

**The University of Michigan
College of Engineering
Curriculum Committee**

**Agenda
February 8, 2011
1:30-3:00 p.m.
GM Room Fourth Floor
Lurie Engineering Center**

1. Approval of Minutes From 01-11-2010
2. Approval Final Version Guidelines and Procedures
3. Proposal for CAF Revisions
4. Proposal: for Certificate for Entrepreneurship
5. Discussion: Topics for Discussion at a Joint Meeting with LSA
6. Matters Arising

**University of Michigan
College of Engineering
Curriculum Committee Meeting
Tuesday January 11, 2011
1:30-3:00 p.m.
GM Room 4th Floor Lurie Engineering Center
Minutes**

Marina Epelman called the meeting to order at 1:40 p.m.

Members Present: M. Epelman, J. Barker, L. Bernal, E. Durfee, J. Holloway, R. Hryciw, A. Hunt, D. Kieras, E. Larsen, L. Meadows, S. Montgomery J. Pan, T. Perakis, R. Robertson, S.Vozar
F. Ward

Members Absent: E. Gulari, F.Terry

The minutes of the last meeting, December 07, 2010 were approved

A correction to the attendee list was made.

CCC Rules for Concentrations

Information regarding this was included in the meeting packet.

Susan Montgomery introduced and talked about this. There was some discussion and some recommendations for changes to this proposal.

Marina Epelman asked for a vote to approve the sections “Creating a New Course” and “Modifying an Existing Course.” Moved and Seconded. Vote: Approved Unanimously.

The section “Cross Listing of a course” will be edited and voted on at a later date.

Course Approval Forms

This course was tabled

Jwo Pan will go back to his Faculty Committee to check on this.

ME 505 Modification— Changing Description; Adding a lab section

Proposal: General Electives – James Holloway

There are two remaining recommendations of the Taskforce on Undergraduate Education to be considered: General Electives and Flexible Common Math and Science Core. Both proposals were included in the meeting packet.

James Holloway introduced the first proposal (General Electives) for discussion. Discussion points included

- Restrictions on courses that do not count for general electives credit (each of the current restrictions was discussed at the curriculum committee in the past few years, but can be revisited as part of the new proposal)
- It was proposed that the pros and cons of the main proposal (mandatory 12 credit hour minimum on general electives in every undergraduate program) are elucidated, to serve as starting points for departmental discussions of the proposal.

Discussion will continue in future meetings.

Adjournment: Motion to adjourn was made and seconded
Motion carried (approved)

Next Meeting: January 25, 2011 1:30 PM, Room 265 Chrysler Center

**THE UNIVERSITY OF MICHIGAN COLLEGE OF ENGINEERING
CURRICULUM COMMITTEE GUIDELINES AND PROCEDURES**

October 24, 2006

Updates - as of Jan 20th 2011 subcommittee meeting

Creating a New Course – this version approved Jan 11, 2011

The proposal for a new course should contain justification for its establishment and an assessment of the course's likelihood of success.

1. The proposed new course should have first been taught as a special topics course. An exception will be allowed if the new course is part of a major program change.
2. Documentation for submission of a new course shall consist of:
 - a. Course Approval Form (CAF), including supporting statements and appropriate signatures.
 - b. Course syllabus, with details to show weekly subject matter, required/recommended reading materials, description of major work in the course, grading policy
 - c. Enrollment numbers and course evaluation results from the special topics offerings
3. Additional documentation for required courses and technical electives at the 400 level or below includes:
 - a. ABET course profile, including course outcomes and assessments;
 - b. Description of how course fits into the degree program
 - c. Sample Schedule as it is to appear in the Bulletin, if this is altered by the proposed course.

Modifying an Existing Course – this version approved Jan 11, 2011

The level of documentation needed to modify an existing course is as follows:

1. For modifications to any courses in the area of program requirements or technical electives, refer to sections 2 and 3 above, under "Creating a New Course".
2. For minor modification to any course, such as updates in prerequisites, title, or course description, only a CAF with supporting statements is needed.

Cross Listing of a Course – This version approved in spirit Jan 11, 2011, we were asked to edit introductory paragraph

Because all cross-listed departments have control over the catalog description of a course, cross-listed courses should reflect substantial intellectual overlap and cooperation between departments in the content of the course. Cross listing primarily for the purposes of circumventing program rules will be considered only for compelling reasons. If a course is highly interdisciplinary and there is little overlap in the background and coursework expectations for students from the different units, alternatives to cross-listing should be considered, such as separate colocated courses.

To request the cross-listing of a course, an explanation of how the course will meet the following guidelines, should be included in the CAF under “Supporting Statement.”

