

# Department of Petroleum and Natural Gas Engineering

## 1. Program Modes

An academic year at Istanbul Technical University (ITU) consists of two regular semesters and a summer school. The Petroleum and Natural Gas Engineering (PNGE) program is offered only through daytime classes in the fall and spring semesters. An academic semester involves 14 weeks of classes, excluding final examinations. The only alternative mode in use is a few freshmen, sophomore, and junior level non-departmental courses offered during summer school. In addition, summer practice in public and/or private companies for a minimum of 60 calendar days is required to graduate.

## 2. Students

Students are evaluated, advised, and monitored to assess the success of the program in meeting its educational objectives. The means to satisfy these goals are explained below.

### 2.1 Admission to the Program

Admission of undergraduate students to the department is administered through a central examination system organized by the "Student Selection and Placement Center" (ÖSYM). Approximately over 1.8 million high school graduates take the ÖSYM exam every year. Students are placed in a higher education program according to their list of preference, their high school GPA, and their score on ÖSYM exam. Students admitted to the PNGE program are within upper 1.3% of all students taking the exam. Each year approximately 10 international students are also accepted to the PNGE program through the "Foreign Student Examination" given also by ÖSYM.

To attract students with higher qualifications, members of PNGE faculty visit major high schools and learning centers to inform the candidates about the petroleum and natural gas engineering and the department's facilities. The PNGE department participates also twice a year to the workshops organized by ITU aiming to introduce the engineering programs and facilities to the candidates. The department's web site ([www.petrol.itu.edu.tr](http://www.petrol.itu.edu.tr)) provides detailed information to the interested candidates and/or applicants, and the e-mail address ([pdgmb@itu.edu.tr](mailto:pdgmb@itu.edu.tr)) is also available for further communications.

## **2.2 Evaluation System**

The evaluation of the student's success is achieved by several means. The class grades are one of the most important inputs for the student's evaluation. The students are also required to complete their summer practices in selected institutions and companies at the end of their second and third years. The performance of each student during the summer practice is evaluated by the company. Each student is required to prepare his/her summer practice report in a predetermined format. First the student's advisor and, then, the department coordinator in the summer practice committee evaluate each student's summer practice report.

The students' academic standing is recorded in a database and continuously monitored at the Registrar's Office. A minimum cumulative grade point average (CGPA) of 2.00 out of 4.00 is required for graduation. Students with a semester grade point average (GPA) above 3.00 are awarded with an honor degree whereas highly successful students with a GPA above 3.50 receive high honors. Students with unsatisfactory performance (having a GPA between 1.80 and 2.00) may register for new courses conditionally, but they have to improve their GPA to 2.00 to continue the program. Those with a GPA below 1.80, however, are regarded as "probation" students and can only register for the courses they have previously taken. Being a probation student for three consecutive semesters results in dismissal from the program. Details of the University regulations about assessment, grades, grade point averages, probation, and dismissal are explained in Articles 10 to 28 in the ITU Undergraduate Academic Regulations. An outline of these rules and regulations are given to all freshman students during the orientation week. This information is also available in the ITU web site at (<http://www.sis.itu.edu.tr/yonetmelik/yonetmelik.html>).

## **2.3 Advising System**

The orientation sessions for incoming students are scheduled in the first week of the fall semester. The orientation program introduces the faculty members to the students, explains the degree requirements of the program, and provides visits to the laboratories, libraries, and other facilities. All freshmen going through the orientation program are encouraged to meet with their student advisors. Once assigned, a student retains the same advisor for the duration of his/her program at ITU. These permanent student advisors are assigned based on a formulation involving the initial registration year of the student. Each PNGE faculty member advises about 20 students.

The advisors meet with the students, whenever a need arises, to diagnose and help to solve their problems associated with the courses, procedures, and campus life. Students are

encouraged to meet with their advisors at least twice per semester. Before registration, students are advised to contact his/her advisor on making decision on course selection. Add, drop, and withdrawal of courses after the registration must be accomplished under advisor's supervision. The advisor's involvement is carried out by the internet-based "Automation Course Registration System" (ACRS) with respect to prerequisites, course sequence, course load, CGPA, and similar issues.

Additional assistance is always available through the Registrar's Office (Office of Student Affairs). Office of the department head is also available for advising purposes. Student petitions and problems are handled through the Department Head or the Dean of Faculty of Mines, depending on the type of concerns.

The sophomore, junior, and senior students are advised about the contents of the technical elective courses offered by the department. The information about those courses and the procedures are available in department's web page.

The course program for the department is publicly available and easily accessed through the ITU's web page. Based on the PNGE basic-level curriculum after 1996 the distribution of semester credit hours for the course groups is presented in **Table 1**.

