



Thoughts on Engineering Education and Offered Programs

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The profession of engineering is essential for the development of any region, country or society worldwide. Engineering has played an important role in human kind progress and prosperity for the last couple of centuries. It is therefore necessary to update engineering education and programs to cope with emerging technologies and innovations.

In order to offer efficient and competitive engineering programs, the following thoughts and observations are highlighted for academics and educational policy makers.

Thought 1: Programs Credit Hours

Are we degrading the engineering profession by reducing number of credit hours, deleting courses; even basic engineering and science courses, eliminating courses accompanied lab works and merging two or more courses' contents. Many regional universities and worldwide are following this policy in order to compete in students enrolment and intake.

Around 1-2 centuries ago, engineering wasn't an existent field or distinct registered program. Then by the introduction of power houses, generators and motors, a few courses were taught in a period of 2 years or so. By the time when the electronic valve and later transistor arrived, electronics was introduced with some more circuits and measurements courses, together with basic communication course. Then the age of computers arose which forced many engineering colleges to introduce computer courses. This was lasted for more than 2 decades and still going. The last decade revealed the age of communication and information technology and its expected to exist for some time now. Therefore, syllabi were diverging in both quantity and specialization from a 2 years program to some 5 years study plan.

Certainly that process was necessary and required by the society. The demand for a overwhelmed professional engineer is tremendous. So, one expects that this trend would continue in supplying engineers who could solve a number of specialization problems and to tackle different fields at a time. In fact two things are happening. First; the society rewards towards engineers in terms of salaries and the like lessened. Now, the industry can employ an engineer with minimum wage for a granted. I.e. the profession changed from a need to a tool. The second

thing happened is that engineering was split into many different fields. This process had to arrive considering the diversity of technology and consequently the increase of load on engineering education.

The question is now do we have to continue with this or shall we preset the society with a professional engineer who will be able to tackle all aspects of one field of engineering at least. The former will degrade engineering into selected topics in engineering, whereas the latter would lay a core stone towards engineering profession. How can this be implemented for example in electrical engineering programs; is the next challenge. One method of achieving this goal is by offering a complete electrical engineering program which covers all basic engineering and science topics. The strategy for such a program is to provide the graduated engineer with solid background that will support him in solving all incoming problems in both engineering and technology. The title of the engineer and program must be unique. The society would then recognize this field and reward it accordingly. Most importantly, devoted engineering students will seek this program and be ready to face the challenges. The last question is who is going to dare offering this program amid tens of ready-made programs which are attractive to both students and society.

Thought 2: Programs Quality

How to come up with a successful engineering program, with graduated engineers who are devoted to the profession, ethics and all aspects of challenges ahead. Many universities worldwide presented different tools to profile this matter. Those who say that design integration should be enforced, some who want to see other soft skills to be instilled in students, some discuss that information technology is still missing in the graduated engineer, thus he's ill-equipped with today's needs, and some argue that the student must be induced with certain courses of different diversities in order to make him ready in dealing with the new economy and globalization.

In the US, many universities enroll students according to apparent wish or desire of student. In Scandinavia and some northern Europe universities, engineering is a tradition and only those who want to be committed seek admission. In England, an engineering student is brought up at the secondary school level when he does the O and A-levels program. At that age and study stage, students are checked for certain topics such as math and Physics.

Here, in Arabia, engineering is taken for granted. This altitude will never be rewarded in terms of establishing front-line design technologies and competing industries. We think it should come from an early age, if we are going to offer the traditional 4-years or less [in future!] programs. So the quality of enrolled students will be judged at an earlier time, the time when students acquire maximum knowledge of basic sciences.

How can we implement this dilemma; the dilemma of reducing engineering program years and on the same time revealing quality engineers who can face the coming challenges of technology. Especially, when this technology is showing no sign of saturation but rather diverging in many horizons. May be a school contact can be a start point. Here at universities, we sit and wait for students; any students to come and to be taught. Rather, once can establish a link with secondary schools, or when we approach students with meetings and even workshops, or when students are invited to visit engineering colleges or even by conducting IQ or similar tests. Better still, by feeding back required updates in essential topics such as Physics and Math among other science subjects.

The alternative option would be an engineering enhanced baccalaureate certificate for students who pursue engineering studies. In that, we can afford reducing engineering program or making it flexible enough to cope up with the new coming technologies.

