

## **Engineering Technology Education in Kuwait (Comparison study)**

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### **Abstract**

In the sixties, engineering technology began in Kuwait with one institute and was followed by another one called Kuwait Institute of Technology. Its name changed to the Technological Studies College. In the early eighties, those colleges and institutes were combined into one authority, and now thousands of students graduate every year.

In this paper, the description of each institute or college will be reviewed. More detailed discussion will cover the Technological Studies College (TSC). Also, the chemical engineering technology curriculum will be examined. Three mechanical engineering technology programs in three different colleges, TSC and two American colleges, will be discussed. TSC offers an advanced integrated technical program covering the basic and advance courses, college workshops and industrial field training. On the other hand, it has a poor program in the basic sciences, mathematics, social science and oral and writing communication.

### **Historical Background**

Kuwait, is located at the northwestern tip of the Arabian Gulf. For many years Kuwait centered on sea trade, and especially pearl exports, before the discovery of oil in the 20th century. Kuwait City, the capital of Kuwait dates from the 1700s and functions as one of the busiest financial and trade centers in the Middle East.

The earliest evidence of a human presence in Kuwait is the existence of Mesolithic tools, dating from about 8,000 B.C. Modern Kuwait began more than 300 years ago when the country emerged as an independent political entity.

The golden age of that region started 1400 years ago and reached the peak of its civilization in the Abbassi Empire, 1150 years ago. The Empire consisted of all the Islamic and Arabic lands and it is considered to be the greatest empire in history. In that period, one of the first universities in the world was established just north of Kuwait. In addition, thousands of specialized higher education schools were founded and thousands of books were published in the fields of Art and Science, for example, technology, medicine, literature, linguistics and religion.

## **Technology Education In Kuwait**

The petroleum companies in the first stages of oil exploration organized training programs intended to prepare national highly skilled technicians for practising some of the professions that are necessary for implementing the activities related to exploration, extraction and exportation. This was done to enable them to participate alongside foreign experts brought by these companies. National manpower in those early days, specialized in administrative, supervisory and financial operations with only a small number of technical and engineering specialists.

The modern state stage includes the decades of the fifties and the sixties when development efforts were directed to urban planning and the modernization of the state's institutions and the formation of the modern administrative system, in addition to the modernization of the utilities and the public services. To these efforts was added the establishment of staff training centers. The Ministry of Education also established some specialized technical colleges, both commercial and industrial, in addition to the establishment of a number of technical institutes such as the Engineering Technology Institute and The Institute of TeleCommunications.

In the early seventies (1972), with the increase in the number of these colleges and institutes and their varied specialties, as well as the Training Centers, it was necessary for the state to establish a central Department (Department of Technical and Vocational Education) to supervise and coordinate these establishments. In addition, the Central Training Department was established to supervise the technical and professional training centers and colleges related to the other ministries. These two departments started their supervisory functions, and technical education and training started to expand considerably during the seventies as a response to the expansion in government spending. This development coincided with an increase in the demand for national and foreign manpower, which consolidated with the continuing expansion in technical education and its various specialties in Kuwait.

The development of technical and vocational education on one hand, and of training on the other, continued until the state felt it was necessary to establish an independent authority to supervise its output and plan its programs. As a result, the Public Authority for Applied Education and Training (PAAET) was established in Dec. 28, 1982.

In accordance with the decree of its establishment, PAAET is comprised of two sectors: Applied Education (formerly Technical and Vocational Education) and Training (formerly Central Training Department).

The activities and functions of the Authority can be classified into the following three main categories:

- The major activity of the Authority is the offering of applied education and training programs, with differing inputs, outputs and duration according to the requirements of each specialization. Such training is divided into two distinct sections:
  - a. Applied education programs are offered by the four colleges of the Authority and are supervised by the applied education sector

- b. The various and diversified training programs offered by PAAET training institutes and training centers are supervised by the training sector.
- The major administrative, financial and support functions of the Authority are centralized and are located at the Authority's headquarters.
- The Authority also participates in many additional activities which are aimed at providing an appropriate academic environment, raising the efficiency of educational and training operations, and strengthening the link between the labor market and institutions related to the main activities of the Authority. These include applied research activities and vocational development programs for the teaching and training staff.

