Research and Education in Istanbul Technical University (ITU)

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TURKEY
A SHORT HISTORY OF ITU

- ITU was established in 1773 during the time of the Ottoman Empire
  - Its original name was The Royal School of Naval Engineering.
  - Its responsibility was to educate chart masters and ship builders.
  - In 1795, The Royal School of Military Engineering was established to educate the technical staff in the army.

- ITU gained the university status in 1928 after the Republic of Turkey founded in 1923.
  - In 1946, ITU became an autonomous university which included the Faculties of Architecture, Civil Engineering, Mechanical Engineering, Electrical and Electronic Engineering.
A SHORT HISTORY OF ITU

- ITU is strongly identified with architectural and engineering education in Turkey.
- Since its inception and foundation under Ottoman rule, ITU has constantly lead the way in reform movements, and in the latter era of the Republic of Turkey.
- ITU has assumed pivotal roles in the reconstruction, modernization, and administration of the country.
- ITU is a state university which defines and continues to update methods of engineering and architecture in Turkey.
CAMPUSES – Main campus

- Of ITU’s five campuses, the main campus is located at Ayazaga, a recently developed business area.
- The reactor’s office and administrative offices are situated on this campus.
- Faculties of: Civil Engineering, Electric and Electronic Engineering, Chemical and Metallurgical Engineering, Mining, Science and Letters, Aeronautics, and Naval Architecture and Ocean Engineering are all on the main campus which extends over an area of 247 hectares.
- Of the five institutes ITU has, four are located on this campus.
CAMPUSES – Main Campus
CAMPUSES
Gumussuyu, Macka and Taskisla campuses are located in the city center.

The campuses at Gumussuyu and Taskisla are both in the Taksim area which has served as the trade and cultural center since the 19th century.

The Faculty of Mechanical Engineering is located on the Gumussuyu campus.

The Faculty of Architecture, the Social Sciences Institute are located on the Taskisla Campus.

The Faculty of Management, the Department of Languages and History of Ataturk Reforms, the Turkish Music State Conservatory are located on the Macka campus.
CAMPUSES

- The Maritime Faculty is located on the Tuzla campus with an area of 16.5 hectares.

- The fully equipped Maritime training pools is on this campus and the ITU Mediterranean Ship is anchored in this campus harbour.
TUZLA CAMPUS
EDUCATION IN ITU

- While developing Turkish as the language of science, ITU also emphasized the importance of compulsory English preparatory classes and 30% of classes are conducted in English.

- Students who pass the Foreign Language Placement Test start their academic program directly while students who do not pass attend the compulsory preparatory program for one or two semesters depending on their level of English.
ITU has reorganized its undergraduate program with the following guidelines in order to educate its students as innovative, technology literate individuals equipped with the necessary learning tools and a broad background:

- Total credits 153,
- 25% of the total credits to be fulfilled with Basic Sciences courses,
- 20% of the total credits to be fulfilled with Basic Engineering courses,
EDUCATION IN ITU

- 20% of the total credits to be fulfilled with Social Sciences courses,

- 25%-35% of the total credits to be fulfilled with Vocational or Vocatian Oriented Design courses,

- At least 17% of the total credits to be fulfilled with Elective and Compulsory courses.
Double Major Program

- Those students who complete all their attempted course with a GPA of at least 3.0, can apply to the Double Major Program, both in their own faculty and the faculty where they want to do the Double Major, one month before the beginning of their third semester with the approval of the advisor. Double Major students can graduate from both departments if they succeed.
Internal Transfer

Istanbul Technical University offers its students the opportunity to make internal transfers. If successful, ITU students can make an internal transfer to the program of their choice provided the quotas allow it. The ordering is done according to students' GPA.

Academic Year

The academic year consists of fall and winter semesters and a summer program. A semester normally lasts fourteen weeks. Courses are all designed to last a semester. The academic calendar is determined by the University Senate every year. Education covers classes, practise, projects, studio work, lab work, seminars, and theses. It also covers both compulsory and the elective courses.
EDUCATION IN ITU

Accreditation

- As part of the globalization process and the European Union's integration policies, universities need constant renewal, updating and versatility. The objectives, inputs and outputs of education programs and methods used in reaching those objectives need to be revised periodically in our day and age. In order to realize this, the ITU administration started the process of international accreditation for all its departments. In this context, important investments have been made not only in the contents but also in the educational technologies to enhance the quality of the educational environment. ITU understands the importance of the principle of separate supervising and supervised bodies and the autonomy of the supervising body.
HYDROELASTICITY RESEARCH GROUP

