

Senior Capstone Project Proposal

The project is designed for a team of students working toward completion of a project, within two semesters¹.

Title	Real-Time Embedded Motor Control System for BLDC Fuel Transfer Pump
Sponsor	Contact person: John Haverstock Company name: Fill-Rite Co.
	Contact info: john.haverstock@fillrite.com (260-299-7031)
Description	<p>Objectives:</p> <ul style="list-style-type: none"> • Hardware Development: Design and prototype a custom Printed Circuit Board Assembly (PCBA) capable of delivering up to 1.5A at 240VAC to drive the BLDC motor efficiently and reliably. • Software Development: Develop real-time embedded firmware to control motor speed, direction, and torque using advanced control algorithms (e.g., PWM, sensorless commutation, and potentially Field-Oriented Control). • System Integration: Interface the control system with appropriate sensors (e.g., Hall effect sensors or encoders) and implement safety features such as overcurrent protection, thermal monitoring, and fault detection. • Testing & Validation: Conduct bench-level and system-level testing to validate performance under various load conditions, ensuring compliance with electrical and thermal specifications. <p>Technical Scope:</p> <ul style="list-style-type: none"> • Microcontroller-based control (e.g., STM32 platform) • Real-time firmware development using STM32CubeIDE • Power electronics design (MOSFET drivers, current sensing, voltage regulation) • Closed-loop control implementation (e.g., PID or FOC)

¹In general, one semester has 15 weeks. For a 3 credit hours course, a student is expected to work minimum of 8 hours per week for the project which is equivalent to minimum of 120 hours.

²This information is for reference purposes only, and it will help us to identify a suitable faculty advisor and form student teams..

	<ul style="list-style-type: none"> • PCB design using industry-standard tools (e.g., Altium Designer) • Integration with diagnostic and telemetry interfaces (e.g., UART, CAN, or I2C) <p>Expected Outcomes:</p> <ul style="list-style-type: none"> • A fully functional motor control system integrated into a custom PCBA • Demonstrated control of the BLDC fuel pump under dynamic operating conditions <p>Documentation including schematics, firmware, test results, and user manual</p>
Disciplines (ME, EE, CS, etc.)	EE / CS
For ECE	Hardware: PCB Design (Altium), Analog Circuit Validation (LT Spice) Software: C, C++, or C#
Estimated budget	\$3500
Technology Disclosed? If so, what?	Firmware for Motor Control
Additional requirements	N/A
NDA or IP Assignment agreement requested?	Yes

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Technology and ECCN:

“If your project involves ‘technology’ that is either (a) not publicly available or (b) includes proprietary source code (not executable files), then it requires an ECCN.” ‘Technology,’ for this purpose, is defined as “information necessary for the development, production, use, operation, installation, maintenance, repair, overhaul or refurbishing of an item. Technology may be in any tangible form, such as written or oral communications, blueprints, drawings, photographs, plans, diagrams, models, formulae, tables, engineering designs and specifications, computer-aided design files, manuals or documentation, electronic media or information revealed through visual inspection.”

Interactive tool to determine ECCN:

<https://www.bis.doc.gov/index.php/export-control-classification-interactive-tool>

NDAs and IP Assignments:

The sponsoring company typically has NDAs and IP assignment forms that it wishes to use. Neither the NDA nor the IP assignment is an agreement with Purdue directly; these agreements are between the students and the sponsoring company. Of course, our office can review the company-provided documents to be certain it aligns with Purdue’s standards. Alternatively, our office has draft agreements which we could provide for the sponsor’s use. Again, as NDAs are between the student and the sponsor, Purdue cannot be a party to or advise the sponsor or the student on the NDAs, other than to outline some basic expectations as to fairness and suitability of the NDA to a student project.

Sponsor Acknowledgements:

By way of background, Purdue University professors who have senior capstone class projects involving outside sponsor companies notify our office so that we can prepare an acknowledgement form for the sponsoring company’s completion. This is not a contract but an acknowledgement form signed by sponsoring companies which lays out Purdue’s guidelines regarding class projects and outside company inputs, potential export control issues, and student intellectual property. Some sponsoring companies offer a monetary donation to the project, but that is not a requirement.