1. The course can be taught by faculty in all cross-listed departments.
2. There will be cognizant faculty for the course in all cross-listed departments.
3. All cross-listed departments actively review and assess curriculum, along with the cross-listed courses consistent with departmental practice.
3. Course content is relevant to all departments cross-listed.

Establishment of a Division (Subject) – Fred following up to learn more about this before we work on it

(Based on Dennis Assanis, Automotive Engineering Program, “Rationale and Proposed Guidelines for Creating a Division in InterPro,” November 29, 2000.)

The following guidelines are proposed when demonstrating a need for the creation of an academic Division:

1. “Successful incubation of the interdisciplinary academic Program under one of the existing Divisions that would serve as the academic home for an interim period of at least three years.”
2. “Successful development of a number of Program-specific courses that would not have been created if the proposed Division did not exist. Offering of such courses for at least two times under experimental numbers in one of the existing Divisions with satisfactory enrollment.”
3. (Successful) “achievement of appropriate metrics consistent with program goals and expectations, such as reaching a steady-state enrollment of x full-time and y part-time students, graduation of z students, etc.”
4. “Establishment of a curriculum committee for that division. The form and organization of the committee should be consistent with the norm of the other divisions in the CoE.”
5. “Demonstrated identity of the Program, as evidenced by external recognition of Program need and objectives.”
6. “Careful assessment of the pros and cons of the creation of a prospective Division by The Program’s faculty council or the Program’s Curriculum Committee and approval of the proposal by at least 2/3 of the faculty council members.”
7. “Approval of the proposal to create a Division by the CoE Curriculum Committee.”
(The CoE Curriculum Committee will evaluate the curricular aspects of the proposal.)
8. “Approval of the proposal by the CoE Faculty Assembly.”

Suggested changes to the CoE Course Approval Request Form
David Kieras, Susan Montgomery, Fred Terry
February 3, 2011
For consideration by College Curriculum Committee

Changes already requested by registrar or otherwise straightforward

1. In "Current Listing" and "Requested Listing"
 - a. Change "Course Number" to "Catalog Number"
 - b. Change "Course Title" to "Course Title (full title)"
 - c. Replace "Title Abbreviation" section to "Abbreviated Title (20 char)"
2. Change "number of weeks" to
 - ___ Full term
 - ___ Half term
3. Change "Is this course repeatable?" to
"Course is repeatable for credit" __Y __N
4. Replace "Can it be repeated in the same term" to
"Can be taken more than once in same term" __Y __N
(example would be taking more than one special topic class
or doing research with more than one faculty member)
5. Change "grading" section to match University Form's Grading Basis that includes
 - Graded (A-E)
 - Credit/no credit
 - Satisfactory / unsatisfactory
 - Pass/fail
 - Not for credit
 - Not for degree credit
 - Degree credit only

Changes to consider

1. Next to "Course Offer Freq"
Include "Term(s) typically offered: __Fall __Winter __ Spring __ Summer"
2. In "Current Listing" and "Requested Listing"
 - a. Include "Subject" in addition to "Home Department" ?
3. Include request for course profile to supporting statement portion of form for required courses?
4. Move "Program outcomes" to supporting statement portion of form?
5. Move "Degree requirements" to supporting statement portion?
(regardless, change "free electives" to "general electives")

6. Prerequisites section
Include minimum grade requirements for prereqs?
Include "must be declared major" option as prereq?
7. Change "contact hrs / week"
Lecture hrs/wk
Recitation hrs/wk
Lab hrs/wk
8. Delete "location" section, assumed Ann Arbor? If keep change to
Ann Arbor
Other _____

Questions:

1. Credit restrictions section
What does this mean? Note University has "credit exclusion" section
2. Level of credit sections
Do people ever check "Rackham Grad" only, i.e. not for UG credit?
3. What is the difference between discussions and recitations? Do we need both?
4. Do we want to implement "Add Consent (dept/instr/no)" and "Drop Consent (dept/instr/no)" option? Would we use it?
5. "Course is Y graded" section
Are there restrictions on what courses a Y can be given for?
If we keep this section, change to "___ Y grade can be assigned"
6. Asked to consider removing "cognizant faculty member" – We think we ought to keep it, thoughts?
7. "Grad course: Attach nomination if cognizant faculty is not a regular graduate faculty" section
Has this option been used recently?

