Industrial-Based Senior Projects

BACKGROUND:

Thank you for your interest in sponsoring a senior project with the Lake Superior State University (LSSU) School of Engineering and Technology. LSSU has conducted numerous senior projects for over two decades, mostly partnering with industry (more information on previous projects can be found at the following link: www.lssu.edu/eng/seniors/). These projects have resulted in excellent outcomes thereby providing an excellent experience for all the stakeholders, namely, the industrial partners, the LSSU engineering and technology graduates, and the LSSU School of Engineering and Technology. We plan to select the senior projects for the 2017-2018 academic year by the mid part of August 2017. In preparation for doing so, there are two deadlines:

- The 1st deadline is July 7. By this date you should submit an “Intent to Apply” email to the SPFB chair. The email should include a few sentences describing the general project idea and a list of the expected student expertise, by major such as 2 electrical engineers + 3 mechanical engineers.
- The 2nd deadline is July 31. By this date you should submit the full proposal (read on for details).

As you may know, all LSSU engineering and engineering technology students are required to work on a senior “capstone” project during their final year. The project can be research based, co-op based or industrially based. Most of our projects are industrially based. That is where you come into the picture, and that is the subject of this document.

During the spring and summer, we recruit projects from industrial partners. Projects are submitted from a variety of companies within Michigan, the surrounding states, Canada, and beyond. Around late July or early-to-mid August, the Senior Projects Faculty Board (SPFB) reviews and then selects the projects for the following academic year and assigns students to the projects. The students begin work on the projects in early September and are scheduled to complete the projects in late March of the following year. The SPFB assigns a Faculty Advisor to each project. Together, the Faculty Advisor, the industrial partner, and the SPFB oversee the project for its entire duration. The SPFB works closely with the industrial partner to define the scope of the project early in the Fall semester. The SPFB also monitors project progress and may adjust the project scope during the academic year after discussions with the industrial partner. More information about the different people involved and their roles & responsibilities can be found in Appendix C.

The fee to sponsor an engineering senior project at LSSU is $5,000. This fee is in addition to actual material expenses necessary to complete project. Neither the students nor the faculty are paid for their engineering work. The customer owns all designs, prototypes, or systems that result from the project, but must agree not to hold LSSU or the students liable for repercussions of any design or build flaw. The customer must provide an engineer who will act as the Industrial Contact for the project. The Industrial Contact is requested to attend a kick-off meeting in late August (if needed), provide input through periodic informal telephone meetings, attend at least one formal design review, and to attend the final presentation in April/May of 2018. The design reviews may be conducted via videoconference or by using other networking tools.

LSSU senior projects have won many awards and national design competitions (8 since the year 2000) and results have also been presented at professional conferences. We are proud of both the quality of our projects and the awards that the projects have received. Your support of an LSSU senior project is an excellent way to receive a student-engineering project (such as a feasibility study, proof-of-concept, or working prototype) at a low cost and to support the LSSU engineering and engineering technology programs.

If you have any questions about the guidelines and/or about determining appropriate goals/an appropriate scope for a project that you have in mind, you are welcome to contact the SPFB chair directly before submitting your proposal; this is especially recommended if you have not been previously involved in Senior Projects at LSSU. The current SPFB chair is Dr. Paul Weber. He can be reached at 906-635-2031 or at PWEBER@LSSU.EDU. We look forward to receiving a project proposal from your organization.

Updated March 24, 2017
Project Selection Criteria

There are numerous factors that are considered by the Senior Projects Faculty Board while selecting the senior projects for an academic year. Here are some of the main considerations:

1) Is there a good match between the senior students and the projects being considered? (For example: in a particular year there may be far more electrical engineering students than in the other fields, which means, more EE based projects will be selected.)

2) Is there a good match between the resources at LSSU (faculty, staff, lab facilities, etc.) and the projects?

3) Does the scope of the project fit the LSSU academic time frame? That is, the project scope should be appropriate so that it can be completed over two semesters (30 weeks) with a student team which typically consists of 5 members who are expected to put in about 15 hours per week per team member towards the project.

4) Is the project clearly defined and with achievable outcomes?

5) Is there clear evidence of engineering and financial support that will be provided by the sponsoring organization?

Project Proposal

INSTRUCTIONS:

Fill in the attached form as best as you can. The areas under the headings are intended for you to insert your own words. A sample proposal, which includes italicized text for a hypothetical project proposal is included and is intended to give you an idea of what to write.