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INTELLECTUAL PROPERTY AND NON-DISCLOSURE AGREEMENT

As a condition to and in consideration of my participation in a _____ Project (“Project”) starting on _____ (“Effective Date”), with _____, or any direct or indirect subsidiaries, their successors or assigns (hereinafter referred to collectively as Sponsor), I, the individual Project Participant named below, agree as follows (“Agreement”):

1. **No use of proprietary information of others.** Unless Sponsor has granted me specific written authorization, I will not disclose to or use in my work with Sponsor any proprietary information of others, including but not limited to any of my prior employers or Purdue University. I affirm that I have not disclosed any such information to Sponsor.
2. **Non-Disclosure of Confidential Information.**
 - a. “Proprietary Information” means any and all non-public, proprietary, or confidential information, knowledge, or data received by me in any form from Sponsor, whether or not marked as confidential, including but not limited to the following categories of information: drawings; blueprints; schematics; specifications and requirements (e.g. material, customer, and supplier specifications); functional details; estimated volumes; financial information; technical information; spend information; financial forecasts; part numbers; trade secrets; information that a reasonable person would consider non-public, confidential, or proprietary given the nature of the information or the circumstances of its disclosure; any derivatives or copies of the foregoing; and any information derived from materials containing any of the foregoing.
 - b. The term “Proprietary Information” does not include: (i) information that is in the public domain at the time of initial disclosure to me by Sponsor, or subsequently becomes publicly known through no wrongful act by me or any other person; (ii) information that is known to me prior to the time of initial disclosure, as evidenced by competent and contemporaneous written documentation; (iii) information that is independently developed by me apart from the Project without the use of or reference to Sponsor’s Proprietary Information; (iv) information that is obtained by me on a non-confidential basis from a third party that was not legally or contractually restricted from disclosing such information; or (v) information that is required to be disclosed pursuant to proper governmental or judicial process, provided that notice of such process is promptly provided to Sponsor in order that it may have every reasonable opportunity to intervene in such process to contest such disclosure.
 - c. I will use such Proprietary Information only for the benefit of Sponsor in obtaining credit for my Project. I will not use Proprietary Information for any other purpose, such as competing with Sponsor, without the express written consent of Sponsor. I will not disclose Proprietary Information to a third party without obtaining written permission from Sponsor prior to said disclosure and ensuring such third party is under obligations of confidentiality substantially similar to those in this agreement.

- d. Notwithstanding any termination or expiration of this Agreement, the obligations under this Agreement as to any Proprietary Information shall survive and continue for three (3) years from the date of the applicable disclosure of such Proprietary Information other than information constituting a trade secret, for which the nondisclosure obligations shall survive in perpetuity so long as such Proprietary Information remains a trade secret.
 - e. Sponsor does not, by virtue of disclosure of Proprietary Information to me, grant me any right or license to the Proprietary Information, including but not limited to any rights or license under any patents, copyrights, trademarks, or trade secrets, other than those rights granted to me in Paragraph 2.c.
3. **Intellectual Property Rights.** I agree that all Proprietary Information, trade secrets, all inventions, all works of authorship (including illustration, writings, mask works, software and computer programs), and all other business and technical information created or conceived by me, either alone or with others, while (1) working with Sponsor and related to the existing or contemplated business or research of Sponsor or (2) resulting from my work with Sponsor, belong to Sponsor ("Sponsor's Intellectual Property"). Until proven otherwise by me, any invention shall be presumed to have been conceived during this Project if within one (1) year after termination of such Project it is disclosed to others, or it is completed, or it has a patent application filed thereon.
4. **Disclosure.** I will promptly disclose to Sponsor any and all Proprietary Information, trade secrets, inventions, intellectual property, works of authorship, and information developed by me during this Project; and I will assign and do hereby assign to Sponsor, or to others as directed by Sponsor, all of my rights, title, and interest in any Proprietary Information, trade secrets, inventions, intellectual property, information, and/or works of authorship created during the course of this Project, and I will execute any papers and do any acts which Sponsor may consider necessary to secure to it any and all rights, title, and interest relating to such Proprietary Information, inventions, trade secrets, intellectual property, works of authorship, and other information, including but not limited to all patents and copyrights (and renewals thereof) in any country. With respect to all copyrightable work products within the scope of this Agreement, I agree that all such work product shall be a "work made for hire" to the extent allowed under the copyright laws of the United States. To the extent that such copyrightable work product is not a "work made for hire", all copyrights therein are assigned by me to Sponsor pursuant to this Paragraph 4. Nothing herein is intended to require that Sponsor register any copyright or otherwise disclose to the public, the government or any other third party any work product developed hereunder.
5. **Assignment.** This Agreement, including the rights and obligations hereunder, may not be assigned or transferred, except with the prior express written consent of the other party, which consent shall not be unreasonably withheld. Notwithstanding anything to the contrary herein, Sponsor may at its sole option and discretion assign this Agreement, including its rights and obligations, to (i) any of its parents, subsidiaries or affiliates; (ii) any purchaser of all or a majority of Sponsor's stock or assets; or (iii) any successor, all of which without my consent. Any attempted assignment in violation of this paragraph is null and void.

