mean any level of qualification but just exit level of qualification)

The signatories to the Washington Accord recognized the need to describe the attributes of a graduate of a Washington Accord accredited program in the beginning of this millennium. The signatories to the Sydney Accord and the Dublin Accord recognized similar needs in 2003. The need was recognized to distinguish the attributes of graduates of each type of programme to ensure fitness for their respective purposes. Therefore, three sets of graduate attributes and three professional competency profiles for graduates of three different accords was developed on a single basis. The Graduate Attributes and Professional Competencies were adopted by the signatories of the five agreements in June 2005 at Hong Kong as version 1.1. Version 2 was approved at the Kyoto IEA meetings, 15-19 June 2009.

4.1– What are Graduate Attributes
Graduate attributes form a set of individually assessable outcomes that are the components indicative of the graduate’s potential to acquire competence to practice at the appropriate level. The graduate attributes are exemplars of the attributes expected of graduate from an accredited programme. Graduate attributes are clear, succinct statements of the expected capability, qualified if necessary by a range indication appropriate to the type of programme. The graduate attributes are intended to assist Signatories and Provisional Members to develop outcomes-based accreditation criteria for use by their respective jurisdictions. Also, the graduate attributes guide bodies developing their accreditation systems with a view to seeking signatory status. Graduate attributes are defined for educational qualifications in the engineer, engineering technologist and engineering technician tracks. The graduate attributes serve to identify the distinctive characteristics as well as areas of commonality between the expected outcomes of the different types of programmes.8

4.2– Some common terms used in defining graduate attribute and competency profiles
The graduate attributes has been organized using twelve headings, where each heading identifies the differentiating characteristic that allows the distinctive roles of engineers, technologists and technicians to be distinguished by range information. For each attribute, statements are formulated for engineer, engineering technologist and engineering technician using a common stem, with ranging information appropriate to each educational track. For example, for the Knowledge of Engineering Sciences attribute:

Common Stem: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization …

Engineer Range: … to the solution of complex engineering problems.

Engineering Technologist Range: … to defined and applied engineering procedures, processes, systems or methodologies.

Engineering Technician Range: … to wide practical procedures and practices. The resulting statements are shown below for this example:

For detailed expression of complex, broadly defined and well defined problems and engineering activities refer http://www.ieagreements.org/GradProfiles.cfm

Graduate knowledge profile, attribute profile and competence profile can be accessed at http://www.ieagreements.org/GradProfiles.cfm

V– IMPACT OF GRADUATE ATTRIBUTES/ABET EC 20009
A three year study titled “Engineering Change: A Study of the Impact of EC2000” was carried out by ABET to assess whether post-EC2000 engineering graduates any better prepared to enter the profession than were their pre-EC2000 counterparts of a decade ago?

Some of the major findings of the report are given below:

- Changes in Emphasis in Programmes

According to program chairs and faculty members, engineering program curricula changed considerably following implementation of the EC2000 criteria. Although few programs reduced their emphasis on the foundational topics in mathematics, basic science, and engineering science, both program chairs and faculty members report
increased emphasis on nearly all of the professional skills and knowledge sets associated with EC2000 Criterion 3.a-k. Three-quarters or more of the chairs report moderate or significant increases in their program’s emphasis on communication, teamwork, use of modern engineering tools, technical writing, lifelong learning, and engineering design. Similarly, more than half of the faculty respondents report a moderate to significant increase in their emphasis on the use of modern engineering tools, teamwork, and engineering design in a course they taught regularly.

**Changes in Teaching Methods**

EC2000’s focus on professional skills might also be expected to lead to changes in teaching methods as faculty members seek to provide students with opportunities to learn and practice their teamwork, design, and communication skills. Consistent with that expectation, half to two-thirds of the faculty report that they have increased their use of active learning methods, such as group work, design projects, case studies, and application exercises, in a course they teach regularly.

**Assessment of Student Performance**

EC2000 also requires that engineering programs assess student performance on the a-k learning outcomes and use the findings for program improvement. Program chairs report high levels of faculty support for these practices. More than 75 percent of the chairs estimate that either more than half or almost all of their faculty supported continuous improvement efforts, and more than 60 percent report moderate to strong support for the assessment of student learning. Faculty corroborated this finding: Nearly 90 percent of the faculty respondents report some personal effort in assessment, and more than half report moderate to significant levels of personal effort in this area. For the most part, moreover, faculty members do not perceive their assessment efforts to be overly burdensome: Nearly 70 percent think their level of effort was “about right.”

**Differences in Student Experiences**

Compared to their 1994 counterparts, and after taking differences in graduates’ and institutional characteristics into account, 2004 graduates reported:

- More active engagement in their own learning;
- More interaction with instructors;
- More instructor feedback on their work;
- More time spent studying abroad;
- More international travel;
- More involvement in engineering design competitions; and
- More emphasis in their programs on openness to diverse ideas and people.

Although they tend to be small, seven of 10 statistically significant differences between pre- and post-EC2000 graduates persist even after adjusting for an array of graduate and institutional characteristics.

**Differences in Learning Outcomes**

The largest differences between 1994 and 2004 graduates are in five areas: Awareness of societal and global issues that can affect (or be affected by) engineering decisions, applying engineering skills, group skills, and awareness of issues relating to ethics and professionalism. The smallest difference is in graduates’ abilities to apply mathematics and sciences. Despite that small but statistically significant difference, this finding is particularly noteworthy because some faculty members and others have expressed concern that developing the professional skills specified in EC2000 might require devoting less attention to teaching the science, math, and engineering science skills that are the foundations of engineering. This finding indicates not only that there has been no decline in graduates’ knowledge and skills in these areas, but that more recent graduates report slightly better preparation than their counterparts a decade earlier.

The evidence suggests that implementation of EC2000 is not only having a positive impact on engineering education, but, overall, that gains are being made at no expense to the teaching of basic science, math, and engineering science skills.

**Conclusions of the study**

The weight of the accumulated evidence collected for Engineering Change indicates clearly that the implementation of the EC2000 accreditation criteria has had a positive, and sometimes substantial, impact on engineering programs, student experiences, and student learning. Comparisons of 1994 and 2004 graduates’ self-reported learning outcomes show 2004 graduates as measurably better prepared than their counterparts in all nine learning areas assessed. The greatest differences in student learning before and after EC2000 are in recent graduates’ better understanding of societal and global issues, their ability to apply engineering skills, group skills, and understanding of ethics and professional issues.

**VI– INDIA’S MOVE TOWARDS OUTCOME BASED ACCREDITATION**

India has become provisional member of Washington Accord since 2007 and has moved towards Outcome based Graduate Attributes latest version is shown in Appendix III.

**VII– CONCLUDING REMARKS**

In the last decade there has been an increase in the number of institutions offering technical Education in the country. Unfortunately, the quality of education and training in many leaves lot to be desired. Quality assurance in education particularly in the case of technical education training institutions have become necessary in view of workforce
mobility and international accords. There is no alternative to accreditation programmes and institutions. The task at hand is huge, however, the way NBA has reformed accreditation process and made it outcome oriented, that is the way to go forward. An accreditation system for VET is also very much need of the hour. It is hoped that it will be realized through improving infrastructure, improving quality of trainer and developing National Vocational Qualification Framework.

**References**


[2]. AICTE Act of Govt. of India, 1987