**Table 1** - Distribution of credit hours for different course groups for the B.Sc.-degree program at ITU.

	Credit Hours
Math&Basic Sciences	49
Engineering Topics	69
General Education	32
Other	1

As Table 1 shows, a total of 151 semester credit hours are required for the B.Sc. degree. At least 30 % of the course load in the program must be given in English.

The department advises a wide selection of courses offered at ITU for the elective course category in order for students to orient their personnel professional development. This list is updated at the beginning of each semester and is available in the web page, as well as on the bulletin boards of the department.

## **2.4 Monitoring System**

A regular student is expected to complete the curriculum in four years under normal circumstances. When changes are made in the curriculum due to the addition or withdrawal of a particular course, the program is renewed, announced, and applied. Students' programs are individually reviewed and adjusted so that they are not penalized by these changes.

Each student has an active log file of up-to-date "Academic Record Form", containing current course schedule, transcript, and contact information that is monitored by the student advisors through the ACRS. In addition, summer practice reports of the students are controlled and approved by the faculty in charge at the department, and the results are sent to the ACRS. Grades are posted on the academic record forms each semester. The students who appear to be having grade problems are called in to discuss their status with their advisors.

At the beginning of their final semester before graduation, Registrar's Office reviews the entire academic record of the students to examine if all of the criteria have been satisfied by the student before graduation. The number of required and elective courses, status of the summer practice, total credit hours, and cumulative GPA for each student are checked. Any difference from prescribed curriculum requirements, such as replacement of a course with another or transfer credits for courses taken from other departments, must be petitioned for. These petitions are first approved by the department and then considered by the Academic Committee of the Faculty of Mines. Some petitions concerning matters beyond (responsibility and control of) the PNGE Department require approval of the "Administrative Board of the Faculty of Mines."

## **2.5 Transfer Students**

The Dean's Office of the Faculty of Mines coordinates the acceptance of transfer students, and the Administrative Board of the Faculty of Mines makes the final decision. The role of the department is to supply expert opinion about the quality of the program and the institution from which the student is applying for transfer. Validating credits for the courses taken in another institution are also coordinated by the Dean's Office. The department supplies expert opinion regarding the contents and the quality of the transfer courses.

Students enrolled in other universities and wishing to transfer to the degree programs of ITU must have a CGPA of at least 2.0 out of 4.0. The students must also have a good academic and disciplinary record at the previously attended institutions. Registrar's office lists the applicants according to their academic achievements (CGPA + ÖSYM score). A transfer student's eligibility for admission is decided by the Faculty Administrative Board. Transfer

credits are evaluated by the Faculty Administrative Committee and some of the transfer students may be rejected. Grades taken from another institution are indicated as “waved” on their ITU transcripts. Internal transfers from one ITU program to another are also allowed, and the same rules for external transfers are applied.

### **3. Program Educational Objectives**

#### **3.1 Program Educational Objectives and Their Relation to the Mission**

The mission of the department is “to provide undergraduate and graduate level engineers, conduct research, and serve for the petroleum and natural gas industry and its relevant sectors worldwide, and to contribute for the sustainable development of the nation and for the commonalty in the utilization of subsurface energy resources.”

The Program Educational Objectives are

1. to provide basic and applied knowledge in petroleum and natural gas engineering with the emphasis on the areas of drilling, production, and reservoir based on mathematics, physics, thermodynamics and engineering sciences;
2. to educate students in engineering applications of technology and science (emphasized on up-stream and down-stream parts of the industry that include transportation and marketing), conducting experiment and system design, analyzing and interpreting data, formulating and solving problems while considering efficiency and optimization;
3. to develop non-technical abilities of students in professional competency on legal, political, and social issues;
4. to develop students’ abilities in resource valuation and management, entrepreneurship, commitment to public health, safety, and environment while considering the economics under the conditions of risk and uncertainty;
5. to improve the personal skills of students in oral and written communications, multidisciplinary team-work, analytical thinking and creativity, leadership and decision making with the discernment of professional ethics, and life long learning.

These objectives have been formulated so that they are consistent with the mission of Istanbul Technical University and that of the department. The program educational objectives, intended to be acquired and/or developed by students, are achieved through several strategies that are implemented in various courses and training practices.

Although not mentioned explicitly in the objectives, the geothermal engineering topics and problems are also covered and taught in the program.

The first Program Educational Objective establishes the importance of essential education for innovative problem solving capability. Such capability requires the acquisition of basic knowledge in mathematics, basic sciences, geo-sciences, and engineering sciences. This objective aims at establishing the essential elements that are required for the further development of students in the petroleum and natural gas engineering education.

The second Program Educational Objective points out the engineering application of technology and science to be covered in petroleum and natural gas engineering program.