### **Technology Education Institution (Before 1982)**

The technology education institutions before the establishment of the Public Authority of Applied Education and Training are stated in table 1. The Institute of Engineering Technology (IET) is one of these institutions. It was established in 1968 and it belonged to the Ministry of Public Works. It accepted Kuwaiti students who had obtained the General Certificate of Secondary Education after two years of study. Admission to this institute was stopped at the beginning of the academic year 1976/1977 when the Kuwait Institute For Technology was started. The degree that the IET gave was on associate degree, with graduates being or as called assistant civil engineer. The specialties of IET were in building, road, surveying and waste water.

### **Technology Education Institution (After 1982)**

Some of the technology education institutions changed after the establishment of the Public Authority of Applied Education and Training (PAAET). Some merged with others and some institutions were discontinued. PAAET is also responsible for many other colleges and institutes such as

- Basic Education College
- Business Studies College
- Health sciences college
- Industrial Institute

It also organizes tens of 1 year and 2 year training programs each year at the request of ministries and companies. The following is the list of the new structure of institutions.

### **Institute of Communications and Navigation (ICN):**

Institute of Communications and Navigation came about as a result of the integration of the Institute of Telecommunications, which was established in 1966, and the Air Navigation Institute, which was established in 1968. The Institute's objective is to train well-qualified technicians, who will be able to fulfill the nation's needs in technical specialties particularly associated with telecommunication and navigation. The institute provides the following programs, Navigation, Radio, External Plant, Computer and Switching.

### **Institute of Electricity and Water (IEW):**

The Institute of Electricity and Water was established in 1968, and it aims to provide a highly skilled technical workforce, capable of fulfilling the requirements of the Ministry of Water and Electricity, with particular reference to the operation of electrical power stations, water distillation plants, water pumps, operation of reverse osmosis units and the maintenance of electrical networks. IEW graduates are assistant engineers with a diploma (Associate Degree) in their specialty.

The Institute includes the following departments;

- The Department of Electrical Powers.
- The Department of Electrical Networks.
- The Department of Mechanical Powers.
- The Department of Water Resources.

### **Institute of Industrial Training (Subah Al-Salem);**

This Institute was established in 1992 in the Subah Al Salim Area. Its activity is based on preparing and graduating technicians in some professional specialty. The institute includes the following departments;

- The Automotive Department.
- The Electrical and A/C Department.
- The Material Department.
- The Construction Department.

### **College of Technological Studies (CTS)**

The Ministry of Education established the Kuwait Institute of Technology in 1976. Its name changed to Technical Studies College at the beginning of 1986 after the shifting of all the technology education to the new authority, PAAET. The aim of the college is to national highly skilled technical labor.

#### ***College Objectives and Study System***

- To provide a technically skilled labor force capable of fulfilling the requirements of industrial and technological enterprises.
- To provide secondary school graduates with an applied technological education, predicated on the needs of local industry

The college admits those holding the General Certificate of Secondary Education or its equivalent for a period of five semesters and one summer of field-training (two and half years). It is aimed at forming industrial technicians and its graduates are granted the Faculty's Diploma in one of the following specialties

- Automotive Engineering Technology
- Air-conditioning & Refrigeration Engineering Technology
- Biomedical Engineering Technology

	College	Starting Year	Ministry	Certificate Required	Study period (years)	Closing Year ©\ Merged Year (M)	Graduate Category or Degree
1	Industrial College	1952	Education	Eighth grade	4	1970 C	Technician Assistants
2	Institute of Agriculture	1968	Public Works	Secondary (12 grades)	2	1975 C	Associate Degree
3	Institute of Engineering Tech.	1968	Public Works	Secondary (12 grades)	2	1977 C	Associate Degree
4	Institute of Telecommunications	1966	Telecommunication	Secondary (12 grades)	2	1982 M	Associate Degree
5	Institute of Air Navigation	1969	Department of Civil Aviation	Secondary (12 grades)	2	1982 M	Associate Degree
6	Water Resources Development Center	1968	Electricity and Water	Secondary (12 grades)	2	1982 M	Associate Degree
7	Center of Construction and Road Works	1966	Public Works	Eighth grade	2	1977 C	Inspector
8	Fire Fighter School	-----	Municipality	Secondary (12 grades)	2	1982 C	Firemen
9	Center For Industrial Training	1968	Social Affairs	Eighth grade	2	Still open	Skilled Staff

**Table 1. The list of the Kuwaiti colleges and institutes with their data before 1982 (C=closed, M=Merged)**

- Chemical Engineering Technology (Petroleum Industries, Chemical Industries)
- Civil Engineering Technology (Building, Highway, surveying)
- Communication Engineering Technology
- Electrical Engineering Technology (Electrical machine, Transmission)
- Electronics Engineering Technology (Industrial)
- Heavy Equipment Engineering Technology
- Marine Engineering Technology
- Mechanical Power Engineering Technology
- Production Engineering Technology
- Welding Technology
- Physics Laboratories Technology
- Chemical Laboratories Technology

