



DOI: 10.1515/rpp-2016-0030

Undergraduate Student, **SHAGIL AKHTAR**  
Integral University, India  
Address: Kursi Road, Lucknow, Uttar Pradesh, India  
E-mail: shagilakhtar@gmail.com

Undergraduate Student, **SYED MUNEEB IQBAL**  
Integral University, India  
Address: Kursi Road, Lucknow, Uttar Pradesh, India  
E-mail: syedmuneebiqbal@gmail.com

Master of Technology Degree, Assistant Professor, **SHRISH BAJPAI**  
Integral University, India  
Address: Kursi Road, Lucknow, Uttar Pradesh, India  
E-mail: shrishbajpai@gmail.com

## CONTROL ENGINEERING AS A PART OF UNDERGRADUATE CURRICULUM FOR MECHANICAL ENGINEERING IN INDIA

### ABSTRACT

*In this present study we have traced the genesis of control engineering in the scope of mechanical engineering and then some analysis on its recent developments, their increasing need and how this particular subject has evolved machines functioning nowadays specifically its standard of education in India. We have probed this field right from its starting. We have examined how it is required as a proper course for mechanical engineering students and in which order the evolution in this field is expanding and, at the same time, its level of education in India and where we are in confronting the business need in terms of quality and quantity of students. The point is that it holds significance in near future. Over the years control engineering has been expanding its perimeter in various branches such mechanics, electronics, instrumentation, electrics, chemistry, aeronautics, mechatronics, etc. As a result, numerous interactive feedback structure from the output and the ability to alter the input accordingly have given the world a new era of equipment commonly termed as "smart devices" which have changed the lifestyle of common people. Furthermore, its various applications in different industry have also favored its development. So, some views from the industry prospective have been included to find out about the skills that are required for aspiring and practicing control engineers having mechanical engineering background.*

**Key words:** control engineering, mechanical engineering, smart devices, feedback structure.

### INTRODUCTION

Control engineering or instrumentation is the engineering course of study that applies control theory to design systems or instruments with desired characteristics or outcome. The practice uses variegated sensors to quantify the output of the mechanism being monitored and these observations are then used to provide response to the actuators available at the initial point that can make appropriate rectification in input towards required performance of the instrument (Stuart, 1993). When a contrivance is designed to



function with almost negligible human interactions for correction then it is called automatic control system (such as control for regulating the torque of the motor's torque in cruise control) (Shrish, Sushant, Rishab, 2016). Due to its scope in other discipline, control systems engineering practices emphasis on the enactment of control systems mainly procured by appropriate mathematical modeling of systems of a diverse range. It plays an important role from elementary ménage washing machines or other electronic gadgets to high-performance aircrafts and spacecraft. It attempts to understand physical systems, with the aid of mathematical modeling as inputs, outputs and numerous other department utilize control systems design tools, to burgeon controllers for the systems and to attain better control in somatic systems engaging convenient technology. The use of control theory for the design of controllers in one or more of the complex s-domains time or frequency etc. depending upon the necessity of the design and above all these mathematical models are used in almost every branch of engineering such as mechanical, electrical, fluid, chemical, financial and even biological.

The initial noteworthy invention of centrifugal governor by J. Watt for the pace steer of a steam engine was considered as an automatic control system in the 18th century. Disparate application of controllers as feedback for frequency regulation, current, voltage, electric motor speed control, ship and aircraft navigation and self-stabilization and temperature, pressure and flow control in the process industries were seen in the early 20th century. Prompt developments in control engineering with the preferment of variegated communication systems were seen during the Second World War. Mathematical model for every component in the control system constitutes the study of control engineering. Any synthetic or artificial intelligent device which tends to have a hold over a plant can be termed as a controller and the concepts involve in making this on the whole comprises the definition of control system.

Control engineering was part of the curriculum of mechanical engineering and was included as a subject in electrical engineering because electrical circuits could often be easily described using control theory techniques but later emerged as an individual discipline. In the inaugural control accords, voltage control input is represented by current output. Due to lack of bona fide mechanization to enforce into the frame of reference of electrical system designers had no option of less economical and unrushed reacting mechanical systems. A very efficacious control system is used in mechanical applications that are still extensively applied at a few hydro plants in the governor. However, many control devices are mended by mechanical engineers using both liquid and gaseous control systems that are still popular presently.