Thought 3: Programs Conduct

Academic dishonesty is a hard burden on the engineering learning process particularly at Ajman University of Science and Technology (AUST) and unfortunately. The faculty members as a whole share this altitude at large, and it has been going on for some time now. The bottom line is that students see no danger of this altitude on their study. Neither, they face the consequences when academic dishonesty is practiced. Some students see it as a solution to their long hour loads, especially if they are on part-time jobs. But the majority of students don't even care since a piece of certificate is what it matters to them and this is disturbing.

This act of academic dishonesty is found not only at exam/test/HW/assignment times, but also when conducting a lab work, when submitting a training or project report; among others. Obviously, this virus-like dilemma cannot be spared when engineering education is sought since special merits are required for successful engineering students. These merits are the ability to analyze, design and solve problems. Acquiring just basic sciences won't do. On the other hand, this ill-spread learning habit degrades students' quality manifolds as they progress from one semester to the next. Lastly but not the least, this dilemma represents a burden on instructors and jeopardize their work. Just imagine the amount of work needed to format PC labs to avoid file copying, or the large efforts to recognize who cheats from whom by checking exam papers, or how to cope with invigilation during exams, the list goes on and on.

First and for most, students should be made aware of this dilemma right from the beginning. They should differentiate between a team work and academic dishonesty. They should be convinced that on the long run it won't pay off, because many courses are heavily prerequisite to other courses and because design integration is required in many senior courses. Rewarding poor but honest test/exam and other assignments' papers more than dishonest good papers, is another tool. For example, a parabolic equation can be used to induce academic dishonesty such as utilizing a function of this form: $F(x) = K(x)^y$, where y is a positive or negative digit corresponding to dishonesty factor. Sometimes, open-book tests would help, especially when it comes to design and analysis. Questions of the following examples should be addressed in many engineering courses:

Redesign circuit with minimum components

Study Noise analysis on circuit

Analyze sensitivity of parameters

Generate bar graph statistics of variables

Student societies can also play a role there too by pinpointing the danger of dishonesty. Some sort of a dialogue among instructors and students should be conducted at many study intervals to signify this matter. As expected, tests shouldn't be duplicated from one year to the next. The teaching process should be more spontaneous and less monotonous. Problem learning should be imposed and practiced through out the program. Remember engineering students are studying for a profession and not a job.

Thought 4: Engineering Curricula

Tuning some of university requirement courses and faculty requirement courses towards engineering curriculum is becoming ever needed due to the generic and not specific attributes of these courses. We would like to see more of those courses oriented for engineering program because of the uniqueness of such a program. By this process, we can afford reducing the long Cr. Hr. load of the program and contribute instead more specialization in it. The alternative is having many vague, void and unpracticed portions of the courses taught. Remember engineering is for knowledge application and practical implementation.

At the moment, the university requirements at AUST of 18 Cr. Hr.'s are:

1. 15 Cr. Hr. compulsory courses comprising Islamic Culture, Arabic language, Statistics, Introduction to Computers and English Language I
2. 3 Cr. Hr. elective courses comprising History of Science in Islam, General Psychology, Scientific Pioneering /Patents and Research Methodology.

It's the three courses of each of the above categories, which is of our concern. Obviously, the outcome of these courses in terms of long-life learning to an engineering students is much less than to other students. For example, we don't have to teach and assign later a course on technical writing, introduction to engineering, probability, computer applications, oral and written communication or other soft attributes for the engineering program. Instead, more and more new technological courses are offered.

Similarly, some of the faculty required courses should be designed for the needs of the engineering program. In particular, all five Math, two Physics, Chemistry, Engineering Graphics, Engineering Economy and Engineering Management courses. For example, Math is a prestige course to engineers that to others. Physics is essential to engineering vision of design and creativity than to other programs. Chemistry should tackle the contents of engineering material and semiconductors for example. Engineering Graphics should be tailored to allocate a major portion of its contents for computer programming and WEB design. Engineering Economics and Management should enhance particularly engineers' soft tools of communication, leadership and control.

The efficiency of the outcome of these courses would be more if taught by the engineering faculty themselves. By this, we can converge engineering learning, orient engineering scopes and afford tune and reduce the long Cr. Hr. syllabus. The program can easily be modified or developed later to cope with new technologies too.

Thought 5: Programs Diversity

The programs of Interior design and architecture [Architectural Engineering] are currently offered by the faculty of engineering at AUST, with objective such as to develop artistic proficiency, aesthetical use of spaces and interiors, serve and interact with community marketplaces. It can be deduced that such programs cannot be flourished and developed under the patronage of engineering and for ever. On the other hand, a program of civil engineering can serve all engineering aspects of architecture particularly in the UAE, where high rising building and shopping malls are marketed.

