

**Notre Dame University  
Faculty of Engineering  
Mechanical Engineering Department**

**Annual Report**

**Academic Year 2007-2008**

**July 2008**

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## 1. Introduction

The Mechanical Engineering Department at Notre Dame University, Lebanon, is striving to graduate mechanical engineers able to cope with all challenging issues that normal engineers may face in nowadays societies. The challenges are not only technical, for which our graduates are well prepared, but also societal and, in this respect, ME graduates have the luggage necessary to help them move forward. To achieve that goal, the ME program at NDU involves a balance between not only theoretical and practical issues, but also between technical and non-technical or cultural aspects.

ME students at NDU are served by a group of devoted faculty members, both full-timers and part-timers, spending their time to guide them in all their expectations. Moreover, the university offers them state-of-the-art laboratories, which are under continuous upgrade. The program is also continuously updated to include the latest ideas related to engineering education in order to offer an up-to-date degree in mechanical engineering.

## 2. Personnel

### 2.1 Full-Time Faculty

- **Walid Assaf**, Professor, Ph.D., Nuclear Engineering, 1965, Iowa State University (USA). *Areas of interest:* Thermodynamics, Energy.
- **Michel El Hayek**, Associate Professor & Chairperson, Docteur Européen, Sciences Appliquées, 1997, Faculté Polytechniques de Mons (Belgium). *Areas of interest:* Fluid Mechanics, Heat Transfer, Numerical Techniques.
- **Ghazi Asmar**, Assistant Professor, Ph.D., Mechanical and Aerospace Engineering, 1997, University of Missouri, Columbia (USA). *Areas of interest:* Mechanics of Materials, Vibrations, Numerical Techniques.
- **Francis Francis**, Assistant Professor, Ph.D., Mechanical and Manufacturing Engineering, 2003, University of New South Wales (Australia). *Areas of interest:* Materials Science, Manufacturing.

### 2.2 Part-Time Faculty

- **Tony Jabbour**, Ph.D., Mechanical Engineering, 1998, Ecole Polytechnique de Montréal (Canada). *Areas of interest:* Mechanical Design, Machinery, CAD/CAM.
- **Ali Hammoud**, Ph.D., Mechanical Engineering, 1990, University of Wales, Swansea (UK). *Areas of interest:* Applied Fluid Mechanics, HVAC.
- **Mohamad-Farid Khalil**, Ph.D., Mechanical Engineering, 1995, University of Alexandria (Egypt). *Areas of interest:* Fluid Mechanics.

- **Gaby Nehme**, Ph.D., Materials Science and Engineering, 2004, University of Texas at Arlington (USA). *Areas of interest:* Materials Science, Tribology.
- **Nagib Metni**, Docteur, Automatique et Traitement du Signal et des Images, 2006, Université de Nice, Sophia-Antipolis (France). *Areas of interest:* Control, Mechatronics.
- **Samir Traboulsi**, ME, Mechanical Engineering, 20--, American University of Beirut (Lebanon). *Areas of interest:* Air-Conditioning.
- **Gaby Bachour**, B.S., Architecture, 1960, American University of Beirut (Lebanon), *Areas of interest:* Drafting.

### 2.3 Full-Time Co-Academics

- **Wissam Daou**, B.E., Mechanical Engineering, 2000, Notre Dame University (Lebanon), Laboratory Instructor.

### 2.4 Full-Time Non Academics

- **Maroun Eid**, Laboratory Technician.

## 3. Promotions & Faculty Development

- Dr. Ghazi Asmar has been promoted to the rank of associate professor in the mechanical engineering department at NDU effective October 1, 2008. Dr. Asmar received his BS in Civil Engineering from the University of Washington in 1989, his MS in Mechanical and Aerospace Engineering in 1993 and his PhD in 1998, both from the University of Missouri-Columbia. He worked as project engineer till 1991 when he decided to follow graduate studies. He joined NDU in 1999 as assistant professor in mechanical engineering. Dr. Asmar is credited for many refereed publications related to his areas of interest.
- Dr. M. El Hayek received a “Certified Online Instructor” certificate in April 2007 after having successfully completed a training course on online instruction in January-March 2007 offered by Madonna University (USA) and Notre Dame University (Lebanon).

