



An Online Course on Intellectual Property for Undergraduate and Graduate Engineers and Scientists

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Introduction

It can be said with a very high degree of confidence that all of the engineers and scientists in our technology University classrooms at some point in their professional careers, will come into direct contact with the Intellectual Property Laws of this or other countries, and these laws will have an impact on their extant projects. Whether using these Intellectual Property Laws to obtain exclusive rights covering their development project for the commercial advantage of the enterprise, or determining how to "work around" and not infringe upon the exclusive rights of someone else in the same technology arena, at least a basic knowledge of the Intellectual Property Laws would be beneficial to these professionals. At the College of Engineering of the University of Illinois at Chicago (UIC), we have developed an online course titled "Intellectual Property Law for Engineers" as part of our Master of Engineering program, and have been offering this course for 20 years. A first textbook for this course was jointly published by John Wiley & Sons and the IEEE in 2004, and a second, updated edition of the textbook was published in December 2019, under the title "Intellectual Property Law for Engineers, Scientists, and Entrepreneurs" [1].

The primary reason that a course in intellectual property principles should be offered in our engineering, science and technology learning institutions is that inventions, innovation, and creativity have always led to advances that ostensibly benefit society as a whole. Today, practically all nations on earth have adopted an intellectual property protection system under their laws, which provide exclusive rights for a limited time to inventors and creators in exchange for the public disclosure of their inventions and creations. These laws, in combination with international treaties, allow any unique development, made or developed anywhere, to obtain exclusive protection globally. These systems are designed to encourage innovators to disclose their developments, rather than keep them secret, where they benefit during the term of protection, and society benefits from the advantages the new technology enables.

Technology has become more complex and mysterious over the centuries. Following in step, the world's Intellectual Property Laws have become more complicated, and admittedly less comprehensible to those other than Intellectual Property attorneys, such as myself, who are charged to know and keep up with such matters. My experience in over fifty years as a practicing Intellectual Property attorney has shown me that engineers, scientists and other technology professionals have little or sometimes no knowledge of how the intellectual property legal

systems operate, or how an innovator can use the IP systems to his or her benefit. Most of those in the technology genre know that patent systems exist, for example, but have scant information as to how the systems work with regard to their technology developments.

For these reasons, I submit that a need exists for a comprehensive course in our engineering, science and technology curriculums, at the undergraduate and graduate levels, directed to the creation and enforcement of intellectual property rights, presented in understandable, plain non-legal language. In this paper, I offer for your consideration an outline for an internet delivered course, or courses, directed to the Intellectual Property Laws and procedures, and how such courses can be readily included in existing course structures.

Intellectual Property Defined

When an invention or other creative work is completed by its developer, the developer has, of course, the right of ownership of the physical embodiment of the invention, song, software, writing, sculpture, etc. However, to promote science and the useful arts, the law, for example the U.S. Constitution, has created certain provisions enabling the inventor or creator to obtain exclusive control over the use and copying of the invention or creative work that has been completed for a limited period of time [2]. These laws, some dating back to the late 1400s, have encouraged invention and creation within the realms that have enacted such laws. Today, the Intellectual Property Laws provide protection only to inventors and creators of new technology and artistic works, and do not reward inventors who import old technologies into a new country. The one obtaining intellectual property protection must be the inventor or the creator of the technology or creative work for which protection is being sought, or the employer of the inventor or creator, or others with the exclusive right to commercialize the invention and/or creation under a license agreement. Those in the engineering, science and technology community, the STEM people as they are now known, have general familiarity with most of the vehicles for intellectual property protection. The most well-known is the patent which protects any new, non-obvious, and useful machine, article of manufacture, composition of matter, process or any improvement thereof that has been created by man or woman. To be patentable, the invention must also fall within normal categories of patentable subject matter. Abstract ideas and concepts and natural phenomenon do not fall within the category of patentable subject matter [3].

Copyright protection provides another vehicle of intellectual property protection that has legally impacted the engineering and scientific community. For example, software can be protected by the copyright laws, and by the patent laws in certain instances. The copyright laws protect any work of copyrightable subject matter such as software, books, music, lyrics, architectural drawings and the structures prepared from those drawings, and the expression of many other artistic and creative endeavors [4].

Where a certain process or substance is capable of being maintained in secret, such as a chemical formula or the program embedded in software, trade secret protection may be the preferred way of obtaining exclusive rights over that development. Obviously, trade secret protection will not be viable with regard to any machine, apparatus or device where the subject matter of the invention is immediately apparent upon viewing the device embodying the invention. For example, merely looking at a semi-conductor chip does not reveal the program embedded in the chip.

The trademark and unfair competition laws offer protection for any symbol, name or other indicia used to identify a producer or seller as the source of a product or service. This includes the brand names of products, logos, package designs and shapes and many other indicia that offerors of a product or service may adopt to distinguish their goods from those of a competitor.

