



A New Process in Engineering Education of Turkey: Biosystem Engineering

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Abstract Engineering education in Turkey had started in 1933, when the first University in Turkey was established. Institute of Machine and Electricity was formed at Istanbul University Faculty of Science. Following the initial process, different branches of engineering have been gradually included to engineering studies in Turkey. However, among those engineering disciplines, the first biosystem engineering departments were founded at Uludağ University, Kahramanmaraş Sütçü Imam University and Tokat Gaziosmanpaşa University in 2009. Biosystem engineering education is a discipline of engineering where engineering science and design are integrated with sciences of biology, environment and agriculture. Biosystem engineering in Turkey has started following a merger at the Faculty of Agriculture, between the Departments of Agricultural Structures and Irrigation and Agricultural Machines. Students of Biosystem Engineering Departments educated on developing land and water resources, land aggregation, agricultural structures, automation in agriculture, precision agriculture techniques, energy and machinery, mechanization applications in vegetative and livestock production and renewable energy resources. Biosystem Engineering has been structured under different faculties such as the Faculty of Agriculture, Faculty of Agricultural Sciences and Technology, Agricultural and Natural Sciences and Faculties of Engineering. Currently, there are 21 Universities providing education on Biosystem Engineering in Turkey. Among those universities, only 10 of them offer undergraduate degree, 8 universities offer graduate degree, while 6 universities offer doctorate degree. The very first Biosystem engineering department students in Turkey were graduated in 2013. Graduates are being employed at the Ministry of Food, Agriculture and Livestock, Ministry of Forestry and Water Affairs and Special Agricultural Institutions. A new process in the engineering studies, Biosystem Engineering Department is continuously raising the level of educational quality and its role within the engineering circles of Turkey is becoming more and more noticeable.

Keywords Engineering education, Biosystem, Turkey

Introduction

Education makes us see the fine sides of life. The joy of life is in its variety. In addition, one of the important advantages of receiving higher education is the opportunity to come together with people who have different interests, skills, opinions and beliefs. This way it becomes possible for someone to broaden his own horizon, reach new synthesis and comments. By receiving university education, a person's purpose should be to have a job that is mentally enjoyable and providing economic advantages, having a new lifestyle with an increased monthly income and social status, becoming a well-educated person, learning new things, increasing self-confidence, broadening horizons etc. [1]. Education starts with self-knowledge. The main purpose of education is for a person to be aware of and educate his own self [2]. Values such as the power of imagination, creating new ideas and originality display the productivity of human intelligence. The main difference nowadays, as we are flying towards the world of information, is right at his point [3]. The successful people of the future will have a productive mind, imagination, flexibility and a powerful vision [4].



Engineering is an occupation of developing methods to use natural power and resources for human benefit by observing sustainability principles and engineering ethics; also to use mathematics and natural sciences knowledge, acquired through education, experience and implementation [5]. According to another definition, an engineer is; “someone who has learned how to learn, conducts researches, produces knowledge, speaks foreign languages, is able to use technology, open to social sciences, questions his environment, is creative, productive, embraces the community, has quality awareness, does not ignore local values, is aware how valuable time is, has peace of mind, ethical values, is intellectual, believes in trade bodies and occupational organizations, and sensitive towards national professional problems” [6].

Even though the term “engineer” is being used in schools and titles in some countries, there are certain differences in the education programs. For instance, graduates of 5 year engineering schools are given the title “engineer” in France, but in England, related to technical areas, the titles of Professional Engineer, Technical Engineer, Engineering Technician, and Engineering Worker are being awarded [7]. In Turkey, Engineering Education started in 1933, within the body of Istanbul University Faculty of Science. In the following years, different Engineering education programs have been established in universities. The period of study of engineering faculties in Turkey is 4 years, and the graduates are awarded the title of “engineer”. Joining the engineering academic processes in Turkey in 2009, Biosystem Engineering has become operational through the merger of Agricultural Structures and Irrigation Departments and Agricultural Machinery Departments, available in many universities under the body of Agricultural Faculties. Going through a rapid academic structuring, Biosystem Engineering continues to school engineers who will be contributing to rural infrastructure works.

