



## College of Engineering & Mines

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### Memorandum

From: ME Graduate Program Committee  
To: CEM Curriculum Committee  
Re: Fast Track Mechanical Engineering Bachelor/Master Degrees

The Department of Mechanical Engineering proposes a new integrated Mechanical Engineering B.S./M.S. degree program for qualified undergraduate students to complete B.S. and M.S. degrees in a shorter time than traditional B.S. plus M.S. degrees. The combined accelerated degree for Mechanical Engineering undergraduate students is designed for students to complete both Bachelor of Science and Master of Science in five years. The basic rationales for the program are:

1. Better use of University resources
2. Leverage existing strong B.S. programs to increase graduate enrollment
3. A national trend in a highly demanding field
4. An attractive option for qualified undergraduate students

Students, university, and industry are the three most important components for technology advancement in engineering. This is an integrated program through planning and commitments, for students with excellent academic achievements, and is a win-win-win (www) program. Students can finish both degrees in a shorter time without sacrificing educational quality in the discipline. The university can retain excellent undergraduate students in the graduate program and increase the enrollment and throughput. Mechanical Engineering graduates have accepted positions with corporations such as Shell, BP, GE, Boeing, GM as well as government agencies (state and federal), research institutes and centers. They are the mainstream industrial workforces for the new globalization era.

We are not requesting additional resources for the proposed degree program. Information regarding existing resources is readily available in recent ABET (2005, 2007) as well as UAF Program Assessment (2007) reports. Consequently, we request a waiver of the Resource Commitment form.

#### Approval:

\_\_\_\_\_  
Department Chair

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Curriculum Council Chair

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Dean

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Dean of Graduate School

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President, UAF Faculty Senate

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Chancellor

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President

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Board of Regents

# Proposal

## **B.S./M.S. Degrees for Excellent Mechanical Engineering Students**

Submitted to

Graduate School

University of Alaska Fairbanks

September 18, 2008

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# Combined Mechanical Engineering B.S./M.S. Degree: A Proposal for an Accelerated (Fast-Track) Degree Program

## I. Proposal Summary

The Department of Mechanical Engineering proposes a NEW integrated B.S./M.S. degree program for qualified undergraduate students to complete B.S. and M.S. degrees in a shorter time than traditional B.S. plus M.S. degrees.

## II. Background

The Department of Mechanical Engineering proposes a combined accelerated degree for Mechanical Engineering undergraduate students. This program is designed for students to complete both a Bachelor of Science and a Master of Science Degree in five years. The basic rationales for the program are:

1. Better use of University resources
2. Leverage existing strong B.S. programs to increase graduate enrollment
3. A national trend in a highly demanding field
4. An attractive option for qualified undergraduate students

The following examples are programs available in the U.S. for combined B.S./M.S. degree programs:

1. University of Alaska Fairbanks: The Computer Science Department offers a five year combined B.S./M.S. program.  
<http://www.cs.uaf.edu/cs/grad/BSMSCheckList.html>
2. Texas A&M University: The Look College of Engineering offers a fast track B.S./M.S. program, beginning graduate studies at the end of the junior year and may complete the B.S. and M.S. degrees within five years.  
<http://essap.tamu.edu/fasttrack.htm>
3. University of Texas Arlington: The Materials Science and Engineering Department offers a five-year joint program that allows a student to earn a bachelor's degree in the Physics Department followed by a master's degree in the Materials Science and Engineering Department.  
<http://www.uta.edu/mse/fasttrack.pdf>
4. Florida Institute of Technology offers a fast track B.S./M.S. in Engineering. It combines a Bachelor's degree in engineering with a Master's degree in engineering. Engineering majors with a cumulative 3.4 GPA and who have completed 95 credits are eligible.  
<http://www.fit.edu/ugrad/admininfo/documents/TransferFastTrackFS.pdf>
5. The University of California San Diego Mechanical and Aerospace Engineering programs offer an integrated B.S./M.S. degree program with either a thesis or comprehensive exam option. This 5-year program requires an upper-division GPA of 3.5 to apply.  
[http://maeweb.ucsd.edu/undergrad/degree/degree\\_prog.php#bsmsprogram](http://maeweb.ucsd.edu/undergrad/degree/degree_prog.php#bsmsprogram)
6. University of Illinois at Urbana-Champaign: The Departments of Computer Science and Accountancy offer a five year joint program that allows a student to earn a bachelor's degree in either department followed by a master's degree in the other department.  
<http://www.cs.uiuc.edu/undergraduate/programs.php#bsms>