## 4. Statistics

Various statistics are given in this section to show the overall characteristics and performance of the mechanical engineering program at NDU.

#### 4.1 Student Enrollment

	Fall 2007	Spring 2008
<b>Year 1</b>	114	87
<b>Year 2</b>	73	77
<b>Year 3</b>	65	60
<b>Year 4</b>	41	49
<b>Year 5</b>	5	13
<b>Total</b>	<b>298</b>	<b>286</b>

#### 4.2 Graduates (see Appendix A for complete lists)

	Fall 2007	Spring 2008	Summer 2007
<b>Total</b>	<b>13</b>	<b>29</b>	<b>6</b>

#### 4.3 New Students (accepted and enrolled)

	Fall 2007	Spring 2008
<b>Total</b>	<b>61</b>	<b>7</b>

#### 4.4 Courses Offered & Results (see Appendix B for detailed results)

	Fall 2007	Spring 2008	
<b>3-Credit Courses</b>	<b>Number of Sections</b>	<b>24</b>	<b>24</b>
	<b>Average Class Size</b>	<b>26.57</b>	<b>28.70</b>
	<b>Average GPA</b>	<b>2.40</b>	<b>2.50</b>
<b>1-Credit Courses</b>	<b>Number of Sections</b>	<b>6</b>	<b>6</b>
	<b>Average Class Size</b>	<b>10.0</b>	<b>14.17</b>
	<b>Average GPA</b>	<b>2.97</b>	<b>3.29</b>
<b>Project Courses</b>	<b>Number of Sections</b>	<b>4</b>	<b>6</b>
	<b>Average Class Size</b>	<b>4.5</b>	<b>3.67</b>
	<b>Average GPA</b>	<b>3.96</b>	<b>3.26</b>
<b>Overall Capacity Ratio</b>		<b>102.64</b>	<b>114.31</b>

#### 4.5 Work Load (in mechanical engineering only – credits taught in other departments / campuses are not included)

	<b>Fall 2007</b>	<b>Spring 2008</b>
W. Assaf	12	10
M. El Hayek	10.5	4
G. Asmar	15	14
F. Francis	15	14
W. Daou	4	4
<b>Total Full-Time</b>	<b>56.5</b>	<b>46</b>
A. Hammoud	1.5	2.5
T. Jabbour	9	9
M.-F. Khalil	0	9
N. Metni	6	6
G. Nehme	9	9
S. Traboulsi	3	5.5
G. Bachour	2	2
<b>Total Part-Time</b>	<b>30.5</b>	<b>43</b>
<b>Total</b>	<b>87</b>	<b>89</b>

#### 4.6 Advising Load

	<b>Fall 2007</b>	<b>Spring 2008</b>
W. Assaf	75	74
M. El Hayek	83	83
G. Asmar	62	58
F. Francis	78	71
<b>Total</b>	<b>298</b>	<b>286</b>

### 5. Curriculum Development

Various proposals to improve the ME program were investigated and approved by the Department's Curriculum Committee and then forwarded to higher committees for further approval.

1. Replace the three existing 1-credit graphics courses (CEN 170, CSC 270, and MEN 360) by a single 3-credit graphics course (MEN 205) involving both lectures and training sessions.
2. Increase the number of laboratory courses to 6 instead of the existing three using the equipment available.
3. Change the suggested ME program to include the above-mentioned modifications.

To be consistent with the general university policy concerning course numbering, stating that 100 courses are usually freshman courses, the ME Curriculum Committee approved a proposal to change the course number of MEN 101, Engineering Mechanics: Dynamics, and MEN 102, Mechanics of Materials I, to MEN 201, Engineering Mechanics: Dynamics, and MEN 202, Mechanics of Materials I, respectively. The proposal was approved by all higher curriculum bodies and will become effective next fall 2007.