In general the study system, as with all other institutions and universities in Kuwait, follows the credit system. It comprises of five semesters during which the student must obtain 84 credits and successfully participate in a specified period of field training. CTS graduates are assistant engineers with a diploma (Associate Degree) in their specialty. The student should choose from four groups of courses. These groups are the basic science courses, the non-technical courses, the social and administrative courses (elective) and the major core courses (compulsory, elective).

The chemical engineering technology department and chemical industries major is chosen in this paper to be studied in detail. This department offers three sections: chemical industries, petroleum industries and petroleum (drilling). The country specializes heavily in petroleum drilling, petroleum refining, petrochemical and other chemical industries related to gas and oil.

The major chemical industries curriculum will be reported here. Table 1 shows the main compulsory major core courses that all students must take. Table 2 lists the compulsory basic courses which are required for all students in the college. Table 3 illustrates the non-technical courses, and these are required for all students in the college too. Furthermore, the general elective technical courses are shown in table 4. The students must take four credits from this group and eight credits from the other technical courses which the department offers them. Finally, the students are required to take courses from the social and administrative courses group offered.

Three two years colleges will be discussed and compared. These colleges are the Technical Studies College (TSC) in Kuwait, the Delaware Technical & Community College (DTCC) and the Erie Community College (ECC), both in USA. The mechanical power engineering technology in TSC and mechanical engineering technology (MET) in the other two colleges were chosen for this study. The total credit hours in TSC are 82, DTCC 79 and ECC 81. For the major technical courses, 64 credits are required in TSC, 44 credits in DTCC and 46 credits in ECC, as shown in table 3. This shows that the number of credits for the technical courses is higher in TSC than ECC and DTCC, by one third.

Courses	Credits
Organic Chemistry	4
Inorganic Chemistry	3
Physical Chemistry	3
Analytical Chemistry	2
Instrumental Analytical	2
Organic Technology	4
Inorganic Technology	4
Fertilizers	2
Polymers	2
Chemical Engineering Calculation	2
Thermodynamics	3
Unit Operation 1	4
Unit Operation 2	4
Measurement & Control	2

**Table 2. The main compulsory major core courses**

TSC offer more advanced thermofluid courses such as gas turbine, boilers & steam turbine and the theory of machines. However, some important basic courses are not included e.g. material science, static and mechanics of material. In the fluid mechanics courses (including the pump and compressor), eleven credits are required while there are no credits available for basic electrical, instrumentation or control. These courses are important for the MET graduates, especially the basic electrical. TSC offers an excellent program for field training where student can train in the industry. Students from three types of industry (Petroleum, power plants and engines workshops) should go for the field training. The student stay in each group for seven weeks to complete eight credit hours for the field-training, which is equivalent to 24 hours weekly. By the experience I got as the supervising student in the field training, the students enjoy this training and they are trained to work as a group, and to apply what they have learned in the college. Also, they can see the complicated equipment that is not available in the college, such the full-scale power plant steam turbines and boilers.

Eight credits or 24 contact hours are offered by TSC in practical training, where student can open, maintain and troubleshoot the mechanical equipment. Many workshops are available in the department, such as Petrol engine, diesel engine, pump and compressor, pipe and valves, steam power plants, A/C, welding and machining. The department has many laboratories for fluid mechanics, theory of machines, pumps & compressors, ICE, steam & gas power plant and A/C.

In the ECC, the program is designed more towards the manufacturing engineering technology. Also, the college offers good basic courses in electrical technology and instrumentation. However, the DTCC has a good complete program which contains more basic MET courses than the other two colleges. No field-training is offered by the American colleges, while ABET requires some credits for training. In addition, the students have no chance to see the equipment parts and how to maintain it in these two colleges.

Table 4 states the science courses that the three colleges offer. The TSC has a poor program for science, mathematics and computer while DTCC and ECC offer better programs. However, the secondary school program in Kuwait covers algebra, trigonometry and some of the calculus subjects such as differentiation and integration. Furthermore, the physics in secondary school covers many of the subjects usually offered in university physics. This may be the reason why the TSC offers less credit hours for science and mathematics. Finally, TSC offers less courses in social science, and oral and written communication. It should be noted that ABET require nine credits for the social and communication and sixteen credits in Mathematics and sciences.

