

SCIENCE IN ENGINEERING CURRICULUM A COMPARATIVE STUDY

Dr. A. B. BHAKE *

ABSTRACT

Considering the importance of basic science in engineering curriculum and looking at the attitude of so called technologist against basic science, this paper is aimed at the comparison of engineering curriculum adopted in India with that adopted in developed countries.

WHAT IS SCIENCE ?

"Science is an attempt to investigate and understand the mystery of the nature perceived by human senses and experiences that correspond to a logically uniform system of thoughts." In other words "science deals with human understanding of the real world about them-the inherent properties of space, matter, energy and their interaction. (1)

SCIENCE - ENGINEERING TECHNOLOGY :

Engineering is the application of objective knowledge to the creation of plans, design and means of achieving desired objectives. It is the professional

art of applying science to the optimum conversion of the resources of the nature to the use of mankind. Engineering is the creative application of scientific principles to design or develop structures, machines, manufacturing processes or works utilising them singly or in combination. Engineering is based principally on physics, chemistry, mathematics and their extension into material science, solid and fluid mechanics, thermodynamics, transfer and rate processes and system analysis (2). The function of a scientist is to know, while that of an engineer is to do. The scientist adds to the store of verified systematized knowledge of physical world, the engineer brings the

* Assistant Professor and Head, Department of Applied Chemistry
Yeshwantrao Chavan College of Engineering
Wanadongri, Hingna Road, NAGPUR - 441 110.

knowledge to bear on practical problems. Scientists investigate law of nature and their efforts are aimed at basic research. Engineers however are directed more at the application than the discovery of the principle.

Technology is defined as the systematic study of techniques of making and doing things. The term itself is a combination of Greek "Techno-art, crafts; Logos-word, speech. It means in Greek "a discourse on the arts both fine and applied". Technology is an outgrowth of science which fuels the industrial engine. Technology comes from employing and manipulating science into concepts, processes and devices (1).

Relation between science, engineering and technology can be very well understood from the example: Certain manufactured parts are required to be thoroughly cleaned. The technological approach is to use more detergent and softener in the wash water, to use more wash cycles, to rinse and re-rinse and to blow the parts dry with stronger warmer airblast. However, if they do not suffice, the basic technique may need to be changed. Thus in this example science might contribute the knowledge that ultrasonically produced cavitation, counteracts surface tension between immiscible liquids and adhesion between clinging dirt and the surface to be cleaned and thereby produce emulsion. Engineering could then plan an ultrasonic generator and a conveyer to carry the parts through a bath tank in which the ultrasonic energy

could clean them. The scientist may use ultrasonic techniques to determine the properties of the materials.

The engineers may design other types of devices that employ ultrasonics to perform other function. The technologist is the specialist who carries out the technique for the purpose of accomplishing a specified function and extend the knowledge and skill of ultrasonic cleaning refinements and perfection of technique for use on various materials soiled in different ways. Technological advances improve and extend the application for cleaning other parts under other conditions.

Science and engineering are viewed as essential ingredients of national development. Without enough science and engineering no country can be counted as modern nation or as a bonafied member of a progressive world community. Globalisation has become a feature of all efforts today not only in economic and industrial growth but also in scientific research and technological innovations (6).

ENGINEERING CURRICULUM :

Comparative study pertaining to science subjects in some of the countries reveals the importance of basic science subjects in engineering curriculum. Engineering education in India is governed by All India Council For Technical Education (AICTE) a Statutory Body. The curriculum frame - work proposed for four year degree course in engineering by AICTE broadly applies to the most of the programmes offered

by different Universities in India with marginal variations(3). The breakdown of the formal contact hours of 27 to 33 hrs.per week within a total of 36 to 40 working hrs.per week is as follows:

- i) Languages, social sciences, humanities and introduction to management = 5 to 10%
- ii) Basic Sciences(General) = 15 to 25%
- iii) Engineering Sciences and Technical areas = 15 to 25%
- iv) Professional subject(specific discipline) = 45 to 65%
- v) Open electives belonging to (iv) = about 10%

It is evident from the above, distribution, that weightage given to the basic science subjects is maximum upto 25%.

In most of the Indian universities basic science subjects are included in first year of course of study which are common to all branches, whereas, in the some universities it is being taught separately to different engineering programmes. Some of the universities are not giving appropriate weightage to basic science subjects.(Pune University).