A proposal to add PHS 203 or CEN 201 as prerequisite for MEN 210, Thermodynamics I, has been approved by the Department Curriculum Committee and will be implemented next Fall 2007.

A senior project policy is under investigation and will be issued once the approvals by the concerned committees are secured.

The department contributed to the proposals made by the Council of Chairpersons to add two new courses to the ENG series. The contribution of the ME Department was mainly related to the proposed course ENG 310 or "Engineering Ethics" by developing the course description and syllabus.

## **6. Laboratory Equipments**

State of the art laboratory equipments are being used in the department in order to train students on various practical issues related to mechanical engineering. The list includes but not limited to:

- Large wind tunnel for various aerodynamics testing
- Energy testing (solar system, combustion, etc...)
- Turbomachines testing (centrifugal pumps, fans, Pelton wheel, Francis turbine, etc...)
- Air-conditioning testing (heating, cooling, refrigeration, etc...)
- Mechanical vibration testing
- Mechanical components and systems

Additional equipments are being added on regular basis. Expected equipments in the near future include machines-tools, advanced instrumentation, and control systems.

## **7. Research**

All ME faculty members are involved in research and publications to various extents. The different fields of research are related to the areas of interest as listed under Personnel section. The following items deserve special mention:

- Dr. W. Assaf is acting as scientific advisor for a project on linear IC engine being developed by Phoenix Machinery, Indevco Group SAL.
- Dr. F. Francis initiated cooperation with Dr. I.A. Youssef, University of Technology, Baghdad (Iraq), on a research project entitled “Design and Manufacturing of an Electrochemical Cell for Fine Finish of Typical Metallic Surfaces”. The project is to be carried out the next academic year 2007-2008 during the sabbatical leave of Dr. Youssef at NDU.

## 8. Senior Projects

The following senior projects were successfully presented during the academic year 2007-2008 and copies of the corresponding reports were forwarded to the central library for archiving.

### 8.1 Summer 2007

Senior Project	Prepared by	Advised by
Swimming Pool Design and Calculations for the four brothers resort- Saida Lebanon	Maroun Choucair	Dr. A. Hammoud
Mechanical For a High Rise Building V1: Cooling and Ventilation V2: Water Distribution V3: Fire Fighting	Hisham Khoueiry Alain Serhan Gilbert Ayoub	Dr. A. Hammoud
Stress and Deformation Analysis of Tow Plastic Gears	Farid Akiki Tony Abi Nakhoul	Dr. G. Asmar
Harnessing of Sea Wave Energy	Jean-Pierre El Khoury Karim Massihi	Dr. M. Hayek

### 8.2 Fall 2007

Senior Project	Prepared by	Advised by
Ventilation System for an Underground Parking	Elias Fahed	Dr. A. Hammoud
Abraj Achrafieh Fire Fighting	Elie Moukarzel	Dr. A. Hammoud
Abraj Achrafieh Heating Distribution Design	Hasan Ali Younes	Dr. A. Hammoud
Design of an overflow swimming pool	Sergio Sabella	Dr. A. Hammoud
Water Distribution for a High rise building	Johnny Kamel	Dr. A. Hammoud
Thermoelectric Plates tool Cooling	Jad Arida	Dr. F. Francis
Breaking of Manufacturing Tools	Georges Nahra Jeff Amine	Dr. F. Francis
La Cigale Hotel Fire Fighting	Bachir Aouad	Dr. M. Hayek
Solar Domestic Water Preheating for Zahle Hospital	Nader Shehadeh	Dr. M. Hayek
Design of a Manual Stair Climbing Wheelchair	Nicole Laba	Dr. G. Asmar