6. **Miscellaneous.** This Agreement supersedes all prior or contemporaneous oral or written agreements, representations, or understandings regarding the subject hereof and is effective with respect to the subject matter hereof subsequent to the Effective Date. This Agreement may not be superseded, amended, or modified except by written agreement between the parties and signed by a duly authorized official of each of the parties. This Agreement shall be governed by and interpreted under the internal laws of the state of Indiana without regard to that state's conflict of laws principles. This Agreement may be terminated by Sponsor at any time. I acknowledge receipt of an executed copy of this Agreement.

This Agreement is executed this _____ day of _____, 20____, at

_____,
City State

SPONSOR

By: _____
Signature

Name: _____

Title: _____

PROJECT PARTICIPANT

By: _____
Signature

Name: _____

Title: _____

Residence: _____

City: _____ State: _____

Zip: _____



Purdue University Sponsored Class Projects and Capstone Projects Sponsor Acknowledgment

Department: «Department»

Course Name and Number: «Course_Name» «Course_Number»

Sponsor: «Sponsor_Name», a(n) «Sponsor_State_of_Formation» «Sponsor_Entity_Type»

Course Instructor: «Instructor»

To better prepare students for real-world applications, Purdue University ("Purdue") encourages students to work on projects of interest to industry in the form of sponsored student projects. Sponsored student projects include class projects, capstone projects, senior design projects (not performed under sponsored research agreements) and other student projects that are sponsored by industry partners.

What are the benefits to sponsoring student class projects?

Tackling problems that have been stagnant due to lack of resources: Most companies have projects or equipment sitting in the corner for months or years at a time, often neglected in favor of devoting more resources to larger or more valuable projects. Many of these projects are very important projects, but just don't make it to the top of the priority list. These types of projects often make excellent and challenging student projects. As an industry partner and supporter of Purdue programs, we invite and encourage you to examine your development needs and nominate topics that will keep the ball rolling on these often neglected projects while also providing valuable experience and stimulation for our students during a crucial development stage for their analytical and design abilities.

Identifying and attracting new hires to your company: In the course of the project, you will be able to evaluate and attract students for positions in your company. Project sponsorship provides the opportunity for students to become familiar with your company and its business, including exciting challenges a job with your company might entail.

Supporting the enhancement of an innovative and highly trained workforce for the State of Indiana and our country: We are all part of the solution. Building and strengthening the quality and capability of the regional and national workforce requires commitment from our faculty and you, our stakeholders. In addition, industry sponsors may take advantage of opportunities to provide active mentoring to the teams and to be part of the presentation and assessment events during the course.

Desired Elements of Student Class Projects: To be valuable to the learning experience of our students, student class projects should have the following characteristics:

- Be **open ended**, requiring evaluation of multiple solutions
- Be **complex and challenging**, requiring innovation and thinking outside the box
- Require **self-directed learning**, with a scope just beyond the scope of their present courses
- Require a **team approach**
- Individual departments and/or Course Instructors may also have additional requirements

Approval Process and Timeline: The Course Instructor will provide you with the project timeline. This form and any other forms or information required by Purdue's Office of Legal Counsel must be executed and received prior to the project start date. Please allow at least two (2) weeks for processing. More time may be required in some circumstances.