Clearly there is a conflict of vision between Arch/ID and engineering as a whole, noticeably at AUST. This altitude is shared among many of the faculty members. One would like to see more harmony between these two critically related fields of engineering and art. The background of the enrolled students varies tremendously too. The two philosophies are in stack because whereas teamwork and integrated sciences are needed for engineering, individuality and personal artistic imagination is sought under Arch/ID. As student learning is developed from one semester to another, this divergence of philosophies is more noticeable.

At the moment, the faculty requirements for Architectural Engineering are only 13 Cr. Hr., which are Physics I, Engineering Graphics, Math I and English Language II. They represent only a tiny fraction of the total studied Cr. Hr. of 169. All these courses are currently taught by other faculties which imply that they are scarcely devoted by the faculty of engineering. It can be noticed that Physics II, Math II, III, IV, V are not offered as to other engineering fields. There is no logic of naming architecture engineering when less than 10% of all engineering courses are taught. This same argument applies to Interior Design when again only 13 Cr. Hr.'s are offered by the faculty of engineering. The alternative is either accommodating architecture with the faculty of engineering by top-to-bottom reshuffling of the program or establishing a faculty of art which will be solely devoted to the artistic, historic and philosophical side of architecture. Interior Design would then fit.

Thought 6: Working Students:

It is a well-known fact that engineering education demands time consuming training of the profession, such as design case studies, practical lab work, technology-relevant seminar, field training, extensive tutorials, computer simulations, web sites surfing as well as vital class attendance in order to digest the heavy theory which is based on math-physics applications. In summary, engineering education consumes extensive time, which means that for full-time students this is 100% utilization of time. This may range from minimum 18 to a more normal 32 hours per week of notes reading and assignments preparation. Taking this into account would eliminate any possibility for work during semester periods.

At the moment, there are more than 50% of all registered engineering students who are engaged in active working, depending on their levels of study. This is an alarming phenomenon and would degrade engineering learning enormously. But, when we analyze this high percentage, one can see that some might actually use education as a mean for residence sponsorship. This might entitles them to work as part timers. In other words, the faculty is being concurrently used as a safe heaven for part time working students. The student then would hope to finish his study with an upgrade promotion to his work. This is fine as long as the student puts more effort towards that goal. Many of these students choose wrong offered courses just to fit their timetable. The academic advisor can do little here to convince the student otherwise. They cannot repeat F or D courses immediately for improving AGPA, for the same reason.

Obviously, this is creating a disturbing result on the engineering faculty performance. There are now more than one third of the total enrolled students at college of engineering who, are academically warned one way or another. This represents a new generation of part-time educators. To solve this dilemma, a lot of faculty resources in terms of faculty and equipments can be drained away. It is recommended here, that university sponsorship must be based on the fact that only full-time study is granted. Evening classes should be gradually abolished on a 25% decline per year to curb this troubled situation.

Thought 7: Field Training

Field training is considered a vital method into engineering education due to its practical nature where technology embraces society and machinery. A careful conduct must be approached since issues such as problem solving, society development, safety; among others are addressed. Unfortunately, training at the moment is considered, by many students as a journey that has to be passed away with unneeded objectives. The student simply looks into it as a 4 Cr. Hr. requirement which can be done eventually at a site or different sites without assignments, tests or even clear objectives.

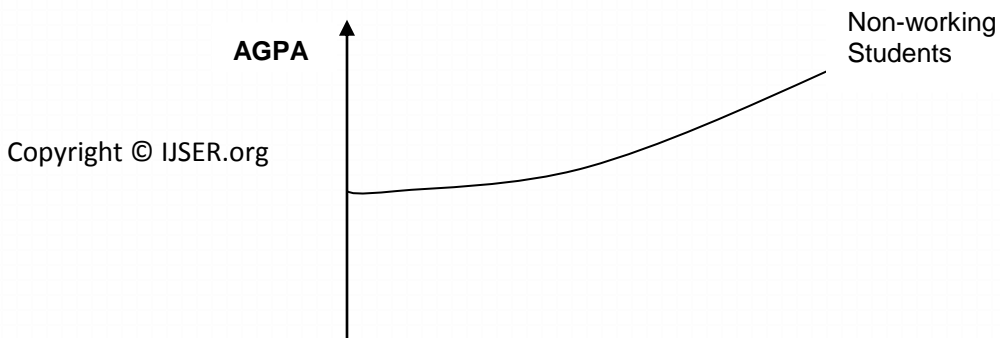
Currently, our major concern at the faculty of engineering is the job market for our graduates. Our students start their problems while graduating. And despite the different assisting offices such as AUST employment offices, finding jobs is still a problem. Clearly this has to do a lot in connection with field training and by how extend the student utilized his training purposes.