To: College of Engineering Curriculum Committee
From: The Center for Entrepreneurship (CFE) and the Interdisciplinary Professional Programs (InterPro)
Date: 12/23/10
Re: Proposal for a Certificate of Advanced Studies in Engineering (CASE) in Entrepreneurship

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This document describes a Certificate of Advanced Studies in Engineering (CASE) in Entrepreneurship program, to be administrated and awarded by the Interdisciplinary Professional Programs (InterPro) on behalf of the The Center for Entrepreneurship (CFE) at the University of Michigan, Ann Arbor.

Section 1 presents an introduction to entrepreneurship education at the University of Michigan and a justification for the creation of this certificate program.

Section 2 provides the admission/completion requirements of the proposed certificate program.

Appendix A Example Student Schedule for CASE in Entrepreneurship Curriculum

Appendix B Required Classes

Appendix C Core Courses

Appendix D Elective Courses

Introduction to Entrepreneurship Education at the University of Michigan

Founded in the winter of 2008, The Center for Entrepreneurship (CFE) exists to empower University of Michigan students, faculty, and staff to pursue entrepreneurial achievements that improve lives and drive the economy. The CFE was initiated when the College of Engineering Committee on Entrepreneurial Environment and Programs (CEEP) realized that young inventors can help stimulate the Michigan economy.

There is tremendous opportunity for students to flourish in the entrepreneurial ecosystem: The University of Michigan contains experts and leaders in all areas of study; there is significant support and encouragement for students from the local business community; and the University has an extensive global network of influential alumni. The Committee acknowledged that there were already a number of potential entrepreneurs at the University of Michigan, but that these individuals felt isolated and generally did not feel encouraged or enabled to pursue their entrepreneurial ambitions. Thus, a center for entrepreneurship was created in the College of Engineering to help University of Michigan inventors, especially student innovators, to bridge the gap between innovation and market implementation.

As part of its academic initiative, the CFE launched a number of entrepreneurship courses intended to expose students to the entrepreneurial mindset, teach them about the entrepreneurial process, and give them direct experience with entrepreneurship in a supportive classroom environment. To date, the CFE has sponsored the creation of nine entrepreneurship courses.

Benefits of a CASE in Entrepreneurship

In Fall 2008, the CFE introduced its first formal academic program: the Program in Entrepreneurship (PIE), an academic subplan comprised of nine credits of courses related to entrepreneurship. The primary purpose of the PIE is to give students a formal structure through which they can acquire fundamental entrepreneurial skills and safely undertake their own entrepreneurial endeavors. The program is designed for students who want to start a company, join a small company upon graduation, innovate within a large organization, or simply learn about entrepreneurship because of its increasing importance in the economy. While venture creation is not the ultimate goal of the PIE, it is worth noting that several PIE alumni have gone on to launch their own company.

Although the PIE is available to graduate students (to date, 17 of the 123 program participants – or 14% - have been graduate students), it is currently only formally approved for MEng students. Therefore, the PIE does not apply to our COE doctoral students and Rackham graduate students who wish to commercialize technology developed as part of their master's or doctoral program, or to apply their robust technical expertise to a startup company after completion of their degree program. Nor is the PIE appropriate for working professionals who aspire to become entrepreneurs or intrapreneurs (an employee of a large corporation who is given freedom and financial support to create new products, services, systems, etc.)

As a companion to their technical education, a CASE in Entrepreneurship program will provide graduate students, as well as non U-M professionals seeking continuing education, with in-depth entrepreneurship and intrapreneurship training, teaching them the fundamental tools and mindset necessary for bringing innovations and ideas to market. Great entrepreneurs come from a wide range of academic, professional, and personal backgrounds, and successful entrepreneurial projects are often those that incorporate feedback from multiple points of view. Thus, students who graduate from this program will have enhanced interdisciplinary and teamwork skills, in addition to the knowledge necessary to guide product and process development both on their own and as part of a larger organization.

Upon completion of the program, students will receive an official graduate certificate, which would validate their entrepreneurial and business skills, knowledge, and experience to potential or current employers, investors, and partners. Moreover, a CASE in Entrepreneurship program will offer students invaluable opportunities for networking with other entrepreneurial graduate students and within the blossoming local entrepreneurial ecosystem.

Intended Audience

There are two intended audiences for the CASE in Entrepreneurship: Graduate students (master's or doctoral candidates) at the University of Michigan (particularly in engineering) and professionals seeking to enhance their entrepreneurial or intrapreneurial skills.

1. Graduate Students in Engineering

In September 2010 the CFE surveyed approximately 170 University of Michigan graduate students to gauge interest in entrepreneurship education in general and a graduate certificate in entrepreneurship in particular. (While the survey was sent to graduate students across the University of Michigan, the majority of respondents were engineering students.)