The appreciation of the legal, political, and social aspects is outlined in the third Program Educational Objective covers the non-technical issues.

The fourth Program Educational Objective exhibits the department's approach to the resource management, enterprise establishment, and global and social concerns in terms of economics, health, safety, and environment.

The fifth Program Educational Objective is formulated to develop the students' skills in team work, written and oral communications as well as in life long learning and professional ethics that are essential for a successful career in petroleum and natural gas engineering profession.

### **3.2 Significant Constituencies**

To formulate and establish program educational objectives, feedback information from the following constituencies is used in the evaluation of the program:

- a. Faculty
- b. Students
- c. New graduates
- d. Alumni
- e. Industrial Advisory Board
- f. Employers
- g. Petroleum and natural gas engineering departments in other universities, particularly in the U.S.
- h. The Chamber of Petroleum Engineers of Turkey

- i. Other departments within the body of the Faculty of Mines at ITU with disciplines close to Petroleum and Natural Gas Engineering (e.g. Mining Engineering, Geological Engineering, Geophysical Engineering)
- j. Colleagues in administrative positions in the state and private industries

Faculty members are directly involved within the evaluation and assessment mechanisms.

Students form one of the major and essential components of the program evaluation as they are continuously involved in the evaluation process.

New graduates provide feedback for the overall performance of the educational program, which they have already completed.

Alumni provide feedback for the long-term progress of the program.

Input from industrial advisory board is a valuable tool to measure the achievement of the educational objectives.

Employers, who are in close contact with our graduates, are in the best position to evaluate the quality and success of our program educational objectives.

The feedback in the form of knowledge and experience exchange from the other petroleum and natural gas engineering departments is considered to be a valuable input for the reforming and evaluation mechanism.

The Chamber of Petroleum Engineers of Turkey is a professional institution that deals with the profession's global and social aspects; hence, its feedback is important.

Information from the related disciplines (Geological Engineering, Mining Engineering, and Geophysical Engineering) is also incorporated in the process through the discussion during the Administrative and Faculty Boards of Faculty of Mines.

The colleagues at administrative and supervising positions in the state and private industries would evaluate the educational program from a global viewpoint.

Several sets of questionnaires have been used to perform surveys among these constituencies for the mission, program educational objectives, course applications, laboratory and classroom efficiencies, as well as the department's program as a whole.

### **3.3 SPE I-Tech Student Chapter**

Students are encouraged to participate in various ongoing technical and social activities, as well as to become a member of the Society of Petroleum Engineers (SPE) Student Chapter at the department, namely SPE I-Tech. Student members of SPE I-Tech become student members of SPE, receive monthly Journal of Petroleum Technology (JPT), and take the advantages of buying SPE publications in reduced rate, and have an SPE mail address for internet communications. In addition to all these opportunities, students have access to SPE e-library, which is an excellent source to develop their competency in petroleum and natural gas engineering areas as stated by the program objectives. Members also attend the seminars given by SPE's distinguished lecturers and participate in the trips to selected oil, natural gas, and geothermal fields in Turkey.

## **4. Facilities**

The department is located in the building of Faculty of Mines. The total space used by PNGE department is 800 m<sup>2</sup> of which 322 m<sup>2</sup> are occupied by laboratories, 278 m<sup>2</sup> by offices, 123 m<sup>2</sup> by classrooms and 92 m<sup>2</sup> by a library.

All of the PNGE courses and some service courses, such as Engineering Sciences (ES) are scheduled in the classrooms within the building of the Faculty of Mines. One classroom and one conference room of the Faculty of Mines building are allocated to the PNGE Department. The classroom and conference room are equipped with overhead projectors and projection screens as other classrooms of the Faculty. PNGE conference room is also used as classroom for graduate courses. An LCD projector system for this room is provided by the faculty whenever is necessary. Faculty of Mines building also has a large conference room with 140 seat capacity which is equipped with state of art video and computer display systems including overhead projector and screen.

Besides the computing facilities provided by the university, the PNGE Department provides a computer laboratory equipped with some commercial simulators (Pipeworks, Eclipse, Sapphire and Though II) for the students' use.



The department has several laboratories. They are being updated, as the funds become available. Some of these laboratories are not used only for courses related to this program, but also for graduate courses and research purposes. Our experimental laboratories are equipped with the health and safety equipment. A detailed health and safety manual is available for all students as well as for the entire department personnel. The rock and fluid property laboratories have insufficient ventilation. The first aid kit is located in a central location.

The department has a workshop with necessary equipment to work on repair of some facilities. The workshop has also core cutting devices to prepare taps for displacement experiments. Two faculty members are in charge of laboratories to keep them operational and well maintained.