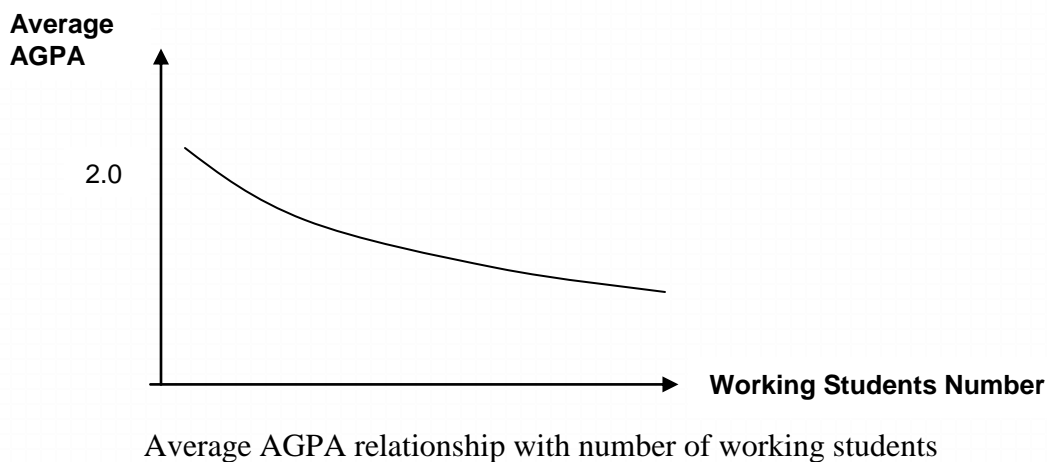
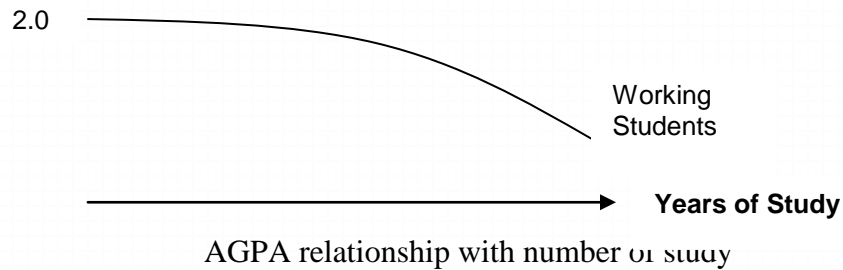
Obviously there are a few problems in achieving our goals such as the limitations of appropriate sites which are relevant to our students fields, proper collaboration with the industry and the time schedule of the student. This is particularly the case in Abu Dhabi region. But this must never detour our goals in achieving adequate field training to our students. The following list is just some of the important issues to be applied instantly:

1. Searching sites where not only students can receive proper training, but also possibilities for projects and jobs.
2. Furnishing comprehensive training plans to students according to site.
3. Maintaining continuous channels with field supervisors and educators.
4. Establishing lasting links with the industry when projects, seminars and visits are maintained.
5. Checking training students frequently and as many as twice per month.
6. Looking continuously for new candidate sites for future training.
7. Conducting proper training assessment by adopting carefully listed training items to be checked such field practical skills, theoretical backgrounds, technical reporting, oral communication & presentation.
8. Considering training at other countries of industrial and technological infrastructures.
9. Searching for paid training, paid supervision possibilities to enhance active training
10. Establishing a link between training students and a body within Techno-Sphere to feedback work possibilities.

Thought 8: Improving AGPA

It has been noticed and researched informally that working students constitute the majority of academically warned students who are not being able to achieve AGPA of 2.00 or more [see Thought 6]. This can be depicted in the following observations:





This is an increasingly worried situation not only to AUST but also the Ministry of Higher Education (MOHE). This same problem might reflect negatively on the name and performance of the university. It also represents a drain of faculty resources as a whole. One acceptable solution is to offer summer courses for those students wishing to repeat D and D+ as well as F previous courses in order to improve their AGPA. The 3 Cr. Hr. courses are offered over a period of 6 weeks where students attend averagely 8 hours per week of semi-intensive lecturing with full-load assignments and lab work assigned for normally run courses. The main objective is to offer specially designed mechanism for improving students AGPA's, without affecting their program timetables. This has the following advantages:

1. Readily available resources of classes, labs and faculty.
2. Students of only similar status are tutored under equal-bases consideration.
3. This may constitute an extra university profit too.
4. Since most of these students are working; this won't impose any restrictions in terms of time and availability. They would only concentrate on their objectives.
5. Active student supervision will be resulted.
6. Minimum time wastage in terms of filling special application forms, transforming courses, exceptional cases, etc.
7. This procedure can be repeated over the mid-term Winter break.