## **Conclusion**

The history of the engineering technology in Kuwait is reviewed. This includes all the public technical institutes, colleges and education centers. These institutions belonged to several government authorities. Later on they were included in two departments, Department of Technical and Vocational Education and Central Training Department.

In 1982, the Public Authority for Applied Education and Training (PAAET) was established to centralize the technological education in the country. The authority's activities and functions have been considered. The College of Technological Studies is evaluated and details of one of the college departments (the chemical engineering technology) are discussed.

The curriculum in two American colleges and the technological studies college (TSC) are discussed in detail. More advanced technical courses are found in TSC program than the two American colleges. However, the program is missing some basic technical courses. Furthermore, poor programs in science, mathematics, social science and oral and writing communication are found in the TSC curriculum.

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DELAWARE TECHNICAL & COMMUNITY COLLEGE-USA	Units	ERIE COMMUNITY COLLEGE USA	Units	Technical Studies College Kuwait	Units
Introduction to MET	3	Technical Graphics I	2	Engineering Drawing	2
Engineering Graphics	4	Technical Graphics II	2	Applied Mechanics	2
Modern Manufacturing	3	Proc. Materials in Manufacturing	2	Theory of Machine 1	3
Advanced Manufacturing	3	Manufacturing Processes & Materials	2	Theory of Machine 2	2
Statics	3	Machine Tools I & Lab	2	Fluid Mechanics 1	2
Dynamics	3	Machine Tools II	2	Fluid Mechanics 2	3
Computer Applications	3	Analytical Mechanics	3	Pump & Compressor 1	3
Material Science	4	Introduction Computer Concepts in	2	Pump & Compressor 2	3
Strength of Materials	3	Computer Aided Drafting and Design	2	Thermodynamics	3
Fluid Mechanics	3	Geometric Dimensioning &	2	I.C.E 1 (Petrol Engines)	3
Fluid Power	3	Mechanics of Materials & Lab	4	I.C.E 2 (Diesel Engines)	3
Machine Design	3	Fluid Mechanics & Lab	3	Gas Turbine	2
Engineering Project	2	Applied Thermodynamics	3	Boilers & Steam Turbines	3
Electro-Mechanical Systems	4	Instrumentation & Lab	3	Fuel & Lubricants	1
		Basic Electricity for Mech. Equip	3	Maintenance 1 (Lecture)	2
		MET Elective	9	Maintenance 2 (Lecture)	1
				Workshop (Workshop)	2
				Practical Training 1 (Workshop)	2
				Practical Training 2 (Workshop)	2
				Practical Training 3 (Workshop)	2
				Field Training 1 (co-op)	3
				Field Training 2 (co-op)	5
				Technical Elective	4
				Mechanical Power Elective	6
Total credits 43	44	Total credits	46	Total credits	64

**Table 3. Comparison between the Technical Studies College and two similar colleges in USA (technical courses)**

<b>DELAWARE TECHNICAL &amp; COMMUNITY COLLEGE-USA</b>	<b>   Inite</b>	<b>ERIE COMMUNITY COLLEGE USA</b>	<b>   Inite</b>	<b>Technical Studies College Kuwait</b>	<b>   Inite</b>
Algebra & Trigonometry I	4	Technical Mathematics	4	Mathematics	2
Algebra & Trigonometry II	4	College Mathematics	4	Physics	2
Calculus I	4	Elements of Calculus with Tech. App.	4	Computers	1
Physics I	4	Technical Physics I	4		
Physics II	4	Technical Physics II	4		
Computer Applications	3	Introductory College Chemistry	4		
Total	23	Total	24	Total	5

**Table 4. Comparison between the Technical Studies College and two similar colleges in USA (Science courses)**

<b>DELAWARE TECHNICAL &amp; COMMUNITY COLLEGE-USA</b>	<b>   Inite</b>	<b>ERIE COMMUNITY COLLEGE USA</b>	<b>   Inite</b>	<b>Technical Studies College Kuwait</b>	<b>   Inite</b>
Composition	3	College Composition	3	Religion Culture	2
Technical Writing & Communication	3	Composition and Occupational Communication	3	English 1	3
Humanities Elective	3	Social Science Elective	3	English 2	2
Humanities Elective	3			Industrial Management	1
				Industrial Safety	1
				General Elective	4
Total	12	Total	9	Total	13

**Table 5. Comparison between the Technical Studies College and two similar colleges in USA (Non -technical courses)**