If the idea of sponsoring a student class project interests you, please complete Parts I-IV below in the DocuSign application. If you prefer pdf, please download the document from DocuSign and send the completed document by email

to legalcounsel@purdue.edu, with a copy to the Course Instructor. Please note that Sponsored Class Projects are intended to be learning experiences for our students. Therefore, Purdue does not guarantee deliverables beyond the project results, nor does it guarantee any particular outcome or quality of performance.

PART I – PROJECT DESCRIPTION: Please upload a brief description (no more than one (1) page) of the project the students will perform or the problem they will be tasked to solve (the “Project”) by clicking on the upload link below and attaching the project description file. If submitting this form by pdf, please attach the description to the back of the document.

Description of Project inputs to be provided by your company:

_____ Monetary support in the amount of \$ _____
_____ In-kind contribution of materials, parts, design files, etc.
_____ Sponsor to allow access to and review of company information

****Please consult with your company’s tax advisors regarding deductibility of any monetary support.**

PART II – EXPORT CONTROL AND TREATMENT OF SPONSOR CONFIDENTIAL INFORMATION

Export Control: Federal export control regulations require that foreign nationals be restricted from access to certain types of technical information. Purdue is a public institution of higher education, and as such its classes are open to foreign nationals. In addition, classrooms are open forums for discussion and presentation, and, absent an agreement to the contrary, project results are typically presented to the class. For this reason, sponsors should carefully consider whether the sponsored class project setting is an appropriate forum for the use of certain sponsor information. Specifically, if confidential sponsor information is to be provided to a student, the sponsor should ensure appropriate confidentiality terms are signed with the student. Even with appropriate confidentiality terms in place, the class project setting may not be appropriate for trade secrets, patentable inventions for which a patent application has not yet been filed, or other information with extremely high sensitivity. Those projects are more suitable for the sponsored research setting. Under Federal export control laws, your company will be the disclosing or deemed exporting party and will be held responsible for complying with all export control laws and regulations in connection with your company’s disclosures for student projects. You are responsible only for the information your company discloses, and not any information or disclosures made by Purdue or its employees. By signing the acknowledgment below, you certify to Purdue that your company will comply with all export control laws and regulations. Purdue reserves the right to perform its own export control review based on the information provided by you and to decline, reject or stop the project at any time if Purdue is unable to take appropriate steps, in coordination with your company, to comply with export control laws. **Please note that Purdue does not engage in student projects where the export control jurisdiction is determined to be the International Traffic in Arms Regulations (ITAR), or projects for which any technology would be listed on the U.S. Munitions List, such as those with a “600 series” ECCN.**

Federal export control regulations define “technology” as information necessary for the development, production, use, operation, installation, maintenance, repair, overhaul or refurbishing of an item. Technology may be in any tangible form, such as written or oral communications, blueprints, drawings, photographs, plans, diagrams, models, formulae, tables, engineering designs and specifications, computer-aided design files, manuals or documentation, electronic media or information revealed through visual inspection. In order to assist us in complying with Federal export control regulations, please answer the following questions:

In the course of the project, will your company be releasing information that meets the definition of “technology” to the students, or are the project outputs likely to consist of such “technology”? ☒ Yes ☐ No

If you answered "Yes" above, does any of the technology contain information that is not publicly available?

☒ Yes ☐ No

If software will be shared with the students, will the students be given access to proprietary (and not open source) source code? ☐ Yes ☒ No

What is the Export Control Classification Number (ECCN) of the technical information? EAR99

How did you determine the ECCN provided above?

☐ Obtained the ECCN from the manufacturer, producer or developer of the technology

☒ Self-classification using the Commerce Control List

☐ Official classification from the Bureau of Industry & Security

Will your company require the students participating on the Project to execute a Non-Disclosure Agreement (NDA)? ☒ Yes ☐ No

Please Note: In order to comply with export control regulations regarding fundamental research, only the Sponsor's confidential inputs to the project can be subject to NDA agreements. The student-created results of the project cannot be subjected to NDA requirements, except that students may be required to delay publication of their project results for up to sixty (60) days to allow for the removal of Sponsor's confidential inputs, or otherwise to allow for Sponsor's protection of patentable intellectual property resulting from the project.