Education in Biosystem Engineering

The very first Biosystem engineering lectures started in Uludag University, Kahramanmaraş Sütçü İmam University and Gaziosmanpaşa University in the year 2009. This Engineering branch has been structured through the merger of Agricultural Structures and Irrigation Departments and Agricultural Machinery Departments under the Agricultural Faculties at some Universities. Biosystems Engineering Departments have been established in 4 different major fields, which are Land and Water Resources, Agricultural Structures, Agricultural Machinery Systems and Agricultural Power Systems. The major field structuring of Biosystem Engineering Departments has been given in Figure 1, while some of the work areas have been given in Table 1.

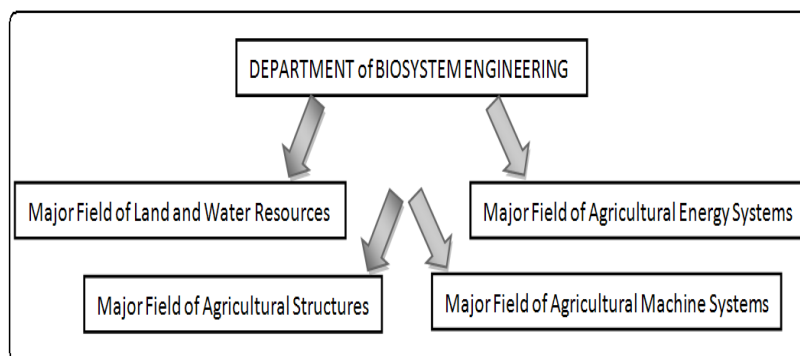


Figure 1: Academic structuring of Biosystem Engineering departments

Table 1: Some of the fields of expertise where Biosystem Engineering may be employed [8]

Areas of Expertise	
Field Measurements	Designing Irrigation Channel
Rural Infrastructure Works	Planning Rural Settlement Areas
Land Leveling Applications	Physical and Chemical Soil Analyses
Irrigation Water Quality Analyses	Designing Drinking and Utility Water Lines
Land Consolidation Works	Agricultural Machinery Systems R & D



Agricultural Meteorology Applications	Flood Protection Facilities and Stream Remediation Works
Designing Drip Irrigation Systems	Test and Evaluation of Agricultural Structure Materials
Using GPS and Satellite Technologies in Agriculture	Planning Surface Irrigation Methods in Agricultural Areas
Designing Centre Pivot Irrigation Systems	Waste Management and Biogas Production in Agriculture
Agricultural Structures Designing	Test and Evaluation of Agricultural Machinery Systems
Designing Agricultural Machine Systems	Installation and Designing of Fruit Gardens
Designing Renewable Energy Systems	Designing Soil Water Structures
Designing Landscape Irrigation Systems	Land Reclamation Works and Designing Drainage Systems
Designing Smart Greenhouse Facilities	Application of GPS Supported Precise Measuring Techniques
Usage of Machinery Systems in Farming etc.	

Education System Structure in Biosystem Engineering

Biosystem Engineering Education in Turkey has been structured in 21 Universities under 6 different faculties. This engineering branch has been structured under Faculties of Agriculture and Natural Sciences, Faculties of Agricultural Sciences and Technologies and Faculties of Engineering-Agriculture, Faculties of Engineering and Natural Sciences, and Faculties of Technology, and particularly under Faculties of Agriculture. In total, 10 Universities provide graduate, 8 Universities provide postgraduate and 6 Universities provide PhD programs.

In other universities Biosystem Engineering education has not started yet, but these universities are trying to meet the physical infrastructure and instructor needs. The language of education in all Biosystem Engineering departments is Turkish; however, in some faculties providing postgraduate education certain courses and thesis stage literature researches are given in English language. In Turkey, Biosystem Engineering education has been structured under different Faculties. Following the decisions taken by the universities, Undergraduate and Postgraduate education is being given in Biosystem Engineering Departments, structured under various faculties. In line with the decision taken by the Council of Higher Education, Biosystem Engineering Departments need to have three instructors, with a minimum title of PhD. Universities and Education Programs providing Biosystem Engineering education have been given in Table 2 per faculties.