### 8.3 Spring 2008

Senior Project	Prepared by	Advised by
Abraj Achrafieh Air Conditioning & Ventilation	Michael Ghanem	Dr. A. Hammoud
Abraj Achrafieh Water Distribution	Tony El-Khoury	Dr. A. Hammoud
Mechanical Design for AL-JAZEERA Headquarters Qatar (Cooling & Ventilation)	Rema Khattar	Dr. A. Hammoud
AL-JAZEERA Headquarters Volume 2 : Fire Fighting	Eddy Jalbout	Dr. A. Hammoud
Heating System Analysis for Ain Zhalta School	Rayan Zakhour	Dr. A. Hammoud
Micro-Electro Mechanical Systems MEMS	Jules Karam	Dr. F. Francis
Water Turbine (Zahle Kaa-L-Reem)	Chafik El Kady	Dr. F. Francis
Underwater Welding and Cutting	Naji Hantouche Joseph Karam	Dr. F. Francis
Measuring Tool Wear Using Sensors	Samir El-Hayek	Dr. F. Francis
Chocolate Machine	Gerges El Hajj Carlos Nakhoul	Dr. F. Francis
Stress Analysis of an Isotropic Plate Containing Two Rectangular Holes Under in-Plane Loading	Charbel Helou Mazen Naoum	Dr. G. Asmar
The Mini Baja	Chadi Moussa Jean-Paul Zakhour Youssef Merhy	Dr. G. Asmar
Minihydro power Plant Design	Bassem Khalil Elie Wakim	Dr. G. Asmar
Feeding System Design for a Blister Packaging Machine	Berj Demerjian Marc Kaddoum	Dr. M. Hayek
Smoke- Flow Visualization around Bluff Bodies	Ohannes Aramali	Dr. M. Hayek
Thermoacoustic: "A Sound Way to Turn Heat Into Power	Nadim Maamari	Dr. M. Hayek
Mechanical Design for Jaber City Center, V1	Charbel El Khoury	Mr. S. Traboulsi
Mechanical Design for Jaber City Center V2: Air Conditioning & Ventilation	Khalil Jabbour	Mr. S. Traboulsi
Mechanical Design for Jaber City Center V3: Water Distribution and Drainage System	Ali Soufan	Mr. S. Traboulsi
Mechanical Design for Bourj al Sakr	Jeffery Daou Youssef Nasr	Mr. S. Traboulsi

## 9. Publications

The following papers were published by ME Faculty during the academic year 2007-2008. All publications are in internationally refereed journals and conferences.

1. G. Asmar, T. Jabbour, Stress Analysis of Anisotropic Plates Containing Rectangular Holes, *International Journal of Mechanics and Structures*, Vol.2, No 1, pp. 51-76,

- 2007.
2. M. El Hayek, Prediction of Turbulent Thermal Boundary Layers Using Scalar Turbulence Modeling Techniques, *WSEAS Transactions on Heat and Mass Transfer*, Vol.2, pp. 28-35, 2007.
  3. M. El Hayek, A New Scalar Reynolds Stress Model for Non-Isothermal Wall Bounded Turbulent Flows, Proceedings of the 5th WSEAS International Conference on Heat Transfer, Thermal Engineering, and Environment, pp.146-151, IASME/WSEAS 2007.
  4. F. Francis, Socially Conscious E-Learning Process, Proceedings of the International Conference on Technology Communication and Education, April 7-9, 2008, Kuwait.
  5. F. Francis, Total Quality Management – A Tool for Sustainable Development, Proceedings of First International Conference on Engineering Management (ICEM-2008), March 4-5, 2008, Pakistan.

The following article was published by ME Faculty in the local NDU Spirit magazine:

1. M. El Hayek, Mechanical Engineering: NDU Success Stories, *NDU Spirit*, Issue 42, pp.35-37, 2008.

## 10. Reviewing

Dr. M. El Hayek is acting as reviewer of the following events:

- 6th IASME / WSEAS Int. Conf. on Fluid Mechanics and Aerodynamics (FMA'07) , Vouliagmeni Beach, Athens, Greece, August 24-26, 2007, <http://www.wseas.org/conferences/2007/athens/fma>
- 6th IASME / WSEAS Int. Conf. on Heat Transfer, Thermal Engineering, and Environment (HTE'07), Vouliagmeni Beach, Athens, Greece, August 24-26, 2007, <http://www.wseas.org/conferences/2007/athens/hte>

Dr. M. El Hayek completed the review of one journal paper for the Transactions of the ASME - Journal of Applied Mechanics.