We do not need to know all the details about your project at this point. We are mainly looking for a broad description of your project and your contact information. It should take you about an hour or less to fill out the form.

You can either send the form by postal mail or by electronic mail.

By postal mail
Dr. Paul Weber
Lake Superior State University
Department of Engineering and Technology
650 West Easterday Ave.
Sault Sainte Marie, MI 49783

By electronic mail
PWEBER@LSSU.EDU

If you need any assistance, contact the SPFB chair, Dr. Paul Weber, at 906-635-2031 or at PWEBER@LSSU.EDU.

Thanks again for your interest!
SENIOR PROJECT SUBMITTAL FORM

See appendix for example proposal

Company Background

Briefly describe your company and your division.

Project Description

Indicate the category of the project, checking all that apply:

☐ Mostly Research   ☐ Mostly Analysis   ☐ Mostly Design   ☐ Design and Build
☐ Electrical Oriented ☐ Computer Oriented ☐ Mechanical Oriented ☐ Multidisciplinary
☐ Robotics          ☐ Process Design    ☐ Other_______________

Also, briefly describe the nature of the project. What is your need? What is the expected outcome? Will the students be expected to travel (from the project budget if outside the area) as part of the project?

Budget

Give a ball park estimate of the cost of materials and supplies for this project. Do not include your engineering cost or the $5,000 project fee.
**Technical Content and Required Expertise**

Indicate which skills will be needed by the students, using the following rating system:

0 – None [Needed]  
1 – Small Amount  
2 – Moderate Amount  
3 – Large Amount

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<th>Rating 4</th>
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<td>Instrumentation &amp; Test Equipment</td>
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<td>Mechanical Design</td>
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<td>Mechanical Design</td>
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<tr>
<td>General Software</td>
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</table>

**Comments (Optional):**

Also, specify the type of engineering work by that will be needed to complete this project. Also estimate the number and discipline of the engineering students that you estimate will be needed.

**Engineering Work:**

**Number and Type of Students Needed:**

Number

<table>
<thead>
<tr>
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<tr>
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<td>______</td>
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<td>Manufacturing Eng Tech</td>
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<tr>
<td>Mechanical Engineering</td>
<td>______</td>
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</tbody>
</table>

Reason: ________________________________

Reason: ________________________________

Reason: ________________________________

Reason: ________________________________

Reason: ________________________________

Reason: ________________________________
**Industrial Support**

List the types of support, other than money the industrial contact’s time, that your company will provide for the project. Also list the types of support that your company will not provide for the project. Successful projects will have support within your organization that have appropriate decision making authority.

**Legal Agreements**

There are two legal forms associated with each project. *Form A: Agreement and Release* is to be signed by each student on the project. *Form B: Agreement* is to be signed by LSSU, your organization, and each student on the project. Both legal forms are attached to the end of this document. Please read them carefully. Using the first set of checkboxes below, indicate whether your organization is able to sign them without modification or your organization wishes to modify them. Using the second set of checkboxes below, indicate whether or not your organization has additional forms to be signed. This is very important and needs to be determined before project acceptance. **Do not edit or sign the forms at this time; actual forms will be sent to you later.**

Forms A and B:  □ may be signed without modification  
□ need to be modified (please attach modified language)

Additional forms: □ are not needed  
□ are needed (please attach additional forms)

**Contact Information**

Provide your information and the information of the likely industrial contact for the project. If you will be the industrial contact for the project or if this person has yet to be identified, just leave the latter part blank. The longer the Industrial Contact has been at your company, the more likely your project will be successful and be selected.

<table>
<thead>
<tr>
<th>Person Submitting Proposal</th>
<th>Likely Industrial Contact</th>
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</thead>
<tbody>
<tr>
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<td>Name ..........................</td>
</tr>
<tr>
<td>Title ..........................</td>
<td>Title ..........................</td>
</tr>
<tr>
<td>Company .......................</td>
<td>Company .......................</td>
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<td>Phone .........................</td>
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<tr>
<td>Email ..........................</td>
<td>Email ..........................</td>
</tr>
<tr>
<td>Tenure ........................</td>
<td>Tenure ........................</td>
</tr>
</tbody>
</table>
Appendix A: Legal Forms

FORM A: AGREEMENT AND RELEASE

I, (insert your name), (the Student) of (insert your address), enrolled at Lake Superior State University (the University), hereby confirm that I have full knowledge regarding the requirements related to EGNR491 and EGNR495, Engineering Design Project I and Engineering Design Project II, and the need to engage in a senior project design effort to receive a degree from the University. I also understand and agree that I may need to seek the assistance, counsel and participation of (insert company name) (the Company), to successfully complete the course project.