Table 2: Faculty Types and Universities providing Biosystem Engineering Education [9]

The Name of Faculties and Universities	Undergraduated Program	MSc Program	PhD Program
Necmettin Erbakan University			
Faculty of Ereğli Engineering and Natural Sciences			
Nevşehir Hacı Bektaş Veli University			
Faculty of Engineering and Architecture			
Bozok University	1		
Faculty of Engineering and Architecture			
Ömer Halisdemir University			
Faculty of Agricultural Sciences and Technologies			
Bilecik Şeyh Edebali University			
Faculty of Agriculture and Natural Sciences			
Adıyaman University			
Technology Faculty			
Kahramanmaraş Sütçü İmam University			
Agriculture Faculty	1	1	1



Uludağ University Agriculture Faculty	1	1	1
Namık Kemal University Agriculture Faculty	1	1	1
Bingöl University Agriculture Faculty			
Mustafa Kemal University Agriculture Faculty	1	1	
Erciyes University Agriculture Faculty	1	1	1
Osmangazi University Agriculture Faculty			
Ordu University Agriculture Faculty			
Adnan Menderes University Agriculture Faculty	1	1	1
Iğdır University Agriculture Faculty	1	1	
Gaziosmanpaşa University Agriculture Faculty	1	1	1
Ahi Evran University Agriculture Faculty			
Siirt University Agriculture Faculty	1		
Yüzüncü Yıl University Agriculture Faculty			
Düzce University Faculty of Agriculture and Natural Sciences			
Total	10	8	6

Curriculum in Biosystem Engineering

Engineering graduate education level courses are grouped under 4 main categories, which are basic sciences and mathematics, engineering courses, specialized field courses, courses related to social sciences and social activities. Biosystem engineering education contains joint engineering course, which are very similar to each other. In Turkey, Biosystem Engineering Education is given in a period of 4 years, consisting of 8 semesters. Some of the courses given during the first two years in many universities have been given below in Table 3.

Table 3: Some of the courses given in Biosystem Engineering Education [8]

I. Period	III. Period
Basic Information Technology	Materials Science in Biosystem Engineering
Physics	Microbiology
Introduction to Biosystem Engineering	Soil Science and Plant Nutrition
Biology	Static
Chemistry-I	Engineering Mathematics
Mathematics-I	Horticulture
Atatürk's Principles and Revolutions-I	Precision Measurement Techniques in Engineering
Turkish Language-I	Elective Course-1
Foreign Language-I	
Common Elective Course- I	
II. Period	IV. Period
Chemistry-II	Statistics
Mathematics-II	Plant Physiology



Engineering Economy	Fluid Mechanics
Climate Information	Strength of Materials
Drafting	Field Crops
Atatürk's Principles and Revolutions-II	Engineering Topography
Turkish Language-II	Organic Farming Practices
Foreign Language-II	Elective Course-2
Common Elective Course- II	

During the first grade of Biosystem engineering education, Mathematics, Physics and Chemistry, as well social oriented classes are being given. In addition, Basic Climate Knowledge, Technical Drawing, and Engineering Economy classes are also being given. During the second year basic engineering classes, as well as agricultural science related classes are given. The farming related classes given during the second grade (3rd and 4th semesters) are basic courses such as Plant Physiology, Field Crops, Horticulture and Organic Farming Practices, and these courses focus on issues such as plant development and growing of plants.

All courses are application oriented, and educational processes continue within the limits of the university laboratory and application infrastructure possibilities. Some of the courses given under this engineering education during the 3rd and 4th years are given in Table 4. During the 3rd grade of this engineering education, the students are given courses under Soil and Water Resources, Agricultural Structures, Agricultural Energy Systems and Agricultural Machinery Systems. In relations with their fields of specialization, the students are being directed towards the areas they want to branch out. During the 3rd grade, the students are being given a total of 4 elective courses, while this figure is raised to 6 during the 4th grade. Some of the courses that may be elected by the students of this program have been given in Table 5.

