1. BACKGROUND

The first professional degree (FPD) in engineering is the customary degree needed for the practice of engineering. Practice is understood to be carried out in an industrial setting, and does not require much additional academic training. It is widely accepted that in a field as large and diverse as engineering, some specialties require significant training beyond the FPD. For example, researchers and academics often need advanced degrees. Individuals who branch into sales and marketing often seek additional degrees in business administration. Still, the concept of the FPD is useful, since it informs the public (and licensing bodies) about the minimum requirements that qualify an aspiring professional for practice.

Since the 1920s, the FPD in engineering in most regions of the world has been a baccalaureate degree, requiring the equivalent of full time study of approximately four years (eight semesters or twelve quarters, typically 60 ECTS or 32 US semester credits per year). Current programs of this scope in engineering typically require schooling in mathematics; exact sciences and life sciences; fundamentals and practice of engineering; laboratory and design experience; metrology and experimentation; ethics and professionalism; and selected topics from other disciplines, including the humanities, business and law. Some programs also include industry-based experience in the form of cooperative education or internships.

While some educational systems (including some that follow the Bologna Process) offer Bachelor degrees after a period of study of only three years (approximately 180 ECTS or 96 US semester credits), these programs are widely considered to provide pre-engineering degrees; an additional year of schooling is generally expected in order for the graduate to be ready to engage in engineering practice. Other systems that traditionally required longer schooling for the FPD in engineering have been largely converted by the early 21st century; most now offer a baccalaureate four-year degree or a three-year Bachelor degree in addition to more advanced degrees.

2. PROPOSALS TO REQUIRE ADDITIONAL SCHOOLING FOR THE FPD IN ENGINEERING

From time to time researchers, professional associations, policy institutes, and licensing
bodies have re-examined the requirements for the FPD in engineering and suggested alternatives to the four-year baccalaureate degree as FPD. Among those alternatives were: (1) a Master of Science degree (approximately 300-360 ECTS or 160-192 US semester credits), (2) a Bachelor+30 US semester credits; and (3) the degree Doctor of Engineering.

The reasoning for the additional requirements often included the following elements: (1) the educational needs of engineers have outgrown the time available for instruction in 4-year programs; (2) other professions (e.g., medicine, law) require more schooling for the FPD; (3) industry finds that many graduates of 4-year engineering programs require significant and costly training in order to function in the workplace.

3. IEEE POSITION ON THE FPD IN ENGINEERING

This position paper focuses on engineering areas within IEEE’s fields of interest.

3.1 IEEE believes that education is an essential life-long need for engineers, and that significant learning is necessary for engineers of all disciplines beyond the studies that qualified them for the FPD. Consequently, continuing education should be an integral part of the career plans of most if not all engineers.

3.2 IEEE believes that studies beyond the traditional four-year degree and the attainment of higher degrees such as Master of Science and Doctor of Philosophy/Doctor of Science are appropriate and in many cases necessary for engineers whose career path requires research, topical specialization, and contribution to the state of the art in engineering science. For many other engineers, higher education in areas such as business, economics and law is equally essential; it improves performance and fosters understanding of systems and processes that are part of the engineer’s professional tasks.

3.3 IEEE does not believe, however, that a mandatory, across-the-board requirement for more formal education for engineers is warranted, beyond the FPD currently decreed by tradition and practice.

There are several reasons for this conclusion: (1) the wide range of engineering tasks and careers is likely to make a meaningful uniform higher education standard for engineers extremely hard to formulate and justify; (2) the increased barriers for entry into engineering, as well as the increased costs brought about by a more demanding FPD are unlikely to strengthen the profession or be offset by the quality gains that more stringent requirements would produce; (3) while training “on the job” is a costly endeavor for employers of engineers, a more demanding FPD by itself is unlikely to provide relief in this area; (4) there does not appear to be evidence of gaps in quality of engineering work or in related engineering-related public interests that a new
requirement for a FPD in engineering would easily address; (5) neither the public nor the employers of engineers appear to demand that, as a general rule, all engineers have a Master of Science or other post-baccalaureate education; (6) those employers who felt that they need engineers with higher degrees have already imposed the necessary requirements. The rules of supply and demand appear to have established equilibrium between these needs and the availability of university graduates with the required credentials.

3.4 IEEE recognizes that the engineering curriculum had expanded to the point that many programs struggle with overly crowded study plans (too many topics, courses, requirements, and sub-disciplines). IEEE believes that the solution to this problem does not lie in extending the period of schooling, but in developing and providing smarter, better designed, and more adaptive curricula. These curricula would offer students choice, good balance between breadth and depth, strong emphasis on developing self education skills, and the ability to manage key resources such as archival literature and time. In the face of the continued expansion of the scientific and engineering disciplines it is unlikely that two additional mandatory years of schooling without curricula restructuring would solve any fundamental problem. Rather, it is likely that new proposals will emerge later to move from six mandatory years of schooling to eight or ten.

3.5 This position paper does not speak to educational or other requirements imposed by nations and governmental bodies to regulate the licensure of engineers.

APPENDIX: HOW THIS POSITION PAPER WAS DEVELOPED

This policy Paper was created by the IEEE Educational Activities Board (EAB). EAB discussed the FPD with pertinent IEEE organizational units, including the IEEE Committee on Technology Accreditation Activities, the IEEE Committee on Engineering Accreditation Activities, the IEEE Accreditation Policy Council, IEEE-USA, the IEEE Educational Activities Board, and the IEEE Board of Directors. An article presenting arguments for and against changes in the status quo was published in the September 2007 issue of The Institute. IEEE members were asked to weigh in on the issues outlined. Several hundred responses were received, read and analyzed. Several regional organizational units were invited by EAB to provide additional input.

15 November 2007 – FPD in Engineering Version 005, composed by Moshe Kam with input from IEEE-USA