Of the students surveyed, 65% of respondents indicated that they have started or thought about starting their own company; 68% have taken or have thought about taking entrepreneurship courses; and 72% have attended or thought about attending an entrepreneurship seminar.

When asked if they would be interested in learning more about entrepreneurship, 85% of respondents expressed interest in taking a short "crash course" on entrepreneurship; 78% expressed interest in taking a series of entrepreneurship courses; and 53% expressed interest in completing a graduate certificate program.

When asked about the value of entrepreneurship courses and an entrepreneurship certificate program, students mentioned that they would take advantage of such offerings as a supplement to technical courses in order to learn about the process of translating their technology into a marketable product or venture. Others felt that typical engineering classes did not include business perspectives, and that entrepreneurship courses would give them an advantage when entering the job market, by teaching them business fundamentals and how to work in multidisciplinary teams. Still others wanted

to explore the concept of entrepreneurship in order to expand their options for their future after university.

2. Professionals

Also in Fall 2010, a leading Internet company located in Ann Arbor approached the Center for Entrepreneurship regarding the possibility of extending entrepreneurship and intrapreneurship education, specifically a graduate certificate in entrepreneurship, to its employees. This industry leader is known for its innovative online products and services, and is constantly introducing new or improved products and services to its already impressive portfolio. Thus, it sees value in encouraging and enabling its employees to take creative risks in regards to product development in order to keep the company fresh and ahead of its competitors. A free-standing CASE in entrepreneurship would offer an attractive flexible educational opportunity for this and other industry partners.

CASE in Entrepreneurship Program Requirements

1. Admissions Requirements

The admissions requirements for the CASE in entrepreneurship are as follows:

- 4-year Bachelor's degree, preferably in Engineering, Physical Sciences, or Life Sciences
- A GPA of 3.0 in the last two years of relevant coursework.
- One year of working experience is highly recommended;
- For international students, the test of English Language Proficiency (TOEFL), or Michigan Language Assessment (MELAB) or IELTS is required;
- In accordance with University policy, admission to the certificate program must occur before six credit hours are earned towards the certificate.

2. Completion Requirements

To qualify for a certificate students must:

- Successfully finish the required 15 credits of entrepreneurship coursework (see below). Any transferred credits must be approved by the COE CFE oversight committee.
- Earn a cumulative grade point average of 5.00/9 ("B" average).
- Complete the program requirements within four years.

CASE in Entrepreneurship Program Structure

To complete the CASE in Entrepreneurship, students must take classes from each of five categories – required, core, elective, flexible technical elective and practicum – for a minimum total of fifteen credits. A core course may be used to fulfill an elective requirement. All courses must be taken for a grade, with the exception of the Entrepreneurship Seminar, which is only offered pass/fail.

The Program in Entrepreneurship uses established classes from the College of Engineering, Ross School of Business, Zell Lurie Institute of Entrepreneurial Studies, School of Information, and College of Literature, Science, & the Arts. In addition, the Center for Entrepreneurship designs new entrepreneurship courses to address relevant themes not covered by existing classes. Students are also encouraged to petition to have an additional course count as a PIE core or elective requirement.

Student must take 15 credits in the following categories: (applicable courses are listed in Table 1):

1. **Two Required Courses** [2 credits]: Entrepreneurship Seminar and Discussion.
2. **One Entrepreneurship Core Course** [3 credits]: Entrepreneurship core courses provide students with fundamental principles in entrepreneurship and new venture creation through a hands on
3. **Two Entrepreneurship Electives** [4 credits]: Elective courses are meant to give students in depth exposure to various aspects of entrepreneurship, including patent law, entrepreneurial ownership, market strategy etc.
4. **One Option Course** [3 credits]: Option courses provide depth in specific disciplines or industries which are relevant to entrepreneurship and innovation.
5. **One Entrepreneurial Practicum** [3 credits]: The entrepreneurial practicum is design to provide hands-on, real-world entrepreneurial experience to students.

1. **Two Required Courses** [1 credit, pass/fail; 1 credit, graded]

The two required courses, ENGR 407 Entrepreneurship Seminar: Distinguished Innovators Speaker Series [1 credit; pass/fail] & ENGR 417 Discussion Session for the Entrepreneurship Seminar [1 credit; graded], inspire students to explore the potential of both entrepreneurship and intrapreneurship from entrepreneurs and innovators across the country. Students use the discussion group to meet with speakers individually and reflect on learnings inspired by the speakers.