In consideration of being allowed to enroll in the course, and for the assistance received from the Company, I agree to hold harmless the Company, its officers, employees, and agents from any claims by me, my heirs or assigns arising out of my participation in the design project.

I further understand and agree that in exchange for the assistance provided to me, I hereby convey all of my rights of whatsoever nature to the design developed by me to the Company.

I further acknowledge that I will not intentionally violate any patent or design rights related to the project.

I have fully informed myself of the contents of this affirmation and release by reading it before signing.

I understand this document and have willingly executed it this (insert day) day of (insert month), 2017.

___________________________
(sign here)

(insert your name in block letters)
(insert your team name in block letters)

Student at LSSU
FORM B: AGREEMENT

This Agreement is made on (insert date), 2017, between (insert company name) (the Company), Lake Superior State University of Sault Ste. Marie, Michigan (the University), and (insert your name) (the Student).

In consideration of the fact that each of the parties acknowledges and agrees that it is in their interest to have the Student engaged in a senior Engineering Design Project, hereinafter referred to as Design, in connection with the Student's academic program at the University, it is agreed that:

1. Each of the parties understands that the Design is being undertaken for EGNR491 and EGNR495, Engineering Design Project I and Engineering Design Project II, and is the work of the Student. The parties further understand that neither the Student nor the University will or has received any compensation for the Student's work from the Company, but that the Company will provide advice and counsel on the Design during the term of the course. The Company may provide equipment, may provide the use of its facilities for the design project, and has agreed to pay a project fee that will go to the School of Engineering and Technology for the support of Senior Projects.

2. Upon completion of the course, the results of the Student's work shall be conveyed to the Company along with all rights of ownership and use.

3. The Company acknowledges that the Design or prototype is a Student product and further acknowledges that neither the Student nor the University warrant its merchantability, use, safety or patentability. Any decision to use the Design or a prototype is solely that of the Company.

4. The Company agrees to indemnify the University, its officers, employees, and agents, and the Student from all liability or loss, including attorney's fees, that the University, its officers, employees or agents, or the Student may suffer or that may occur arising out of any claim, action or proceeding that may be brought against the University, its officers, employees or agents, or the Student for:
   a. Any violation of any patent in connection with the use, distribution, or sale of the Design or any prototype;
   b. Any injury or loss to any person or damage or loss to property including that of the Company arising out of the use, distribution or operation of the Design or a prototype.

The Company agrees to indemnify the University, its officers, employees and agents, and the Student against any claims brought, or actions filed, against the parties in respect to the subject of indemnity herein recited, whether or not such claims or actions are valid, and against all costs incurred. The
Company further agrees that the University, its officers, employees and agents, and the Student may employ an attorney of their selection to appear and defend the action at the Company's expense.

In witness whereof, the parties below indicate that they have reviewed and accept the terms of this Agreement.

________________________________________
Company Representative
(insert representative name)
(insert company name)

________________________________________
Dr. David Finley
Acting Dean for the School of Engineering & Technology
Lake Superior State University

________________________________________
LSSU Student
(insert your name)
(insert team name)
Appendix B: Example Proposal

SENIOR PROJECT SUBMITTAL FORM
(This is a sample proposal for a hypothetical project.)

Company Background

Briefly describe your company and your division.

Vivicom is a division of Vivitel International, Inc. Vivitel International has 8,500 employees at 13 sites throughout the United States. The company designs and manufactures specialized electronic components for electrical equipment manufacturers in the United States and Europe. Vivicom has 1,250 employees and is located in Ann Arbor, Michigan. Vivicom designs and manufactures ultra fast electronic switches to telecom companies and satellite manufacturers.

Project Description

Indicate the category of the project, checking all that apply:

☐ Mostly Research  ☐ Mostly Analysis  ☐ Mostly Design  x Design and Build
x Electrical Oriented  x Computer Oriented  ☐ Mechanical Oriented  ☐ Multidisciplinary
☐ Robotics  ☐ Other_________________

Also, briefly describe the nature of the project. What is your need? What is the expected outcome? Will the students be expected to travel (from the project budget if outside the area) as part of the project?