7. George Mason University: Qualified undergraduate students may apply for a five-year combined B.S./M.S. program leading to a Bachelor of Science in an engineering discipline and an MSSE degree. The combined B.S./M.S. program can be completed in 144 credit hours. [http://ite.gmu.edu/undergraduates/accelerated\\_bs\\_ms.php](http://ite.gmu.edu/undergraduates/accelerated_bs_ms.php)

### III. Proposed Program

1. Complete the following admission requirements:
  - a. ME major (junior preferred) or senior standing.
  - b. GPA 3.25 or above (based on minimum of 24 credits in ME major requirements). Students must maintain a cumulative GPA of 3.0 to remain in the program.
  - c. Submit three letters of references.
  - d. Submit GRE (general) scores.
  - e. Submit a study goal statement.
  - f. Submit a UAF graduate application for admission.
2. Complete the general university requirements.
3. Complete B.S. degree requirements (As part of the B.S. degree requirements, complete MATH F201X, PHYS F211X and PHYS F212X).
4. Complete the master's degree requirements.
5. Complete the following B.S. program (major) requirements:

ES F101-Introduction to Engineering	3
ES F201-Computer Techniques	3
ES F209-Statics	3
ES F210-Dynamics	3
ES F301-Engineering Analysis	3
ES F307-Elements of Electrical Engineering	3
ES F331-Mechanics of Materials	3
ES F341-Fluid Mechanics	4
ES F346-Basic Thermodynamics	3
ESM F450W-Economic Analysis and Operations	3
MATH F202X-Calculus	4
MATH F302-Differential Equations	3
ME F302-Dynamics of Machinery	4
ME F308-Measurement and Instrumentation	3
ME F313-Mechanical Engineering Thermodynamics	3
ME F321-Industrial Processes	3
ME F334-Elements of Materials Science/Engineering	3
ME F403-Machine Design	3
ME F408-Mechanical Vibrations	3
ME 415W-Thermal Systems Laboratory	3
ME 441-Heat and Mass Transfer	3
ME 487 W,O-Design Project	3

6. Complete the following M.S. program (major) requirements:

ME F631-Advanced Mechanics of Materials	3
ME F634-Advanced Materials Engineering	3
ME F641-Advanced Fluid Mechanics	3
ME F642-Advanced Heat Transfer	3
ME F608-Advanced Dynamics	3

7. Complete the thesis or non-thesis requirements:

**Thesis**

Complete the following:

ME F699-Thesis	6
Electives*	9

**Non-Thesis**

Complete the following

ME F698-Project	3
Electives**	12

\*At least 3 credits at the graduate level.

\*\*At least 6 credits at the graduate level.

Electives are ME or other engineering, science, or mathematics courses at F400-level or above approved by the student's advisory committee.

8. A minimum of 150 credits is required for both degrees.

Note: This degree program must be completed in 7 years or the student will be disqualified from the program. If a student is disqualified for exceeding the 7 year limit for the fast track degree program, a ME B.S. will be awarded if: 1) completed in 10 years, and 2) meet ME B.S .requirements.

Taken separately, the degrees would require 161 credits (131 B.S. and 30 M.S.). The difference of 11 credits comes from the electives of the B.S. program:

- Taking the B.S. degree and the M.S. degree separately, the student needs to take 11 elective credits (6 for ME electives, 3 for technical electives, and 2 for free electives) for the B.S. degree, another 9 or 12 graduate elective credits for the M.S. degree for the non-thesis and thesis option, respectively.
- Taking the B.S./M.S. degree, the student needs to take 9 or 12 elective credits (for thesis and non-thesis option, respectively) instead of both B.S. elective credits and M.S. elective credits.

The minimization of overlaps, maximizing the benefits of continuity, and taking graduate level courses in lieu of undergraduate ones justify the reduction.

See section XII for an attached example of a 5-year study plan.