2. **One Entrepreneurship Core Course** [3-4 credits; graded] :

Core courses in entrepreneurship offer a broad introduction to entrepreneurship, and show students how to turn innovative ideas into viable businesses. Core classes are often project-based, and designed to guide students through the entrepreneurial process. At least 80% of the curriculum needs to focus on entrepreneurship for it to be considered a core course in the framework of this program (see Table 1).

3. Two Entrepreneurship Electives [min 4 credits; graded]:

Elective courses focus on entrepreneurship, or relevant, auxiliary topics, such as entrepreneurial ownership, intellectual property, business skills, marketing, and general industry trends. Although the central theme of these courses is entrepreneurship, broader latitude is given to subject matter.

4. Option Course [min 3 credits; graded]:

For this requirement, students may select a 500-level or above technical elective from their particular area of focus. (e.g. clean tech, tissue engineering, etc.)

In the event that a student is not simultaneously enrolled in a graduate degree program (free-standing CASE model for professionals), that student will be asked to complete three elective courses for a minimum of 7 credits, rather than two elective courses (4 credits) and one technical elective course (3 credits).

5. Entrepreneurial Practicum [3 credits; graded]:

The practicum is a self-directed project-based course, designed to give students firsthand experience in entrepreneurship, by allowing them to work on their own business idea. Through this course, students will learn how to assess the viability of a business concept, along with the steps involved in starting a company. Enrollment in the practicum is by application only.

All students enrolled in the practicum meet weekly to share lessons learned from their experiences, receive feedback and guidance on their projects, and hear from guest speakers. At the end of the semester, students hand in a final report and give a presentation to a panel on what they did and what they learned during the semester. The expected workload of the practicum is estimated to be 9-12 hours per week for a 14-week period.

Students are not expected to launch a business following the course. In fact, there is no penalty for discovering that an initial idea is not workable. Rather, the goal of the practicum is to transfer entrepreneurship knowledge and skills to students through practical exercises. The ability to adapt or pivot is one such fundamental skill.

There are currently two practicum courses:

- ENGR 490.094 Entrepreneurship Practicum**
- ENGR 490.009 Social Venture Creation Practicum**

The Entrepreneurship Practicum accepts projects from a wide range of industries, while the Social Venture Creation Practicum is dedicated exclusively for students that wish to launch a socially-oriented enterprise.

Note: ENGR 490.094 has been in existence for 6 semesters and will go to the curriculum committee in Winter 2011 for an official number. ENGR 490.009 has been in existence for 2 semesters and will also be submitted to the curriculum committee for an additional number. As graduate enrollment grows, a new graduate level practicum course will be created, increasing the involvement of U-M Tech Transfer and the U-M Business Engagement Center.

Table 1. Course Offerings for the CASE in Entrepreneurship (detailed descriptions of the courses are provided in the Appendices)

Required Courses	ENGR 407 ENGR 417	Entrepreneurship Seminar: Distinguished Innovators Series Distinguished Innovators Series Discussion Group
Core Courses	DESCI 501 EECS 406 ENGR 520 ES 715 FIN/ES 629	Analytical Product Design High-Tech Entrepreneurship Entrepreneurial Business Fundamentals for Engineers & Scientists Innovative New Business Design Financing Research Commercialization Practicum
Elective Courses	ECON 412.002 EECS 495 EECS 498 ENGR 405 ENGR 490.005 ENGR 408 ENGR 409 ENGR 521 ES 520 ES 569 IOE 548/OMS548 MKT 625 PSYCH 487.001 SI 663	The Economics of Entrepreneurship Patent Fundamentals for Engineers Smart Phone Programming Problem Solving and Troubleshooting in the Workplace Entrepreneurial Ownership Patent Law Venture Business Development Clean Tech Entrepreneurship Clean Tech Venture Opportunities Managing the Growth of New Ventures Integrated Product Development Innovation and New Product-Service Leadership Entrepreneurship: Its Social and Psychological Basis Entrepreneurship in the Information Industry
Flexible Technical Elective	500-level or above elective in industry focus area	
Entrepreneurial Practicum	ENGR 490.001 ENGR 490.009	Entrepreneurial Practicum Social Venture Creation Practicum

Accessibility, Support, and Advising

Advising for interested or declared students will be handled in coordination with the Center for Entrepreneurship Academic Programs Office and Interpro. The CFE Academic Programs team – including the Assistant Director, Programs Manager, and Programs Assistant – will assist students with course selection, academic planning, and program registration; and will maintain relevant academic records for the program. Interpro will be responsible for the admission process and program oversight as discussed in the Governance Section below.

Governance

A CASE **Executive Committee** will govern the program. The Executive Committee will include two COE faculty members, the InterPro director and the Assistant Program Director for Academic Programs in the Center for Entrepreneurship.

