Select your area of Research in Engineering Science

By Dr. V.P. Chandramohan

Asst. Prof., Mech/NIT Warangal

In the present scenario, Indian students are refreshing their mind set regarding higher education. Awareness comes on every studentmind about the need of higher studies. Once they completed their Under Graduate courses, few get industrial jobs in both core and non-core areas. Another group of students have been flownto abroad for their job. Very less percentage of students comes as small level entrepreneurs. Few percentage students are coming for higher studies intentionally. Remaining students are forced to come to higher studies as they are not getting their expected opportunities.

Once Post Graduate course is completed again the above issues were experienced by the student society. Once again certain ratio of students thinks about their job and remaining students are coming for research work. But the numbers of candidates are very low compare to students required for Indian universities to do research. Also, it is noticed that there are lack of information from the students on the research topic, objective of the research work, problem solving tactics and so on. This article analyses the above main aspectsinEngineering science research.

There are three aspects of area of research, named (i) Experimental work, (ii) Mathematical work and (iii) Theoretical work. These can be briefly explained in the next paragraphs.

Experimental work

One should know his own capabilities and strength to pick his research area. This is the place one should judge himself to select an appropriate area of research. If someone feels that he/she is uncomfortable with Engineering mathematics, he/she can pick this experimental area.

The quantity of experimental work performed in Indian universities is low compare to foreign universities. Indian universities and financial institutions couldn't spend much fund on the annual budget as they want to develop other parallel sectors like agricultural, rivers, defends service and so on. Government of India's financial help to each IIT (Indian Institute of Technology) is Rs. 100 crores approximately. Therefore a single student cannot expect his/her experimental setup with high accurate instruments and accessories in few crore rupees. Hence, it is better to pick the budget of particular experimental setup in few lakhs of rupees. Budget will increase if we expect better accuracy of the parameters. For example, the electronic weighing balance used for measuring mass of small biological product (Maximum capacity, 210 gram) is costing in the range of Rs. 10,000 to 25,000 at the accuracy of ±1 gram. If we need better accurate instruments, let say the accuracy is, ±1 milli gram, the cost of the instrument varied from Rs. 75,000 to 1.5 Lakh. Similarly select the other instruments and accessories as per your applications with reasonable accuracy. The experimental solution of a problem is an exact solution as it is the reliable solution, even it has experimental and instrumental uncertainties. For checking the experimental solutions, we can do the repeatability tests (on any one case or more) with the same observers and same atmospheric conditions.

Mathematical work

Engineering science researches with the help of mathematics are called mathematical work. It is again subdivided into two major areas, one is analytical work and the other one is numerical work.

In **analytical work**, the parameters involved in the practical problems have to bethoroughly analysed.

By using the parameters, a simple mathematical formulation can be created. In most of the simplified cases the analytical solution of mathematical formulation can be estimated. Finding such type of analytical solution is considered as one of the major task in engineering field. If we want to add more reasonable parameters with the main simplified mathematical formulation (called de-lineation), then the nature of mathematical equations become non-linear. It is tough to find the analytical solution of such type of formulations. Still there are lot of mathematical problems could not be solved by our mathematicians and engineers analytically. Day by day the unsolved mathematical problems are increased as the researches in engineering fields are increased. The analytical solution is the most important one as it is the only actual solution of a mathematical problem.

The 2nd one is **numerical work**. The mathematical equations which cannot be solved by analytically can be solved by numerical work. It is again subdivided into **numerical solution by existing code** and **numerical solution by own code**. If we de-lineate the practical problem by adding more reasonable parameters, then the main equation becomes highly non-linear. The only way of solving these problems are numerical method. The other advantages of numerical methods are, (i) analyse the complete problem by estimating all the parameters involved, (ii) ability to simulate the realistic and ideal conditions and (iii) estimating the parameters which are impossible to measure through experiments.

The differential and integral equations of mathematical formulations are converted into algebraic equations. The practical domain is divided into number of nodal points or control volumes. Each nodal points or control volumes are governed by the algebraic equations.

The entire process is called discretization. Solving these set of algebraic equation by means of computer code is called numerical solution of that problem. Numerical solutions are approximate solutions only, as we approximated the differential equation into finite difference equations. Numerical solutions sometimes create the error upto 10% of its experimental values, but we don't have the other options to solve similar type of problems.

Such type of numerical problems will be solved by existing commercial softwares or existing computer code is called as numerical solution by existing code. A new computer code is developed by the user to solve the problems is called numerical solution by own code. The computer code can be developed by the programmic languages C, C++, FORTRAN, MATLAB and so on. Depends upon the user's interest and confident one can select any one numerical solution and programmic tool to solve their problem.

Theoretical works

If someone is reluctant to do experiments, not having enough confident on numerical works, can pick this theoretical work. It means that finding the relation between the existing parameters. From that developing new theories and giving more explanations about the particular parameter. Or the parameter is newly defined as different manner. Sometimes, such type of theoretical work gives huge scope in engineering field. It creates huge interest to learners and leads better understanding of particular parameter with different aspects. In theoretical research work, sometimes we need some simple experimental works or numerical works to justify the theoretical inventions.

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