8. Only limited number of carefully, chosen courses, are offered to serve the majority.
9. This at the end will activate the faculty during closing summer periods.

Thought 9: Assessment Rules

It's well thought that proper assessing mechanisms would promote high standard programs for any type or kind of educational institution. After all, the process of lecturing should be considered as the highest priority of the educational hierarchy. The following general outlines must be pursued carefully:

1. Exam papers must be of highest standards and not easy or vague. A predetermined average class grade of not greater than C should be realized. This is considered the world standard for good educational institute.
2. Papers should be framed neatly with extensive use of tools. They should reflect clearly the utilization of up-to-date technologies, know-how privileges as well as well high educational documents.
3. The final mark should compromise of a portfolio of different assessing tool such as tests, home works, quizzes, assignments, lab works, lab assignments, projects, seminars & presentations, research & further studies. Each of the above mentioned items must possess a mark percentage. AUST is basically a technical university where technology is embraced by theory. This concept can be enhanced and justified through external communications with other universities and relevant ministries.
4. Dates for all kinds of assignments must be carefully addressed. We assess students with time and getting loose in timetable frames and tests allotting time will disable the assessing procedure.
5. There should be some sort of free and independent way of the assessment procedure for any instructor. This reflects the individual and universe character of the teaching process in an advanced university. This can be implemented on Centers level too. This would make the learning procedure from the student point of view more competitive and interesting. Both instructors and lab assistants must act as freely as possible in their assessing procedures.
6. Marking should be as accurate as possible. The statement "*A student grade is known before hand*" must not be admired. We cannot judge till the last minute in which way a student is progressing; else we shouldn't be here. Any discrepancy in assessing a student is a negative point in the path of the university.
7. Accordingly, the AUST grading system must be accurate to the tenths digit. Marks must not be rounded up in any direction. The honesty in marking should be preserved. Marks should be listed as are with no flickering or uncontested adjustments for any reason. In this way, university tools and mechanisms are respected and appreciated by students before others. The awareness that a student may object due to a one mark up or down is baseless under the laws of any university. It's clearly stated in many student documentations at enrollment time that the university reserves the right to apply its rules without objections.
8. Accordingly again, students would then have some mark conscious and this will assist also into their AGPA improvements.
9. There is a shortage of statistics in the assessing reports, which are considered to be important tools for future improvements.

Thought 10: Faculty Academic Load

The academic load of an instructor is not only the time he spends at class. Rather, it is class lecturing+ research +training & self-training +consultations+ seminars & workshops +visits & exchanges + student counseling + administrating, which makes up the total hours assigned to a faculty. At the College of Engineering, where again education is embraced by technology, the following activities must be taken into serious consideration in order to preserve competition of the profession:

1. Self-training and developing in terms of new technologies, applications and software programs, as well as general computer-networking literacy.
2. Upgrading and modifying courses since they are developing with time.
3. Updating current programs and checking the possibility of new programs.
4. Proposing new equipments and practical materials to cope with competing market.
5. Preparing new projects of up-to-date quality and usage.
6. Checking the possibility for post-graduate studies and future programs.
7. Maintaining academic links with other institutions in terms of research and visits.
8. Studying market of industry and its requirements in terms of know-how.
9. Extra-curriculum activities such as Techno-Sphere and the like.

Obviously, this measure will enhance the quality of the faculty to cope with the needs of the society around. Each member of the faculty is therefore responsible for a number of such assignments and his load must be carefully designed. The academic title of a faculty will decide the percentage of hours allocated for this or that assignment. A “Professor” member can achieve more in research than an “Assistant Professor” while the later requires more self-training than the former.

On the other hand, Architecture and Interior Design departments at the faculty of engineering, has to look into real academic load from the prospective of hours devoted for design. A faculty at this department will have more hour weight of contact design hours than others of general practical assignments nature. Thus his load hours must be up-weighted to reflect personal skills development and imaginative abilities. In this, he is not only offering mere practical assignments.