Conclusion

A CASE in Entrepreneurship will be a unique and valuable educational opportunity for engineering graduate students and professionals who wish to become leading entrepreneurs and intrapreneurs, and we hope that you will approve this program for the earliest effective date.

Appendix A: Example Student Schedule for CASE in Entrepreneurship Curriculum

Comment [SMM1]: A SCHEDULE MAKES ME THINK THAT YOU'LL SHOW HOW MANY SEMESTERS IT WOULD TAKE TO DO THIS, WHAT COURSES WOULD GO TOGETHER, ETC.

Required [2 credits]:

Course No.	Course Title	No. of Credits
ENGR 407	Entrepreneurship Seminar: Distinguished Innovators Series	1
ENGR 417	Distinguished Innovators Series Discussion Group	1

Core Course [3 credits]

Course No.	Course Title	No. of Credits
ENGR 520	Entrepreneurial Business Fundamentals for Engineers & Scientists	3

Elective Courses [4 credits]

Course No.	Course Title	No. of Credits
ENGR 408	Patent Law	1
ES 569	Managing the Growth of New Ventures	3

Flexible Technical Elective [3 credits]

Course No.	Course Title	No. of Credits
BioMedE 584	Tissue Engineering	3

Practicum Courses [3 credits]

Course No.	Course Title	No. of Credits
ENGR 490.094	Entrepreneurship Practicum	3

Appendix B: Required Courses

ENGR 407 – Entrepreneurship Seminar - Distinguished Innovators Series

For this one-credit, pass/fail seminar the CFE invites successful entrepreneurs to speak to students about their experiences. Lectures are held weekly, for one hour. Students are graded on attendance and a class project. This course is intended to expose students to entrepreneurship and to inspire them to undertake their own endeavor through interaction with business leaders, venture capitalists, attorneys, and other individuals involved in emerging business models, new venture creation, and technology commercialization. Past speakers include: Tim Westergren, the Chief Strategy Officer and Founder of Pandora Media; Dean Kamen, Inventor of the Segway; Joel Martin, Eminem's Producer and Founder of 8 Mile Style Music; Robert Wolfe, Co-Founder of Moosejaw; and Jay Adelson, former CEO of Digg.

Instructor: Doug Neal

ENGR 417 – Distinguished Innovators Series Discussion Group

For this one-credit, graded course, with three key objectives: 1) To understand the key elements of entrepreneurship as a mindset in approaching problems and opportunities; 2) To learn how to apply entrepreneurship characteristics in your own life goals; 3) To identify and understand entrepreneurial characteristics as presented by the distinguished innovator speakers in ENGR 407. Students are graded on weekly assignments that relate to an entrepreneurial topic or the presentation during that week or the topic of the week's discussion session, such as a preparatory paper or a follow-up questionnaire. In some cases, personal response or feedback is required, or a CTOOLS-enabled quiz will be administered.

Instructor: Doug Neal

Appendix C: Core Courses

DESCI 501 – Analytical Product Design

Prerequisite: Graduate Standing

The design of artifacts is addressed from the multidisciplinary perspective that includes engineering, art, psychology, marketing, and economics. Using a decision-making framework, emphasis is placed on understanding basic quantitative methods employed by the different disciplines for making design decisions, building mathematical models, and accounting for interdisciplinary interactions throughout the design and development process. Students work in teams to apply the methods on design project from concept generation to prototyping and design verification.

Instructor: Panos Papalambros

EECS 406 (ENGR 406) - High-Tech Entrepreneurship

Prerequisite: None. (4 credits)

Four aspects of starting high-tech companies are discussed: opportunity and strategy, creating new ventures, functional development, and growth and financing. Also, student groups work on reviewing business books, case studies, and elevator and investor pitches. Different financing models are covered, including angel or VC funding and small business (SBIR) funding.

Instructor: Mohammed Islam

ENGR 520 – Entrepreneurial Business Fundamentals for Engineers & Scientists

Prerequisite: Senior or Graduate standing. (3 credits)

This course provides students with a perspective in looking to form or join startup companies and those that are looking to create corporate value via industrial research. The students are taught the entrepreneurial business development screening tools necessary to translate opportunities into businesses with focus on: strategy, finance, and market positioning.

Instructors: Peter Adriaens, Tim Faley

ES 715: Innovative New Business Design

Prerequisite: Graduate standing. (3 credits)

This synthesis-focused, project-based course integrates elements of various business school and engineering courses into a high-level process for determining how to capture value from an innovation source—specifically a new technology. Designing a new business from an innovation source is the first step in creating a new business from a technological discovery. This course is focused on the design of

the business: formulating a sound, detailed, market-driven, value-capturing business concept from a new technology. In this course the product offering (including its sustainable differentiation), a specific target market, and the company's core business model will all be specifically defined.