The Awareness of Intellectual Property Rights

Over the last 40 to 50 years, intellectual property rights have risen to the surface of public awareness. Many news items on the front pages of newspapers and on TV today relate to problems, and solutions, that have their origin in the Intellectual Property Laws. See, for example the U.S. - China trade dispute over intellectual property rights.

Several countries that still face severe AIDS epidemic problems treat their AIDS patients with a series of pharmaceutical cocktails made of a combination of several patented drug products. Some governments, at least on the past, have gone around the patent laws and obtained less expensive drug cocktails from non-licensed manufacturing sources.

Another example is where the copyright laws provide a composer of music, and the company that records that music on a tangible medium such as a disc, control over the reproduction, distribution and performance of that composition. The recording industry has filed myriad lawsuits obtaining injunctions against illegal music and video downloaders.

My present comments are directed to the following:

1. The importance of offering intellectual property protection instruction to higher education students in the STEM disciplines;
2. A brief summarization of the subject matter that should be offered to students;
3. The proposed pedagogical approach to imparting intellectual property principles to STEM students;
4. How this pedagogical approach has been implemented successfully at the College of Engineering in a major university; and

5. The results of and student reactions to this course of study.

The Imperative of Teaching Intellectual Property Procedures and Rules to STEM Students

A large majority of the innovation that has propelled the world forward has been developed by those who have technology, engineering, science and/or creative studies as a significant part of their curriculum vitae. Intellectual Property Laws will invariably be used by these individuals to benefit from the exclusive use for a limited time of the innovations they develop.

In my view, it is imperative that instruction in intellectual property subject matter be available to those STEM students who are most likely to be exposed to the rules governing the protection and use of their creative and innovative efforts. The STEM students who graduate from our educational institutions and proceed to invent, create, develop, and manage technology during their professional careers need immersion in those laws that relate to novel, non-obviousness and useful creations that move technology and science and civilization forward.

Generally, currently offered course content fails to provide the depth of educational substance or time sufficient to cover the broad spectrum of Intellectual Property Laws and procedures that the students will be exposed to during their careers. As a result, most students who graduate with degrees in engineering and science have little or no knowledge as to how the laws of intellectual property can be used to their benefit.

Based on my experience, each time I contact an inventor, or a creator of a copyrightable work, for the purpose of advising them on the protection of their intellectual property, it seems that I am explaining intellectual property concepts from ground zero. I deem this unfortunate because, as one example, an inventor can disclose his invention to the public prematurely and possibly entirely destroy his or her ability to obtain intellectual property protection under the patent laws. For instance, an inventor seeking to obtain patent protection on an invention that he/she has been using or that has been disclosed to the public over the last 13 months, has lost any right to obtain protection, and has in effect dedicated his or her invention to the public [5]. Had this inventor been sufficiently informed as to how to seek protection for his or her invention under the Intellectual Property Laws before making a public disclosure of the invention, his or her options on obtaining exclusive rights to the invention for a limited period of time would have been preserved.

Many of today's STEM students during their professional careers will also be managing the innovations that will benefit the welfare of humanity in the coming years. Among such managerial tasks will be those that institutions of higher learning have most knowledge of and experience with. These are the institutional development and research grants that support many

research colleges and universities. The management of these grants normally requires oversight over inventions developed using grant resources, and the requirements for patenting or otherwise obtaining protection of innovations resulting from these grants. The managerial skills needed to properly advance these grant projects will require knowledge of the patent and intellectual property provisions to which those working on the grant resources will necessarily be held to compliance.

In addition, many technology institutions of higher learning provide facilities for incubator projects upon which startup companies rely. Proper management of innovations resulting from such incubator facilities will also require the knowledge of Intellectual Property Laws if optimum benefit to both the organization taking advantage of the incubator facilities and the academic institution is to be achieved. STEM students, whether they become entrepreneurs or work in commercial, government or academic environments, must be aware of the degree of freedom and limits they face on the use of proprietary, patented or copyrighted products or processes of others, and also how to best protect the results of their own innovations and creative efforts.

The Content of a Course on Intellectual Property Rights

At the College of Engineering of the University of Illinois at Chicago, we have developed Intellectual Property Law for Engineers course content and an updated text that we recommend be offered to STEM students.

Prior to development of an Intellectual Property Law for Engineers course, two avenues of research should be explored. First, the course developer will determine those intellectual property subjects that an engineer or science student will most likely encounter during their professional careers. Second, a brief survey will be conducted among alumni of the engineering or science college to obtain input as to Intellectual Property Law issues they have actually faced based on their own professional experience. An example could be developing license contracts for the transfer of intellectual property rights. If an engineering or science alumni association is not available, the brief survey could be conducted among members of the local engineering societies.