**IV. Benefits to UAF and Students**

- Increase graduate enrollment
- Reach critical mass in Mechanical Engineering graduate program for future funding opportunities
- Attract exceptional and advanced undergraduate students
- Increase University throughput
- Reduce student total education cost
- A model for other demanding degrees/programs
- Create possibility of inter-department combined degrees
- Provide workforce needed for university/state research community

**V. Personnel Directly Involved with the Program**

See attached resumes of directly involved ME faculty.

It is important to note that many faculty members in Mechanical Engineering are funded by external grants based on the high caliber research that they are conducting. These grants generally include research assistantship at both the graduate and undergraduate levels. Professor Jonah Lee has worked on theoretical and experimental solid mechanics, finite element and material point methods. Dr. Ed Bargar has worked on

thermodynamics and energy systems, controls and instrumentation, HVAC and building systems. Dr. Cheng-fu Chen has worked on computational mechanics, reliability of electronic packaging, motion planning and controls. Professor Deben Das has worked on fluid mechanics, heat transfer and cold regions engineering. Professor Doug Goering has worked on computational fluid mechanics, heat transfer, geotechnical and arctic heat transfer. Professor Ron Johnson has worked on fluid mechanics, energy systems, air pollution, water and wastewater treatment. Dr. Chuen-Sen Lin has worked on machine design, CAD, mechanical system modeling and simulation. Dr. Rorik Peterson has worked on frost heave, frozen ground engineering, and atmospheric dispersion modeling. Dr. Jing Zhang has worked on material science and engineering, multi-scale modeling, coupled phenomena with applications to processing. Dr. Gang Sheng has worked on dynamics, acoustics and tribology applied to automotive systems, data storage systems, and mechanical/structural systems in arctic regions. This is an excellent research department and will provide valuable experience to our students who choose to enter this program.

For the past three years, 22 of the ME M.S. students were funded in the form of research assistantships related to the high quality research being conducted by faculty members. As the program grows, we expect the number of research opportunities to grow.

## **VI. Enrollment Information**

See section XI for the current enrollments and graduates in the past five years.

Projected enrollment is 4 to 8 students per year with a maximum of 30 students in total. This will triple the current and recent enrollments, and triple the graduate credit hour production. In the past, we spent most our efforts on recruiting outside graduate students (both national and international) and most of our graduate students are international. In recent years, we have seen a significant drop in the number of international applicants to our graduate program that is attributed to globalization and rapid economic developments in countries such as India and China. This program aims to discover a "new" source of our homegrown excellent students. On average, we have about 13 undergraduate and 5 M.S. graduates each year with the number expected to increase as indicated by the recent increase in mechanical engineering undergraduate enrollment. We are able to provide a quality educational experience to these additional students without extra resources.

## **VII. Resources Requirements**

The department had a peak of enrollment of 22 M.S. students in 2003 and 2004 without any issues in resources. Consequently, we are not requesting additional resources for the proposed program.

## **VIII. Implementation Plan**

1. Departmental Approval- Sept. 15, 2008, Department of Mechanical engineering
2. College Approval- Sept. 30, 2008, CEM
3. Senate approval- Oct. 16, 2008, UAF Faculty Senate
4. Board Approval- Dec. 2008, UA Board of Regent
5. Student recruitment- In Spring 2009, all qualified ME students will receive an invitation to this program
6. Open house- In Spring 2009 all qualified students are invited to a program orientation
7. Program starts- Fall 2009

## **IX. Assessment**

The Mechanical Engineering Department has assessment plans for the B.S. and M.S. degrees. These assessments will be applied to this program also as the students will be receiving both degrees. These

assessments are done on a regular basis for the Graduate School, Accreditation Boards, and department self-study. After three years of the program, we will do an assessment of

1. the number of students applied, admitted, and graduated
2. their career paths
3. their feedback on the program

This will enable the Mechanical Engineering Faculty to judge the effectiveness of this program independent of the traditional B.S. and M.S. programs and make recommendations on how to further improve the program.

## **X. Notes**

Double major with Mechanical Engineering's fast track program is possible but is only recommended for highly qualified individuals due to the additional requirements in ME B.S. Double major with the fast track will have the same requirements as other combined degree students as far as ME major is concerned.