Instructor: Tim Faley

FIN/ES 629/329 Financing Research Commercialization Practicum

Prerequisite: MBA student (629) or permission of instructor. (3 credits)

This course is a practicum, offering an opportunity to apply collective team work of a student/mentor alliance to building a launch pad for a technology-based venture. This course is open to Ross School MBA and BBA students as well as all UM graduate students. Student teams will work with mentors and principal investigators (PI) from UM faculty in the Medical School, College of Engineering and other divisions to build a business and marketing plan for a new technology or invention. Projects are based upon disclosures made to UM Office of Technology Transfer, other universities and industrial companies.

Instructor: David Brophy

Appendix D: Elective Courses

ECON 412.002 – The Economics of Entrepreneurship

Prerequisite: ECON 402 or Graduate standing

This course will apply insights from economic theory to the practice of starting a new business or expanding a current business. The course will combine elements of strategy, marketing, and entrepreneurial finance courses as typically taught in a business school and an industrial organization class as taught in an economics department. We start by examining general issues regarding entrepreneurship, in particular the search for markets that can support entrepreneurial profits. The next section turns to specific strategic decisions that entrepreneurs make: pricing, advertising, product location, deterring entry by competitors, etc. The last section examines practical issues in entrepreneurship, e.g. finding capital, business plans, patent protection, negotiation, and employee compensation.

Instructor: Daniel Ackenberg

EECS 495 - Patent Fundamentals for Engineers

Prerequisite: Junior standing or above. (4 credits)

This course covers the fundamentals of patents for engineers. The first part of the course focuses on the rules and codes that govern patent prosecution, and the second part focuses on claim drafting and amendment writing. Other topics covered include litigation, ethics, and licensing.

Instructor: Mohammed Islam

ENGR 405 – Problem Solving and Troubleshooting in the Workplace

Prerequisite: Senior Standing. (3 credits)

The goals of this course are to help students enhance their problem solving, critical thinking, creative thinking, and troubleshooting skills and to ease the transition from college to the workplace. The course includes a few guest speakers from the industry. Students work in teams to complete homework problems and the term project.

Instructor: Scott Fogler

EECS 498 – Smartphone Programming

Prerequisite: Senior Standing. (3 credits)

This seminar will be a project-oriented, software construction-focused course. Students will design and build applications for the iPhone and/or the Android phone. Students will form project teams for the design and development effort, and will review key resources such as websites, blogs, articles, and books. In particular, to help contextualize the construction effort, the course will use The Art of the

Start” by Guy Kawasaki as the core textbook in the course. The intent of the course is to produce commercially viable applications for either the iPhone or the Android phone.

Instructor: Elliot Soloway

ENGR 408 - Patent Law

Prerequisite: None. (1 Credit)

Inventors and entrepreneurs have four concerns related to patent law: protecting their inventions in the very early stages of product development, determining the patentability of their invention, avoiding infringement of a competitor's patent, and leveraging their patent as a business asset. This course will address each of these concerns through the application of case law and business cases to an invention of the student's choice.

Instructor: Jeffrey Schox

ENGR 409 – Venture Business Development

Prerequisite: Junior standing or above (or permission of instructor), by application. (1 Credit)

This course will prepare students to identify and evaluate commercial opportunities for emerging technologies. The emphasis will be on the design and evaluation of business models and on the methods necessary for rapid yet rigorous analysis of these models. Projects will span multiple disciplines and markets. Students will work in interdisciplinary teams; yet are also expected to contribute to the success of the other teams.

Instructor: Marc Weiser

ENGR 490.005 – Entrepreneurial Ownership

Prerequisite: None. (1.5 Credits)

Once entrepreneurs launch a new venture, they must then decide how to split up the pie between founders, employees, and outside funders. Most entrepreneurs are ill-equipped to make strategic decisions regarding company ownership structures. This course provides an analytical framework to evaluating various ownership models, such as employee and individual ownership models. It will also improve entrepreneurial skills and understanding of the way ownership decisions affect organizational dynamics, and look at specific mechanisms that create positive ownership outcomes.