- Developing a general 3D hydroelasticity method
- Experimental studies; modal analysis, operational modal analysis, vibration measurements
- Outcomes are reported in *Journal of Sound and Vibration*, *Journal of Fluids and Structures*, *Journal of Ship Research*, etc.
- Research Projects founded by *Technical Research Council of Turkey*
**AN EXAMPLE SHIP OPTIMIZATION PROBLEM**

<table>
<thead>
<tr>
<th>GA Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population size</td>
<td>30</td>
</tr>
<tr>
<td>Representation</td>
<td>Binary</td>
</tr>
<tr>
<td>Selection strategy</td>
<td>Deterministic Tournament</td>
</tr>
<tr>
<td>Crossover Rate</td>
<td>60%</td>
</tr>
<tr>
<td>Mutation Rate</td>
<td>40%</td>
</tr>
<tr>
<td>Survival Selection</td>
<td>Elitist with 1 individual</td>
</tr>
</tbody>
</table>

**Intervals for parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>pt</th>
<th>nos</th>
<th>swl</th>
<th>swt</th>
<th>sfl</th>
<th>sft</th>
<th>nof</th>
<th>fwl</th>
<th>fwt</th>
<th>ffl</th>
<th>fft</th>
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</thead>
<tbody>
<tr>
<td>Lower limit</td>
<td>0.004</td>
<td>2</td>
<td>0.05</td>
<td>0.004</td>
<td>0.03</td>
<td>0.004</td>
<td>1</td>
<td>0.25</td>
<td>0.004</td>
<td>0.1</td>
<td>0.004</td>
</tr>
<tr>
<td>Upper limit</td>
<td>0.03</td>
<td>10</td>
<td>0.22</td>
<td>0.02</td>
<td>0.15</td>
<td>0.02</td>
<td>4</td>
<td>0.6</td>
<td>0.03</td>
<td>0.4</td>
<td>0.03</td>
</tr>
</tbody>
</table>

**Comparison of Initial and Final Designs**

<table>
<thead>
<tr>
<th>Design</th>
<th>Weight [ton]</th>
<th>Equivalent Stress (von Mises) [N/mm²]</th>
<th>Critical Buckling Load [N/m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>4.775</td>
<td>9.467E+07</td>
<td>7.96E+05</td>
</tr>
<tr>
<td>Final</td>
<td>4.105</td>
<td>9.40E+07</td>
<td>8.12E+05</td>
</tr>
</tbody>
</table>

May 21, 2009  Yokohama Japan
NOx Emissions Limits for Ships
IMO-MARPOL 73/78/97 Annex 6
(Professor Selma Ergin)

\[ \text{NO}_x \text{ (g/kWh)} = 17 \times \frac{1}{\text{rpm}^{0.2}} \]
\[ = \begin{cases} 45 & \text{rpm} < 130 \\ 9.8 & 130 \leq \text{rpm} < 2000 \\ \text{rpm} \geq 2000 \end{cases} \]

The “IMO curve”

Test Procedure according to IMO NO\textsubscript{x} Technical Code
Reference Fuel: Marine Diesel Oil
Implementation: New Ships from 1.1.2000
NOx EMISSION CONTROL SYSTEM

- An Emission Control System (ECS), which is based on the continuous water injection into the charge air, was developed for the reduction of NOx emissions from the marine diesel engines. The ECS comprises of a humidification vessel and its control unit.

- The ECS was installed into a medium speed diesel engine in a general cargo ship and tested under various speed and load conditions.
The Humidification Vessel
The Control System
EFFICIENCY OF DEVELOPED SYSTEM

- By using the measured NO$_x$ concentration values, the averaged NO$_x$ emissions were calculated in accordance with the international standards (IMO, 1997; International Organisation of Standardisation, 1996).

- The calculated NO$_x$ emissions were 6.1 g/kWh$^{-1}$ and 19.8 g/kWh$^{-1}$ for the engine equipped with and without the ECS, respectively. Namely, the reduction of NOx emissions was found to be about 70%.

- The NOx emission of 6.1 g/kWh$^{-1}$ is well below the permissible value of 13.8 g/kWh$^{-1}$ given in (IMO, 1997) for this type of engines.
ECS Sisteminin şematik resmi
SHIP EQUIPED WITH NOx EMISSION CONTROL SYSTEM
RESEARCH ON PROPELLER RELATED ISSUES

Pressure contours on pod and strut with the effect of propeller.

J = 0.5

Thrust coefficient values of propeller with the effects of pod and strut.

ISTANBUL TECHNICAL UNIVERSITY

May 21, 2009 Yokohama Japan
Numerical Results - Propeller with the effect of pod

Pressure contours for suction side, $J = 0.8$.

Pressure contours for pressure side, $J = 0.8$. 
ISTANBUL - HAYDARPASA TRAIN STATION AND FERY TERMINAL

May 21, 2009  Yokohama Japan  ergina@ltu.edu.tr