## **XI. Regents Guidelines**

The Department of Mechanical Engineering proposes a NEW integrated Mechanical Engineering B.S./M.S. degree program for qualified undergraduate students to complete B.S. and M.S. degrees in a shorter time than traditional B.S plus M.S. degrees. The combined accelerated degree for Mechanical Engineering undergraduate students is designed for students to complete both a Bachelor of Science and a Master of Science in five years. The basic rationales for the program are:

1. Better use of University resources
2. Leverage existing strong BS programs to increase graduate enrollment
3. A national trend in a highly demanding field
4. An attractive option for qualified undergraduate students

Students, university, and industry are three most important components for technology advancement. Since this is an integrated program for excellent students through planning and commitments, it is a win-win-win (www) program. Students can finish both degrees in shorter time without sacrificing educational quality in the discipline. The university can retain excellent undergraduate students in the graduate program to increase enrollment and throughput. Mechanical Engineering graduates have accepted positions with Shell, BP, GM, GE, Boeing as well as government agencies (state and federal), research institutes and centers. They are mainstream workforces for the mechanical, automotive and aerospace areas.

## XII. Sample Five-Year Study Plan

<b>YEAR 1</b>			
<b>FALL</b>	credits	<b>SPRING</b>	credits
Math 200X	4	Math 201X	4
ES 101	3	ES 201	3
Core 1	3	Core 2	3
Chem 105X	4	Chem 106X	4
English 111	3	Comm 131/141	3
	17		17 = 34
<b>YEAR 2</b>			
<b>FALL</b>	credits	<b>SPRING</b>	credits
Math 202X	4	Math 302	3
ES 209	3	ES 210	3
ME 321	3	ES 346	3
English 211/213	3	Core 3	3
Physics 211X	4	Physics 212X	4
	17		16 = 33
<b>YEAR 3</b>			
<b>FALL</b>	credits	<b>SPRING</b>	credits
ES 307	3	ES 341	4
Core 4	3	Core 5	3
ME 302	3	ME 313	3
ES 301	3	ME 334	3
ES 331	4	ME 308	3
	16		16 = 32
<b>YEAR 4</b>			
<b>FALL</b>	credits	<b>SPRING</b>	credits
ME 441	3	ME 403	3
ME 408	3	ME 415	3
ME 4xx or 6xx	3	ME 487 W,O	3
ME 6xx	3	ME 6xx	3
ESM 450W	3	Core 6	3
	15		15 = 30
<b>YEAR 5</b>			
<b>FALL</b>	credits	<b>SPRING</b>	credits
ME 6xx	3	ME 6xx	3
ME 4xx or 6xx	3	ME 6xx	3
ME 6xx	3	ME 6xx/699	3
ME 698/699	3		
	12		9 = 21
		<b>total</b>	<b>150</b>

### XIII. Sample Three-Year Teaching Plan

		<b>Mechanical Engineering</b> <b>Sample Three-Year Plan of ME Courses</b> <b>Fall 2009-Spring 2012</b>					
		Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12
<b>MAJOR</b>	ME 302	x		x		x	
	ME 308		x		x		x
	ME 313		x		x		x
	ME 321	x		x		x	
	ME 334		x		x		x
	ME 403		x		x		x
	ME 408	x		x		x	
	ME 415		x		x		x
	ME 441	x		x		x	
	ME 487		x		x		x
<b>ELECTIVE</b>	ME 401	x				x	
	ME 409				x		
	ME 414			x			
	ME 416			x			x
	ME 450			x			
	ME 451				x		
	ME 452	x				x	
	ME 453		x				x
	ME 458	x				x	
	ME 464		x		x		x
	<b>GRADUATE</b>	ME 601			x		
ME 602					x		
ME 608				x			x
ME 609					x		
ME 617				x			
ME 631			x			x	
ME 634			x			x	
ME 641		x			x		
ME 642				x			x
ME 658		x				x	
ME 685		x				x	
ME 687			x				x
<b>PROJECT THESIS</b>	ME 698	x	x	x	x	x	x
	ME 699	x	x	x	x	x	x

**XIV. Mechanical Engineering B.S. and M.S. Enrollments and Graduates Data**

Degree	Fall 03	Fall 04	Fall 05	Fall 06	Fall 07	Fall 08
B.S. Enrollment	81	81	89	81	102	122
B.S. Graduate	10	11	13	18	8	13
M.S. Enrollment	22	22	19	12	7	8
M.S. Graduate	4	5	9	3	8	4