#### **THE AIM OF THE STUDY**

In this paper we aim to study the role of control engineering in the field of mechanical engineering and how its development can be beneficial to build more efficient and reliable machines in future. The control systems have a concept of feedback abstraction, which is very essential and fruitful in machines as it helps us to keep a regular check on the performance of the system that ultimately increases its efficiency. Nowadays, we can see that there is an outburst of smart devices such as smartphones, smart house, smart refrigerators and air conditioners autonomous vehicles, etc. All these are the result of the expansion of control theory in various fields of engineering science.

#### **THEORETICAL FRAMEWORK AND RESEARCH METHODS**

Theoretical framework of our research comprises the current situation of the study system of control engineering in the undergraduate curriculum of mechanical engineering in India. Mainly, the exact statistics which we have used in this paper are provided by the various websites of Indian institutions (mainly the premier institutes) and the Government of India (Shrish, Sushant, 2015). These websites along with some of our observations have



led to the complete information we have put in this paper. As we ourselves have gone through the education system in India, we can suggest now what changes should be made in the curriculum or how the students can now increase their knowledge. We have observed that control engineering is a promising field and hence sowing its seed since earlier classes can prove beneficial for the progress of the education system in India. This research intends to athwart all these matter and provides data about how anyone can learn about in whichever way it is suitable for them. We have collected various information related to it described in the following sections (Shrish, Siddiqui, Syed, 2016). The recent statistics on the pedagogy about engineering in India for control engineering with respect to the curriculum of mechanical engineering undergraduates. In our paper we used scrutinization procedure as ethnographic reports, case studies, action research and several online searches. From the methodological view, the fact-finding was based on multifaceted and meticulous resemblance.

### RESULTS

Control engineering is offered as a both core and elective subject in mechanical engineering in various premier institutes of India. It is taught under the name of advance automatic control, modern control theory and sometimes robotics. Control engineering is researched in all basic parts in which considerable parts are continuous control, path-planning, designation of autonomous vehicles, embedded control, multi-agent systems, robotics, game theory, information theory, veering mode control and function, fractional-order modeling and control, identification, optimization-based control, course control, performance approach, automotive control, matrix computing, stochastic operation, etc. (Stuart, 1996).

Almost all the premium technical institutes of India teach control engineering or its related subjects. Not just in undergraduate curriculum the students of mechanical engineering can also pursue their postgraduation in control engineering as it offers specialization in Control and Computerization, Control System Engineering, Control and Automation, Systems and Control (Sushant, Shrish, Bharati, 2015). Presently control theory finds its place in the curriculum of mechanical engineering in 20 out of 23 IIT's as it is shown in Figure 1(a) whereas in NIT's the count is reduced to 7 out of 31 represented in Figure 1(b). Nearly, all other private institutions offer this subject to mechanical engineering students under open elective (optional subject which is supposed to be chosen from other department).

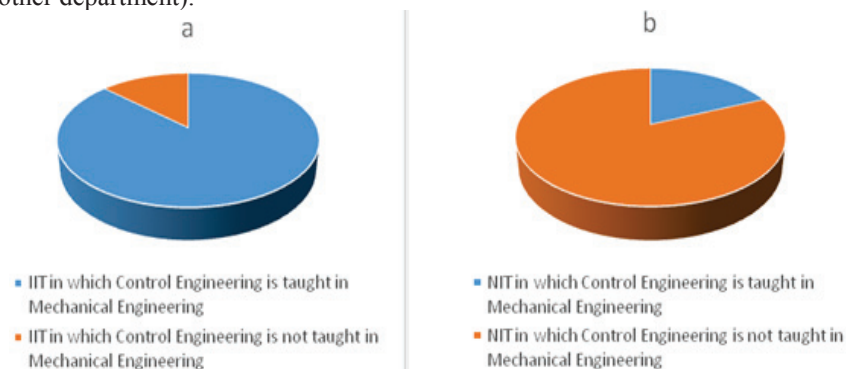


Fig. 1. Pie Chart representing portion of IITs/NITs teaching and not teaching Control Engineering in the curriculum of Mechanical Engineering

MATLAB, NI Lab VIEW, Mathematica, Plant Simulation and Maple are applied for the composition of the experimental atmosphere in control engineering workshops for



students of sophomore study. Scilab is an open source tool, which is applied as a substitute for the above software (Sushant, Abhishek, Shrish, Bharati, 2015). GNU Octave, Freemath Maxima are some open source applications handy for dealing with mathematical calculation obstacles of control engineering. Beside these tools, control analysis is also performed on PLC in computation labs.