Dr. W. Assaf and Dr. M. El Hayek are undertaken a research proposal review for the LNCSR.

Dr. M. El Hayek acted as the local NDU coordinator for the mechanical engineering section of the 6th FEA Student Conference at AUB, May 23-24, 2007.

## 11. Students' Excellence

- Nancy Daher received the Said Akl's Award for her outstanding performance in mechanical engineering. She is now pursuing a master of engineering degree at AUB with scholarship.
- Nancy Daher and Joe Rached presented a paper entitled "Numerical Prediction of Slip Flow and Heat Transfer in Microchannels" at the 6<sup>th</sup> FEA Student Conference on May 23-24, 2007, AUB, Beirut, Lebanon.
- Michel Akiki has been accepted at the University of Tennessee – Space Institute (UTSI) to pursue a master degree with full scholarship. He has been also awarded the Lloyd Crwaford Award (UTSI) for his outstanding performance while still at NDU.
- Nadim Zgheib has been accepted at the University of Tennessee – Space Institute (UTSI) to pursue a master degree with full scholarship.

## **12. Exchange Programs**

Within the framework of the exchange program with Vaxjo University, Sweden, the ME Department received Dr. Samir Khoshaba, Program Director, Product Development and Industrial Design, during summer 2006 for a two-week period at NDU. During his stay, Dr. Khoshaba acted as guest speaker in the course MEN 437, Mechanical Design, and delivered various lectures related to class materials.

Dr. Khoshaba is also expected this summer 2007 for a similar 2-week stay during which, a series of seminars about mechanical design and failure modes is to be organized.

## **13. Committees & Services**

All full-time faculty members were involved in a way or another in committee works at all levels, from the departmental level up to the university level.

### **13.1 Departmental Level**

The department control bodies are made of the following three committees with their composition:

- Department Personnel Committee: Dr. M. El Hayek (Chairperson), Dr. G. Asmar, Dr. F. Francis (Secretary).
- Department Curriculum Committee: Dr. M. El Hayek (Chairperson), Dr. W. Assaf, Dr. G. Asmar, Dr. F. Francis (Secretary).
- Department Outcomes Assessment Committee: Dr. G. Asmar (Chairperson), Dr. W. Assaf, Dr. F. Francis (Secretary).

Various meetings were organized throughout the academic year for which minutes were issued and archived in the department files.

### **13.2 Faculty Level**

The department contributes to the control bodies of the faculty as following:

- Council of Chairpersons: Dr. M. El Hayek.
- Faculty Personnel Committee: Dr. M. El Hayek
- Faculty Curriculum Committee: Dr. G. Asmar.

### **13.3 University Level**

The department contributes also to various control bodies at the university level. During the academic year 2006-2007, ME faculty members were representing the Faculty of Engineering in the following committees:

- University Curriculum Committee: Dr. W. Assaf.
- University Student Affairs Committee: Dr. G. Asmar

### **13.4 Community Services**

Besides committee works, the ME faculty members are well known for their commitment and continued services to ME students and to the entire NDU community in general. In fact, two student branches of learning societies are operating within the mechanical engineering department, namely, the ASME Students Branch, advised by Dr. G. Asmar, and the ASHRAE Students Branch, advised by Dr. M. El Hayek. Beyond that, the same ME faculty members are also advisors for two major student clubs operating at a university scale.

## **14. Student Activities**

Several activities were organized by the department during the academic year 2006-2007, especially by students clubs and local branches. Some of them are listed here:

- Lecture entitled “Vision-Inertial SLAM using Natural Features in Outdoor Environments” by Dr. D. Asmar (AUB), December 08, 2006. ASME/ASHRAE.
- Field trip to API SAL organized by the ASHRAE student branch, March 28, 2007.
- Lecture entitled “Engineering Maintenance” by G. Issa (Sanita SAL), April 24, 2007. ASME.
- Training seminar “Mathematica” by Dr. G. Asmar (NDU), May 16, 2007 ASME/ASHRAE.
- Training seminar “Pro/E” by Dr. T. Jabbour (NDU), June 01, 2007. ASME/ASHRAE.