The suggested content for the course includes the following:

1. Defining Intellectual Property Law, defining terms, identifying several intellectual property vehicles, and determining when each is applicable and/or desirable.
2. The strategic use of intellectual property by business entities.
3. The historical foundation of the Intellectual Property Laws.
4. The categories of patentable subject matter, including non-obviousness, usefulness, novelty and patentable subject matter.

5. The requirement that an invention must be novel and non-obvious to be patented, and the time limits for filing a patent application.
6. Details of the patenting process.
7. The different types of searches of prior art that can be conducted.
8. The content and inventor's review of a patent application.
9. The all important claims used to define the invention in a patent.
10. The patent application examination procedure before the U.S. Patent and Trademark Office (USPTO), and other international Patent Offices.
11. How design patents can be effectively used to protect technology.
12. The specialized nature of patenting computer related inventions and software.
13. The patenting of biotechnology inventions.
14. Patent protection for methods of doing business.
15. Obtaining international patent protection, at minimum expenditure of resources.
16. The enforcement of your patent rights and avoiding infringement of someone else's patent.
17. Patent licensing advantages.
18. Employment contract provisions that relate to intellectual property and confidentiality.
19. The engineer and scientist selected to consult or testify as an expert witness, and professional ethics.
20. Copyright protection for technology, including copyright registration for computer programs, automated databases and on-line works.
21. The Digital Millennium Copyright Act and the prevention of the circumvention of technical protection measures, such as anti-copying programs embedded in CDs and DVDs.
22. Trade Secret protection, federal and state, including steps to be taken to prevent the theft of trade secrets. Also covered are confidential disclosures as a means of protecting one's intellectual property.
23. Trademarks and brand protection for technological developments.

The course topics listed above can be tailored to fit the students' time and credit hour requirements. Certain of the above subjects can be omitted. Also, the 2019 Second Edition text that is now available for the course includes sufficient detail on each of the above subjects and others to be added to the course material as desired by faculty.

A Pedagogical Approach to an Intellectual Property Rights Course for Engineering and Science Students Offered Over the Internet

A. How an Internet Delivered Course Works

Internet delivered education material allows the educator to exchange information with anyone in the world at any time. Students in the course are from worldwide locations in our

experience, and the internet delivery system increases student access to advanced learning sources and opportunities. Course materials are available 24 hours a day and can be accessed repeatedly by a student. The learning process is self-regulated requiring increased discipline from the students since the student decides the pace which he/she will access the lectures and complete the assignments. The instructor maintains a degree of control over the student's pace by requiring weekly submittal of homework assignments, in response to which the instructor provides the student with somewhat instant feedback.

Distance learning provides educational opportunities particularly to continuing education students residing in remote geographical areas, those who have work or family obligations that prohibit attendance at a traditional learning environment or institution, or those who cannot pursue an on-campus education due to a disability. The program we use is valuable to people with limited access to educational institutions and also to students with limited financial resources. Also, instructional material can be shared among different educators and academic institutions. Once established in an electronic format, the course material is easy to modify and keep up to date.

At the College of Engineering of the University of Illinois at Chicago, the Blackboard program or platform is used. Course materials are delivered to the students via audio, text and slides. The slides provide the learning points of each lecture and an audio file projecting the voice of the instructor is streamed and is associated with each slide. Hyperlinks are provided to direct the student to replay the material such as a video presentation of Hollywood's version of a patent infringement lawsuit. The syllabus of the course is posted for access by the students.

At UIC, we initially prepared 16 lectures on selected subjects of Intellectual Property Law. Each lecture was scripted and a series of slides was simultaneously prepared to accompany the dictated lecture material. Each lecture was uploaded into the audio system server of the Blackboard program and the Powerpoint slides were timed to be displayed at the corresponding place in each lecture. Beside the lecture material, various ad libs and attempts at humor were also infused into the oral presentation.

The efforts of the University computer center help keep the cost of delivering the course at a minimum by offering all the necessary hardware, software, input devices and server resources free of charge. Using the Blackboard platform, enrolled tuition paying students can log in, see the classes in which they are enrolled, gain access to the lecture materials and the associated assignments, communicate with the instructor and/or other students and check the progress of their grades. All lectures are downloadable which becomes convenient for those students who may desire to take their own notes while listening to the instructor. Students cannot gain access to the program unless they obtain a password from the school upon payment of tuition.