The accomplishment of this generation started to be cataloged and logged in publication presented along the 1940s and early 1950s. The inaugural publication pledged to control systems was Ed. S. Smith's "Automatic Control Engineering" presented in 1942. Various publications are penned by the Indian analysts that serve as preeminent volume linked to control engineering at junior and alum level engineering study. M. Gopal, I. J. Nagrath, S. Saeed, A. Tewari are major Indian writers whose publications are embraced in various institutes athwart India for various control engineering educational programs for aspiring engineering graduates (Sushant, Shubham, Shrish, 2014). These publications comprise the course on control engineering that are trivial for all attributes of engineering. The notions wrapped in these publications are the preface to control structures and its categories, z- and s-domains for reasoning of disparate systems, criterion for strength of structures, preface to state-space theory and to digital control and the effects of inspection (Schmid, Ali, 2000).

### CONCLUSIONS

Everywhere in the world there is no specific industry that would not require or make use of control engineering. The extent of control engineering in various industries is very high. After all the utilization of contemporary methods of manufacturing and also the apparent and steady entanglement of human with the equipment are exceedingly condensed and a crucial role is played by control engineering. The theoretic abilities of mechanical engineers help them to acquire greater and better opportunities in the various fields of automation in industries, avionics and other fields as well. The need of control engineers is great in overseeing different machines in all the industries. The engineers who study control engineering can be easily dubbed as remarkably desired after the various fields of sciences. It does have a very vast and marvelous range of applications varying from a simple timepiece to a drifter collecting valuable info on other planets: it has limitless potential as a segment of engineering. Recently the Government of India has given an indication of allowance for FDI in defense sector; various businesses are invited to India to establish their branches in the region, where the control engineers will have a scope of applying their expertise in the matter. The Government of India also seems to be cooperating in these prospects and is also supporting studies related to control engineering in various establishments of sciences.

Rather perspective we consider comprehensive and voluminous research on accelerated school-production affiliation and student interdependence programs.

### REFERENCES

1. Bajpai, S., Asif, S., Akhtar, S. (2016). Electromagnetic Education in India. *Comparative Professional Pedagogy*, Volume 6, Issue 2, pp. 60–66.
2. Bajpai, S., Khare, S. (2015). Mechatronics Engineering Education in India. *Comparative Professional Pedagogy*, Volume 5, Issue 4, pp. 73–79.
3. Bajpai, S., Khare, S., Yadav, R. (2016). Control Education in India: Present and Future. *IFAC-PapersOnLine*, Volume 49, Issue 1, pp. 813–818.
4. Bennett, S. (1996). A Brief History of Automatic Control. *IEEE Control Systems Magazine*, Volume 16, Issue 3, pp. 17–25.



5. Bennett, S. (1993). *A History of Control Engineering, 1930–1955*. London : Peter Peregrinus Ltd, 250 p.
6. Indian Government. (2015). *Make in India*. Retrieved 08.09.2015 from : <http://www.makeinindia.com/>.
7. Kaur, M. (2016). Make In India-Issues. *Indian Journal of Applied Research*, Volume 5, Issue 9, pp. 335–336.
8. Khare, S., Bajpai, S., Bharati, P. (2015). Production Engineering Education in India. *Management and Production Engineering Review*, Volume 6, Issue 1, pp. 21–25.
9. Khare, S., Chatterjee, A., Bajpai, S., Bharati, P. (2016). Manufacturing Engineering Education in India. *Management and Production Engineering Review*, Volume 7, Issue 1, pp. 40–44.
10. Khare, S., Chowdhry, S., Bajpai, S. (2014). Control Engineering Education in India. In: Proceedings of International Conference on *Power, Control and Embedded Systems (ICPCES)* (26-28.12.2014). Allahabad : IEEE, 4 p.
11. Sangwan, S. (2015). Making “Make in India” a Realism: Role of FDI. *International Journal of Applied Research*, Volume 1, Issue 7, pp. 770–773.
12. Schmid, C., Ali, A. (2000). A Web-Based System for Control Engineering Education. In : *Proceedings of American Control Conference* : IEEE, pp. 3463–3467.