

Physics in ENGINEERING EDUCATION 1958

By R. J. Seeger and E. Weber

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ABOUT three years ago a "Progress Report on Physics in Engineering Education"¹ ended with the hope that "through pioneering and experimental, co-operative planning physicists and engineers will now enter enthusiastically and adventurously a new era in the teaching of Physics and in the teaching of Engineering". This hope was the result of a report² of the Committee on Evaluation of Engineering Education by the American Society for Engineering Education in June 1955. At its June 1958 meeting, E. Weber, Chairman of the Follow-up Committee (ad hoc) on Evaluation of Engineering Education, made a more detailed report of the engineering sciences, which had been merely mentioned in the original report. It consisted of a number of individual reports of special committees, varying from the presentation of broad principles to detailed courses. The subjects were:

Mechanics of Solids
Mechanics of Fluids
Transfer and Rate Processes
Thermodynamics
Electrical Sciences
Nature and Properties of Materials
Engineering Analysis and Design

A Committee of the American Institute of Physics had also issued a report on "The Role of Physics in Engineering Education".³ The very first recommendation of this Committee was the need for "improved communication between Engineers and Physicists at the institutional level to discuss objectives and determine mutual needs". It occurred to the writers that a check on communication between Physics Departments and Engineering Departments might be in order in view of the lapse of three years. Accordingly, with the approval of E. Hutchisson, Chairman of the original AIP Committee, the writers agreed upon a questionnaire that

would be sent simultaneously to the Engineering Schools by the ASEE and to the Physics Departments of the same schools by the AIP. The questions in general were similar. The physics questionnaire asked:

1. To what extent have there been discussions between Physics and Engineering Departments concerning the appropriate divisions between courses in physics and those in engineering sciences?
2. Have such discussions and others assisted in determining the courses, or the contents of courses, in Physics Departments? In Engineering Departments?
3. To what extent, if any, have endeavors to formulate the subjects of engineering sciences reacted upon the physics teaching as far as you can judge?
4. What undergraduate physics courses are now required of engineering students? Are any of the advanced physics courses popularly elected by students? Are any of the advanced physics courses elected by engineering students? In other words, what attempt, if any, has been made to utilize additional undergraduate courses in physics to supplement engineering sciences?
5. To what extent, if any, is there a definite attempt to build engineering science courses upon prerequisite physics courses?
6. It has been suggested that the Institute reactivate a committee on the "Role of Physics in Engineering Education". Is this, in your judgment, an appropriate time to restudy this matter?

A rough analysis of the physics replies was made by R. J. Seeger. A reply that seemed to indicate reasonable progress was rated as good. Evidence of greater progress was noted as very good, whereas a definite inadequacy was poor (cf. Table I).

¹ R. J. Seeger, *American Journal of Physics* **24**, 70 (1956)

² *Journal Engineering Education* **46**, 25 (1955)

³ *Physics Today* **8**, 12 (1955)

TABLE I
PHYSICS REPLIES

Question No.	Total Replies	Poor	Progress	
			Good	Very Good
1	133	50	45	38
2	131	52	58	21
3	124	78	42	4
4	132	82	44	6
5	120	75	41	4
6	112	28	28	56

The corresponding Engineering questions are listed below:

1. Have there been discussions between Physics and Engineering Departments concerning the appropriate division between Physics and Engineering Sciences?
2. Have such discussions or any others assisted in formulating curricula in Engineering Departments?
3. Have endeavors to formulate the subjects of engineering science reacted upon the physics teaching as far as you can judge?
4. What attempt, if any, has been made to utilize advanced undergraduate physics courses to supplement engineering sciences?
5. Which courses offered in the Physics Departments are required by Engineering Departments, listing both general physics and advanced undergraduate physics courses?
6. Which physics courses are most popular as electives with engineering students?

It will be noted that the first three are very similar to those in physics, the last one is quite different. Questions four and five together are believed to be comparable to physics question four. An analysis was made of these replies on the same basis as those in physics (cf. Table II, Evaluation A).

TABLE II
ENGINEERING REPLIES

Question No.	Total Replies	Poor	Progress	
			Good	Very Good
1	110	29	75	6
2	104	36	65	3
3	104	68	34	2
4	103	96	7	0
6	109	63	44	2

Question No.	Total Replies	Negative	Evaluation B	
			Perfunctory	Positive
1	111	9	25	77
2	111	25	15	71
3	111	43	27	41
4	111	22	39	50

Eighty-seven of the institutions sent replies from both Physics and Engineering Departments. In general, the rating by the physicists agreed with that by the engineers, neither poor, nor very good—barely good.

The engineering replies were analyzed in a somewhat different manner by E. Weber. Definitely positive or negative answers were compared with the common, perfunctory statements, which were not particularly revealing. In the answers to question six, E. Weber found that nuclear physics courses were mostly preferred; in second place, modern physics; then, atomic physics, and finally solid-state physics (cf. Table II, Evaluation B).

In summary:

- (1) There seems to be definite evidence that some progress has been made despite the brevity of the questions and of the replies. Many of the remarks made in the answers, however, signified somewhat peculiar points of view. They do not represent the average opinion; on the other hand, they do indicate some sore spots that need attention.
- (2) The second outstanding characteristic of the replies is the need for considerably more communication between Engineering Departments and Physics Departments, particularly at the local level.
- (3) The writers recommend the ASEE and the AIP review the situation more thoroughly and advise upon definite steps that should be taken in order to encourage the physics and engineering faculty to solve their mutual problem by recognizing the complementary advantages of physics and of engineering teaching. It is agreed that physics should be taught as physics and engineering as engineering. Their mutual interdependence should be recognized not only as research and development out of school but in the curricula in school. Brother Conrad Gabriel of Manhattan College called our attention to a remark of Robert A. Millikan,⁴ "I should like to do a little bit if I can toward bridging the chasm which we have foolishly—I almost said idiotically—allowed to grow up between the physicist and the applied physicist, who is commonly called an Engineer."

The AIP Report concluded: "Recent meetings of the American Association of Physics Teachers and of the Physics Division of the American Society of Engineering Education have had sessions devoted entirely to the teaching of general physics to engineers. We urge that meetings of this kind be continued, and that whenever possible further joint meetings be held. Such meetings, by bringing together researchers and teachers, physicists and engineers, to share their experiences, their faiths, and their hopes do much to stimulate further interest and understanding of the "Role of Physics in Engineering Education". If the questionnaires and their replies have any merit, it is to emphasize the wisdom of this statement in these Post Sputnik days.

⁴ American Institute of Electrical Engineers 36, 235 (1917)