At the end of each lecture, an assignment consisting of 3 or 4 questions is posted for access by the students. Each student is required to respond to these assignment questions by posting their answers into a "digital drop box" embedded in the Blackboard program. The assignment answers are then downloaded by the instructor. The instructor grades the papers and adds comments. The graded papers are then transmitted to the students by email or handout with the comments of the instructor placed either on a document or onto the digital format of the assignment answer. We have found that some students print the lecture for each week and use the printed lecture material to follow the audio portion before answering the assignment questions. Many of the assignment questions are of the Socratic or essay type, where the absolute answer is less important than the analytical process used by the student to reach the answer. This is a learning process that may be somewhat challenging to engineering students. However, our students have shown enthusiasm when faced with this different pedagogical approach.

In accordance with school policy, the mid-term and final exams are all proctored even as to those students who reside away from the campus. The exams of distant students are emailed to the distant proctor, and forwarded to the student after grading. Grades of all assignments are entered into the Blackboard program which automatically calculates the student's grades in real time. The program is adjustable to provide varying weighted values to exams and homework assignments. Particularly, in our course, multiple choice assignments and exam questions should not and are not being used.

B. A Course on Intellectual Property Rights is Suitable for Delivery over the Internet.

The class materials prepared for our course were specifically designed for internet delivery. It was discovered that approximately 6 to 8 months lead time was required to set up the course. A key factor in the success of the online course is the time and effort the instructor dedicates to making the student's participation a remarkable learning experience such that the students find the course stimulating and motivating.

The content of our Intellectual Property Law course, which particularly avoids legal jargon, is suitable for delivery and presentation to students over the internet in an asynchronous environment. Students questions are answered by the use of emails that pass between each student and the instructor. The feedback from our students has been positive and they have had no difficulty understanding the material as it is delivered. Students noted the ability of taking the lecture at any time they desire as an advantage. They also appreciated having one homework assignment/quiz for each lecture, and help sessions available before each examination. Students remarked that they found that the course was enjoyable as a break from the grind of calculations usual to engineering education.

Our course development experience has proven that when properly prepared and presented, the subject of intellectual property rights can be effectively delivered to engineering and science students using a delivery style that maintains positive student interest and involvement.

The Advantages of Offering a Course on Intellectual Property Rights to Engineering and Science Students Over the Internet

The past 30 years I have been an adjunct professor of Intellectual Property Law at the John Marshall Law School in Chicago, now a part of the UIC system. My law school courses are taught directly face-to-face with the students, and I enjoy the face-to-face teaching experience. I was initially reluctant to begin teaching an internet course for fear that such teaching would not provide the interest that a part time instructor gains from the classroom experience. However, once I became immersed in the internet delivery process, I became aware of two primary advantages of this educational system. First, students who work full time jobs and reside away from college campuses can still gain a degree through enrollment in the Masters of Engineering course offered by UIC totally over the internet, of which my two courses, Engineering Law and Intellectual Property Law for Engineers, are a part. I have had students taking my courses while residing in Saudi Arabia, Hong Kong, California, Toronto and Halifax Nova Scotia. One of my students who resided in suburban Chicago was transferred to the Florida facility of the company for whom she worked. She continued to complete the course through a seamless change.

A second advantage in this age of decreasing availability of education funding is that the school can enroll a student who is nowhere near the campus who otherwise would not be an enrollee. This feature of a combination of the internet and the educational experience is of primary importance and provides students who cannot physically come to the university facility an opportunity to earn a degree.

I also perceive that a course in intellectual property rights would be sought by students in other university disciplines, such as business administration, medical and dental students, and others. It is my perception that intellectual property today is a subject of interest across a wide spectrum. However, the subject still remains a mystery to all but the approximately 50,000 patent attorneys in the United States, and our international counterparts.

Conclusion

The results of the student reactions to our internet delivered intellectual property course reflect an enthusiasm among the students as shown in their answers to their assignments and exams. While some students present just a perfunctory answer to a question, I have noted that the

vast majority of students respond by presenting a thorough answer to each question, sometimes expressing their own views as a way of reaching their conclusions. This is a major advantage of the Socratic Method, where the right or wrong answer doesn't matter, but how the student reached their answer determines their grades.

As a measure of the enthusiastic way in which our courses have been received, several of our students decided to apply to law school to pursue careers as Intellectual Property Attorneys. At least two of my students have become Patent Examiners in the United States Patent and Trademark Office. I have been asked on several occasions to offer my recommendations for students to further their careers. Thus, it is my experience that by using course delivery technology over the internet, and tailoring the course material to the modality of distance learning, both an interesting, effective, and substantially rewarding course presentation of important content for engineering and science students can be achieved.

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- [2] e.g.: U.S. Patent Law, 35 U.S.C. §1 et seq.; U.S. Copyright Act, 17 U.S.C. §101-1331.
- [3] *Alice Corp. Pty. Ltd. v. CLS Bank Int'l*, 573 U.S. 208, 217-218, 134 S.Ct. 2347, 2354 (2014).
- [4] 17 U.S.C. §§102, 103, 104, 120.
- [5] 35 U.S.C. §102(b).

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