Instructor: William K. Hall, Moses Lee, Aileen Huang-Saad

ES 520 – Clean Tech Venture Opportunities

Prerequisite: None. (1.5 credits)

In 2006, Clean Tech became the third-largest sector for venture investment (\$2.9 Bn), indicating the potential for economic growth in this technology innovation space. The growth in this area is primarily driven by investments in Energy, with lesser investment in Water, Transportation, Advanced Materials, Manufacturing and Agriculture. Clean technologies have the opportunity to deliver dramatic improvements in resource efficiency and productivity, creating more economic value with less energy and materials, or less waste and toxicity. The course will focus on value creation in this space, with emphasis on how strategic business drivers (e.g. regulation, subsidy, and market valuation) influence innovation and investment, and how this may impact research hypotheses and needs. The perspectives provided in this course will be valuable for students that are both looking to form or join startup companies as well as for those that are looking to create corporate value via industrial research.

Instructor: Peter Adriaens

ENGR 521 – Clean Tech Entrepreneurship

Prerequisite: Senior and Graduate Standing. (3 credits)

This course teaches the students how to screen venture opportunities in various clean tech domains. Venture assessments are approached through strategic, financial, and market screens, with consideration for the impact of policy and regulatory constraints on the business opportunity. A midterm, final project, and six homework assignments are required.

Instructor: Peter Adriaens

ES 569 – Managing the Growth of New Ventures

Prerequisite: Strategy 502/601 (1.5 Credits)

New entrepreneurial ventures, once successfully past the formation stage, often encounter problems caused by their very rapid growth. Different functional and technical skills are needed. More reliable information is a must. Both external support groups (bankers, attorneys, accountants, and investors) and new company employees have to be integrated into the goals and operations of the firm. The activities of the entrepreneur have to change from innovation to delegation, communication, and organization. This is a very basic change that many entrepreneurs never make. The purpose of the course is to convey in a very pragmatic fashion the reason, the areas, the tools, and the urgency of that critical leadership change.

Instructor: Thomas Porter, Anthony Grover

IOE 548 / OMS 548 - Integrated Product Development

Prerequisite: Graduate Standing & Permission of Tauber Institute. (3 credits)

This is a Tauber Institute-sponsored graduate elective. Students form teams of four to five, each with mixed disciplinary backgrounds spanning business, engineering and art/architecture. A product category is announced, and each team acts as an independent firm competing in that product market

against other teams while working independently through an integrated exercise of market research, product design, product development and manufacture, pricing, demand forecasting, and inventory control. Market share of each team is determined through both a web-based competition and a physical trade show.

Instructor: William Lovejoy, William Jackson

MKT 625 – Innovation and New Product-Service Leadership

Prerequisite: MKT 501 or 503 (3 Credits)

Innovation and development of new products and services are essential for the success of any organization. At the same time, designing and launching new products is risky. Managing new-product development therefore involves identifying new product ideas that have great potential and lowering the risk of their failure. This course discusses the stages in the process and avenues for making the process more productive. Specific topics covered include: creative techniques for idea generation, designing new products and services using analytical techniques, sales forecasting, testing, and tactics and strategies for new-product launch. The course uses lectures, cases, and outside speakers. Moreover, the course includes a project wherein student teams will use the creativity techniques covered in this class to come up with new product ideas and perform a concept test in order to evaluate their feasibility. The course has a quantitative focus and covers issues relevant to managers on a daily basis. The course will be especially useful for those interested in product/brand management, management consulting, and entrepreneurship.

Instructor: Srinivasaraghavan Sriram

PSYCH 487.001 – Entrepreneurship: Its Social and Psychological Basis

Prerequisite: PSYCH 111, 112, 114 or 115

Entrepreneurship, to many people, is difficult to define and can represent a mysterious outcome by which new businesses are started. Entrepreneurship, though, not only involves the creation of new firms, but it can also occur within existing organizations-whether in the pursuit of profit or other social goals. Further, regardless of where entrepreneurship occurs, the process not only involves enterprising individuals, but also the availability of opportunities, which can be created, discovered, and exploited. A person could be creative and enterprising but this does not guarantee the creation or discovery of opportunities. In this course a major focus will thus be on the concept and study of opportunities, which we will pursue by considering the social context in which they are embedded and the psychological and behavioral processes that influence their creation, recognition, evaluation, and exploitation. The course material will be based on scholarly articles and cases on entrepreneurship and related subjects, and the class format will involve group presentations, lecture, class exercises, and active discussion in a seminar format.

Instructor: Oscar Ybarra

SI 663 - Entrepreneurship in the Information Industry

Prerequisite: Graduate Student. (3 Credits)

This course prepares students to start businesses in the information industry or to work effectively in new start-up businesses. It discusses aspects of creating a business and expects students to develop an idea into a business plan that could be used to either guide the creation of the business or secure funding for a new business.

Instructor: Victor Rosenberg