## 15. Future Plans

Even though the department was operating smoothly and in a satisfactory way over the past years, the time has come to move forward by upgrading strategies and equipments. Several plans are being considered in order to improve the overall performance of the department in meeting students' and market needs.

- Expansion of the laboratories to includes new tools and systems that can be used to operate a set of new laboratory courses being studied by the appropriate committees. On top of the list are equipments to operate a manufacturing laboratory (set of machines tools for student training) and instruments to operate correctly all mechanical engineering laboratories, especially the wind tunnel for which appropriate measurement systems (LDV or PIV) are needed. Such an expansion will turn the ME laboratories at NDU into a testing center that can offer services to both NDU users and the local industry.
- Development of computational facilities by acquiring both the hardware and software required. Such facilities may be used to create a kind of computational research center whose main goal may be to serve both NDU users and the local industry in term of computational expertise.

To achieve those goals and to sustain possible expansion, additional faculty members may be needed in a near future. The capacity of the department to add new faculty members is rather large taking into account the non-negligible percentage of services being fulfilled by part-time faculty (see section 4, Statistics, for more details).

## Appendix A: ME Graduates 2006-2007

### Summer 2006 ME Graduates

ID #	Name (First ... Last)	GPA	Major GPA
2000 1642	Charbel Elias Khalil	2.38	2.35
2002 0547	Rawad Said Eid	2.66	2.54

### Fall 2006 ME Graduates

ID #	Name (First ... Last)	GPA	Major GPA
2001 1124	Ramzi Said Azar	2.70	2.89
2001 2586	Sannine Tanios Beaino	2.49	2.48
2002 0092	Nancy Mikhael Daher	3.82	3.84
2002 0192	Jihad Mounir Bou Chrouch	2.53	2.55
2002 0364	Roy Charbel Khalil	3.64	3.48
2002 0577	Simon Pierre Slan	2.66	2.69
2002 0767	Joe Antoine Rached	3.02	3.15

### Spring 2007 ME Graduates

ID #	Name (First ... Last)	GPA	Major GPA
98-0140	Hady Elias Haydamous	2.82	2.90
2000-2614	Pierre Chawki Abi Sleiman	2.13	2.22
2001-1255	Elias Joseph Sfeir	3.38	3.21
2001-1301	Jacques Samir Fahd	2.53	2.34
2001-2522	Nadim Yaacoub Zgheib	3.79	3.76
2001-2834	Jalal Selim Samaha	2.69	2.66
2002-0049	Charbel Samir El Aaraj	3.04	3.09
2002-0165	Kevork George Kazanjian	3.35	3.33
2002-0476	Ramzi Atef Akl	2.52	2.61
2002-0593	Imad Antonios Taok	3.55	3.67
2002-0610	Alain Youssef Sfeir	2.50	2.62
2002-1003	Joseph Michel Ghobeira	2.83	2.92
2002-1007	Michel Henri Akiki	3.90	3.92
2002-1323	Georges Toufic Naoufal	2.68	2.77
2002-2001	Youssef Iskandar Ghoussoub	3.71	3.64
2004-6554	Nicolas Farid Nasrallah	2.91	2.82

## **Appendix B**

### **ME Courses 2006-2007 - Grades Statistics**

The following two charts show the distribution of grades and their standard deviations for all courses offered by the Mechanical Engineering Department in Fall 2007 and Spring 2008. The courses are grouped in three categories:

- 3-credit regular courses
- Senior projects (MEN 460)
- 1-credit courses

For each category the mean value and average standard deviation are given along with the overall mean value and standard deviation for the entire set of courses.

### ME Courses - Fall 2007