In U.K., quality engineering education has given equal importance to the technological principles and other disciplines such as science, mathematics and value judgements(4). In U.S.A., most of the good universities design their curriculum by keeping in mind that we live in the world of rapid technological change-a world in which today's

technology can be obsolete tomorrow. The education programme in engineering has to take heed of this fact. It is generally accepted that the only way is to inculcate in the students a command not of empirical formulae but of basic principles which underlie a subject, to develop the habit, not of using only a hand book but the habit of systematic thought and analysis. The curriculum followed at MIT (Massachusetts Institute of Technology) begins with mathematics, physics and chemistry bringing the proficiency in the students because of which they experience the ways and means in which the scientific knowledge can be put to use in the development and design of useful devices and processes to solve engineering problems (5).

In the engineering education curriculum proposed for the year 2000 Fred W. Beaufait, Dean of Engineering, Wayne State University U.S.A. has suggested the inclusion of basic science subjects upto third semester (6).

FIRST SEMESTER

Intro to computer system
General Chemistry
One Foreign Language
Engg. Design and Decision making
Linear and non-linear algebraic equation

SECOND SEMESTER

Software systems
Engg. Physics-I
One foreign Language
Life Science elective
Computer Calculus

THIRD SEMESTER

Computer Calculus-II
Material Science
Engineering Physics-11
Programme requirement
Technical communication

FOURTH SEMESTER

Deferential and difference equations
Computer Calculus-III
General education elective
Programme requirement
Professionalism and ethics

FIFTH SEMESTER

Engg.Sc.prog.requirement
Probability and statistics
General education elective

SIXTH SEMESTER

Engg. Sc.Prog.Requirement
Engg.Design prog. requirement
Project management

SEVENTH SEMESTER

Engineering economics
General education elective
Computational methods
Engg.Design elective
Free elective

EIGHTH SEMESTER

General education elective
Engg. Design Project
Free elective
System engineering

It is important to note while framing the curriculum that the fresh students get a good, strong start with

their studies. We should recognize that many students will be in management position within 10 years of graduation. Study of foreign language and subjects economics finance, accounting and project management would strengthen their general education. Students also need a broad education in the humanities and social sciences. In USSR students are exposed to the full range of science requirements in each discipline, regardless of their education path (7).

Engineering education in Japan emphasize on understanding of fundamental scientific principles and basic knowledge. A distribution of subjects for first three semesters of engineering education in University of Tokyo is given

1. Two cultural science courses (Philosophy, history, literature, psychology, anthropology)
2. Two Social science courses (Politics, economics, law, statistics, international relations)
3. Mathematics
4. Physics
5. Chemistry
6. Computer programming
7. Biology or Physical Geography
8. Foreign Languages (English, German, French, Russian)
9. Physical education

In Japan engineering curriculum is divided in three years. In fourth year students are allowed to select the

industry as per their choice and then they are put to rigorous training in the training institutes of the industries wherein they are moulded as per their requirements (8).

The countries like U. S.A., U.K., US SR and Japan have taken care that their technical hands should have enough scientific knowledge.

SCIENTIFIC RESEARCH :

Scientific research also plays a very important role in developing the appropriate attitude in engineering students. Research helps in developing the scientific temper of the teachers in engineering colleges. Hence it is necessary to motivate the teachers for undertaking the research in educational institutes. Research develops the first hand knowledge about a subject specifically to enhance their teaching ability. Research activity is considered to be an integral part of an academic position. They are expected to undertake the research as per the national requirements. Engineering education should not just develop kit culture which prevents us from building our own capabilities and technologies(7). Scientific attitude in the teachers will not definitely end up with only setting up laboratories but should be extended upto the result oriented research.

Considering the salient features of the curriculum of engineering education in developed countries following suggestions may be taken into account while framing the curriculum for Indian universities.

1. Sufficient weightage must be given to basic science subjects.
2. Syllabus of basic science subjects should be as per the requirement of various courses of study in engineering which may be extended upto third semester,
3. Workshop practice may be dropped as the subject is studied at the highschool level.
4. Engineering drawing should not be considered as an essential subject because of the availability of many software packages for drafting and drawing.
5. Weightage of humanities and social science should be increased.
6. Subject like professionalism and ethics should be included.
7. Study of Foreign languages may be introduced.
8. To develop scientific attitude in students, teachers should be motivated to undertake research.
9. Contact hours of the students in institute should be restricted to 20 to spend more time for self study.

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