We have a $22.6M contract to design a digital router that may be packaged into a subsystem for a satellite. The router must run at 30 GBytes per second and must run off of 12 V and consume less than 25 mW of power. The router is currently being designed and we plan to manufacture prototypes by July 2013.

We want LSSU to design and build a test stand to verify the operation of prototypes of this router unit. The test stand should allow our engineers to insert router prototypes and test their operation. The test stand should simultaneously send 300 10MHz test signals to the router and then check the output signal to see if any error has occurred.

The expected outcome will be a fully functional test stand that our engineers can use to test router prototypes and documentation that would allow us to construct additional test stands. We expect the students to travel to Vivicom in the fall semester to have a plant tour and view several existing products. The travel costs for this student travel are included in the projected budget below.
Budget

Give a ball park estimate of the cost of materials and supplies for this project. Do not include your engineering cost or the $5,000 project fee.

*I have forecast that this project will cost approximately $50K. The cost for building materials of the physical test stand structure will be about $10K. The cost for the high-speed electronics in the test stand will be about $40K.*

Technical Content and Required Expertise

Indicate which skills will be needed by the students, using the following rating system:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – None [Needed]</td>
<td>1 – Small Amount</td>
</tr>
<tr>
<td>Machine Shop</td>
<td><em><strong>0</strong></em></td>
</tr>
<tr>
<td>AC Wiring</td>
<td><em><strong>0</strong></em></td>
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<td>NC/CNC</td>
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</tr>
<tr>
<td>CAM</td>
<td><em><strong>0</strong></em></td>
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<td>CAD</td>
<td><em><strong>1</strong></em></td>
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<tr>
<td>Machine Vision</td>
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<tr>
<td>PLC’s</td>
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<td>Microcontrollers/Embedded Systems</td>
<td><em><strong>3</strong></em></td>
</tr>
<tr>
<td>Classical (ex: PID) Control</td>
<td><em><strong>0</strong></em></td>
</tr>
<tr>
<td>Other:</td>
<td>___________</td>
</tr>
</tbody>
</table>

Comments (Optional):  
This project is very heavy in CE/EE/EET
Also, specify the type of engineering work by that will be needed to complete this project. Also estimate the number and discipline of the engineering students that you estimate will be needed.

Engineering Work:

This project will entail the following technical tasks:
- 20% identification and purchase of high-tech communication modules
- 35% hardware design to mount and interface the communication modules
- 35% assembly level programming
- 10% design of prototype package

Number and Type of Students Needed:

Number

<table>
<thead>
<tr>
<th>Number</th>
<th>Type of Student</th>
<th>Reason</th>
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<tbody>
<tr>
<td>1-2</td>
<td>Computer Engineering</td>
<td>Program in assembly and thoroughly understand communication mathematics</td>
</tr>
<tr>
<td>1-2</td>
<td>Electrical Engineering</td>
<td>Same as above</td>
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<tr>
<td>1</td>
<td>Electrical Eng Technology</td>
<td>Validate prototype via instrument testing</td>
</tr>
<tr>
<td>1</td>
<td>Manufacturing Eng Tech</td>
<td>Design small, lightweight packaging of electronics</td>
</tr>
<tr>
<td>0</td>
<td>Mechanical Engineering</td>
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</tr>
</tbody>
</table>

Sample Project Proposal  
Page 2
Industrial Support

List the types of support, other than money and the time of the industrial contact, that your company will provide for the project. Also list the types of support that your company will not provide for the project.

The industrial contact will provide expertise in the area of high-speed electronic communication theory and high-speed electronic communication software algorithms. Several engineers within the company will provide expertise regarding high-speed electronic hardware. The company will also provide a C programming developmental environment and an extensive C communications library.

We cannot provide any mechanical expertise in designing or building the physical structure of the test stand. The physical construction of the test stand must be done at LSSU.

Legal Agreements

There are two legal forms associated with each project. Form A: Agreement and Release is to be signed by each student on the project. Form B: Agreement is to be signed by LSSU, your organization, and each student on the project. Both legal forms are attached to the end of this document. Please read them carefully. Using the first set of checkboxes below, indicate whether your organization is able to sign them without modification or your organization wishes to modify them. Using the second set of checkboxes below, indicate whether or not your organization has additional forms to be signed. This is very important and needs to be determined before project acceptance. Do not edit or sign the forms at this time; actual forms will be sent to you later.