All laboratories, with the exception of water analysis and simulation laboratories, are associated with required undergraduate courses. Thus it is assured that all graduates have had hands-on experience on the operation of petroleum and natural gas engineering laboratory equipment and basic experimental techniques.

#### **4.1 Drilling Fluids Laboratory**

The foremost objectives of drilling fluids laboratory as a part of PET 322 – Drilling Laboratory course are to inform students about (1) the primary functions of the drilling fluids, (2) the test procedures used to determine whether the drilling fluid has suitable properties to perform these functions, (3) the common additives used to obtain the desirable properties under various well conditions, (4) the main factors governing the selection of drilling fluids, (5) the ecological and environmental considerations, and (6) the basic objective of drilling fluid optimization. Another important objective is to familiarize the students with the laboratory and equipment, including demonstrations of equipment, setup, care and maintenance instructions.

#### **4.2 Rock Properties Laboratory**

The main objective of rock properties laboratory, as a part of PET 321 and PET 492 courses, is to provide the undergraduate students to develop the ability of conducting the experiments to determine on some physical properties of rocks. The laboratory is equipped with the necessary facilities to conduct experiments on measuring the fundamental transport properties of rocks needed in reservoir studies. The students gain a good understanding of experimental techniques, analytical thinking, data analysis, and calculation methods. The students improve their ability in written and oral communications as well as in teamwork.

#### **4.3 Fluid Properties Laboratory**

The main objective of fluid properties laboratory, as a part of PET 321 and PET 492 courses, is to provide the students to develop the ability in conducting the experiments on some physical and thermodynamical properties of fluids. The laboratory is equipped with the necessary facilities to conduct experiments on measuring the fundamental properties of fluids used in reservoir studies. The students gain an understanding of experimental techniques, analytical thinking and visualization of phase behavior, the data analysis, and calculation methods. The students improve their ability in written and oral communications as well as in team work.

#### **4.4 Water Analysis Laboratory**

The main objective of this laboratory, as a part of PET 321 and PET 492 courses, is to provide the students to develop the ability in conducting the experiments to determine some properties. Water samples taken from oil and geothermal fields are analyzed in this laboratory. Complete cations and anions are determined.

#### **4.5 Simulation Laboratory**

This laboratory is used for research subject to PET 492 and partially in PET 417 and 428. In the simulation laboratory there are four Windows based and two UNIX based computers. In addition, a A0-size plotter is available. Those computers are suitable for studying reservoir simulation, production, drilling, and well logging problems. Some commercial software is installed on those computers such as Pipe Works for gas-pipe networks design, Eclipse and Saphir for reservoir simulation and well test analysis, and Though II for geothermal reservoir modeling.

#### **4.6 Displacement Laboratory**

The displacement laboratory is maintained to serve for search purposes and for flow through porous media and displacement experiments in PET 321 and 492.

#### **4.7 Project Office**

For research, industrial projects, and student training, the department has a project office equipped with two computers, one printer and adequate furniture.

#### **4.8. SPE e-library**

The department provides access to SPE e-library, which is an excellent source to develop faculty and students competency in petroleum and natural gas engineering areas as stated by the program objectives.

#### **5. Program Criteria**

ABET Criterion 8 requires that the Program Criteria for Petroleum and Similarly Named Engineering Programs must be satisfied. This particular criterion, in turn, requires demonstration that the graduates have competency in the following areas:

- Mathematics through differential equations: PNGE curriculum contains a course on differential equations (MAT 201). In various other courses in the program, applications of differential equations are also covered.
- Probability and statistics: This requirement is satisfied with MAT 271 (Probability and Statistics).
- Fluid mechanics: A second year course, coded AKM 204 provides the necessary background. Other courses such as PET 311 E, 312, 321, 331, and 332 further emphasize this topic.
- Strength of materials: STA 204 satisfies this requirement.
- Thermodynamics: TER 201, PET 311 E, and PET 312 provide the necessary competency.
- Design and analysis of well systems and procedures for drilling and completing wells: PET 331, 437, and 336 satisfy these requirements.
- Characterization and evaluation of subsurface geological formations and their resources using geoscientific and engineering methods: This requirement is satisfied with PET 211 E, 212 E, 341 E, 417, 421, 428 E, and 467.
- Design and analysis of systems for producing, injection and handling fluids: This is satisfied with PET 322, 332, 427, 431 E, 438, 441 E, and 468.

- Application of reservoir engineering principles and practices for optimizing resource development and management: PET 342 E, 431 E, 467, 428 and 316 satisfy these requirements.
- Use of project economics and resource valuation methods for design and decision-making under conditions of risk and uncertainty: This requirement is satisfied with PET 331, 411, 412, 487 E, and 492.