Table 4: Some of the classes given in third and fourth grades in Biosystem Engineering in Turkey [8]

V. Period	VII. Period
Basic Principles of Irrigation	Design of Irrigation Systems
Agricultural Machinery	Waste Management and Bioprocesses
Renewable Energy Sources	Graduate Studies-I
Remote Sensing and Geographic Information Systems	Elective Course-7
Internship-I	Elective Course-8
Elective Course-3	Elective Course-9
Elective Course-4	
VI. Period	VIII. Period
Drainage and Land Reclamation	Rural Settlement and Land Consolidation
Automation in Biosystems Engineering	Project Preparation Technique
Planning of Agricultural Structures	Graduate Studies-II
Air Conditioning and Refrigeration in Agricultural Production	Elective Course-10
Internship-II	Elective Course-11
Training	Elective Course-12
Elective Course-5	
Elective Course-6	

Table 5: Some of the elective courses in Biosystem Engineering Departments [8]

Elective Course	Elective Course
Soil Water Structures	Irrigation in Landscape



Weeds and Control	Soil Mechanics
Planning Animal Shelter	Agricultural Tractor
Irrigation Networks and Operation Methods	Plant Protection Machinery
Sensitive Farming Technique	Harvesting and Threshing Machines
Power Systems and Equipment In Biosystem	Solar Energy Systems and Design
Hydrology	Greenhouse Production Technique
Design of Product Storage Building	Mechanization and Model Planning for Biosystems
Mechanization in Animal Production	Wind Energy Systems and Design
Water Quality and Salinity	Reinforced Concrete
Biogas Production Technology	Environmental Agricultural Policy
Drinking and Using Water Supply	Planning of Land and Water Resources
Processing Technology	

Students of this program can specialize by taking elective classes at the 3rd and 4th grades. For instance, students who would like to specialize on Land and Water Resources can get classes such as "Planning of Land and Water Resources", while students aspiring to specialize on Agricultural Mechanization can get elective courses such as "Harvesting and Threshing Machines". If the students would like to specialize on Agricultural Power Systems, they may elect to receive courses such as "Solar Energy Systems and Design", while those students aspiring to gain knowledge on Agricultural Structures, may choose to elect the course titled "Design of Product Storage Building". The students of this department are given the freedom to select the field they would like to specialize, and as such, they are entirely free when it comes to elect the courses they want to receive.

Physical Infrastructure and Laboratory Possibilities in Biosystem Engineering

New universities have been established in Turkey in 2006 and afterwards. Biosystem Engineering departments which have been included to the educational processes of universities established prior to 2008 do have the necessary laboratory infrastructure and research opportunities available, hence applied education can be provided. However, in Biosystem Engineering departments which have been structured within the universities established after the year 2006 do not have sufficient laboratory and research field opportunities as they are only new, however, such deficiencies go through a phase of improvement as these improve their facilities.

Sectors Where Graduates Can Work in Biosystem Engineering

The first Biosystem Engineering students in Turkey graduated in the year 2013. Students complete their study programs and graduate by being awarded the "Biosystem Engineer" title. Individuals graduating from this program can find employment at the Ministry of Forestry and Hydraulic Works, Ministry of Food, Agriculture and Livestock, Ministry of Environment and Urbanization, Municipalities, Universities and private sector. For the graduates to be able to work in public institutes, they need to sit the Public Personnel Selection Exam, which takes place once every 2 years in Turkey, and get a valid degree. With the points they achieve, they can be appointed to the public sector as an engineer, depending on the number of vacancies offered by the related institution.

Graduates of Biosystem Engineering departments can also serve as academic personnel at the universities, by submitting their applications to the research assistant vacancies offered by universities at certain periods. To do this, they need achieve an acceptable degree from the foreign languages exam, and they also need to document that they have achieved 70 points from the Academic Postgraduate Education Exam. Biosystem engineers desiring to be employed in private sector can apply to be interviewed by the private sector offering vacancies related to their specialty, and inform them about their experiences.

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