Forms A and B: ☑ may be signed without modification
☐ need to be modified (please attach modified language)

Additional forms: ☑ are not needed
☐ are needed (please attach additional forms)

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<tr>
<td>Name......................... Rufus Leaking</td>
<td>Name ....................... Sharon Sharalike</td>
</tr>
<tr>
<td>Title......................... Senior Design Engineer</td>
<td>Title ....................... Design Engineer</td>
</tr>
<tr>
<td>Company..................... Vivicom, Inc.</td>
<td>Company ................ Vivicom, Inc.</td>
</tr>
<tr>
<td>Phone........................ 734-123-4567</td>
<td>Phone ...................... 734-123-4568</td>
</tr>
<tr>
<td>Email......................... <a href="mailto:rleaking@vivicom.com">rleaking@vivicom.com</a></td>
<td>Email ..................... <a href="mailto:ssharalike@vivicom.com">ssharalike@vivicom.com</a></td>
</tr>
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<td>Tenure ..................... 17 years</td>
<td>Tenure ................. 8 years</td>
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Appendix C: Senior Project Constituent Roles & Responsibilities

The following is an attempt at defining the roles and responsibilities of each of the concerned constituents of the LSSU Engineering Senior Projects program.

**Senior Projects Faculty Board (SPFB):** The body that organizes & oversees all Senior Projects activities.
- Consists of the chair, the faculty advisors (FAs), the laboratory engineers, and others (when needed)
- Typically meets weekly to address project needs and student/team requests
- Defines policies for the LSSU Engineering Senior Projects course/experience (within the constraints of other LSSU policies)
- Implements policies: Oversees the course, assigns grades, and determines disciplinary actions
- Defines course objectives, lectures, and creates/edits class PowerPoint slides
- Determines, with the recommendation of the team’s FA, when a team's project has satisfied the acceptance criteria and is therefore complete

**Faculty Advisor (FA):** The faculty member that advises at least one of the Senior Project teams.
- Participates as an active member of the SPFB
- Creates, critiques, and grades the team members’ assignments, group interactions, and performance
- Advises the team on:
  - Class assignments (PDP, Scope Presentations, Timeline, Design Reviews, etc.)
  - Group interactions and professional behavior
  - Interaction with the Industrial Customer (IC), SPFB, other FAs, and other Senior Projects groups and students
  - Project direction, design, content
- Initiates disciplinary action of team members
- Guides ICs, especially new ICs, with understanding the roles and responsibilities stated in this document
- Shields the team from unreasonable expectations (e.g. students should not be treated as if they were full-time employees)
- May share technical ideas with the team, but is not personally responsible for the outcomes of the project nor is there an expectation for the FA to have expertise in the specific area
**Industrial Customer (IC):** The contact at the company that is sponsoring one of the projects.

- Submits a project proposal (including a budget and the identification of a project leader at the sponsoring company)
- Works with the FA and team to establish project acceptance criteria
- Supports the Senior Project team assigned to the project by:
  - Maintaining contact (outside of email) with the team at least once every 4 weeks via events*, including:
    - Weekly (or bi-weekly, or whatever the group decides) team meetings,
    - Graded design reviews, and
    - Presentations
  - Advising the team on specialized topics or expertise (to be determined by the specialization of the company, the project, and the expectations of the IC)
  - Providing funds for the project and the project fee, which may constitute performing some of the purchasing for the team (as directed by the IC)
  - Communicating with the FA as needed
- Does not manage the [student’s portion of the] project, but rather externally advises it in coordination with the FA

*Note: Some of these events can be attended via phone and/or video conference calls.

**Student:** A student enrolled in EGNR491 and/or EGNR495.

- Attends all senior project functions as assigned, including:
  - All team meetings
  - All IC meetings
  - All class and other team activities (lectures, labs, design reviews, presentations, etc.)
- Submits or participates in all class, lab, and FA assignments
- Learns and starts to apply management skills (peer evaluations, Gantt charts, RASI charts, meetings/agendas/minutes, etc.)
- Acts as a role model to the underclassmen (acting in a professional manner at all times)
- Holds a general responsibility for the project
- Is always prepared to discuss their project and/or give impromptu demonstrations to visitors
- Is responsible for completing the project by spring semester’s end, ensuring the result fulfills the stated acceptance criteria; students will generally be required to stay beyond the end of the semester if this responsibility is not fulfilled