Non-Disclosure Agreement Practices: The Course Instructor will have the responsibility for explaining the NDA requirement and obtaining the signatures of the students enrolled in the course. Sponsor may negotiate the terms of the NDA independently with the students, and only the students and Sponsor will be party to the NDA. Purdue does not sign NDA agreements in connection with sponsored student projects. Students acting as course participants are not employees of Purdue (or if they are employees of Purdue in a separate capacity, they are not acting within their scope of employment as course participants). **Purdue expressly disclaims any liability for a breach of a non-disclosure agreement by a student.** In the case of a confirmed breach of confidentiality by a student, Purdue will cooperate with a Sponsor complaint to the fullest extent possible. Please note, however, that certain personal information possessed by Purdue regarding its students is protected under the Family Educational Rights and Privacy Act ("FERPA") and cannot be released absent an exception or unappealable court order. If your company requires the Course Instructor to sign a NDA, the NDA will be a personal agreement with the Course Instructor regarding the confidential information released to that instructor, and Purdue will not be a party to the agreement. Purdue expects that Sponsors will treat students fairly in obtaining NDA agreements from students by using the following guidelines:

1. Give students ample opportunity to consult with independent legal counsel prior to signing.
2. Clearly identify all confidential information delivered to students. Many students have not developed the judgment necessary to determine which information is confidential on their own as a result of not having been in the corporate environment.
3. Include the typical exclusions for information that (a) was lawfully in the public domain when first received; (b) becomes publicly available through other means other than the student's disclosure; (c) is lawfully disclosed to the student by a third party without restriction; or (d) is developed by the student entirely independently, outside of the project and without use or reference to Sponsor's proprietary information.
4. The NDA should provide that students may disclose confidential information in response to a subpoena or court order duly issued in a judicial or legislative process, provided that student has used reasonable efforts to give Sponsor advance notice of the disclosure in order to allow Sponsor to assert any protections against disclosure and/or to obtain a protective order narrowing the scope of the disclosure.
5. The NDA should be properly drafted to contemplate a student participating in a student project, not a supplier NDA or other business relationship NDA.

PART III – INTELLECTUAL PROPERTY

Purdue's intellectual property policy generally allows students to retain ownership and title to intellectual property that is created through sponsored class projects and capstone projects. Generally, the sponsor only receives the results of the project ("Project Results"), which may be used for internal non-commercial purposes. The students reserve the right to publish the Project Results, including class presentations for purposes of class discussion and assessment/grading; provided, however, that Sponsor shall be provided with pre-publication copies at least one (1) week in advance (for class presentations) and at least thirty (30) days in advance for all other types of intended publications in order to remove from the manuscript and/or disclosure all sponsor confidential information.

Notwithstanding the foregoing, students are free to negotiate intellectual property licenses and ownership directly with the Sponsor if they so desire. Purdue does not participate in those negotiations, but does encourage students to seek legal counsel in negotiating such agreements. Neither Purdue, nor the Course Instructor, assume responsibility for disclosure of intellectual property created by the student. Intellectual property disclosure is subject to the terms of the agreement between the student and the Sponsor.

Does your company intend to obtain any intellectual property from the student? X Yes No

If you answered "Yes" above, please indicate the type of agreement you intend to obtain: (Mark all that apply)

 License

 X Assignment

 Other Arrangement (Please describe: _____)

PART IV - SPONSOR ACKNOWLEDGMENT AND PURDUE APPROVAL

Sponsor Acknowledgment: On behalf of Sponsor, I represent and warrant that I have read the above acknowledgment in full, that all information that I have written above regarding the project description, project inputs to be provided by my company, export control review regarding confidential information, and intellectual property expectations is true, correct and complete. I represent that I am authorized to execute this acknowledgment on behalf of Sponsor as its agent.

Note: Your project cannot begin until this form has been approved by the Office of Legal Counsel. This acknowledgment is valid only for the term of the Project. New Projects require separate approval.

«Sponsor_Name», a(n) «Sponsor_State_of_Formation» «Sponsor_Entity_Type»

Sign: 

Printed Name: Aaron S Johnson

Title: Director of Engineering

Date: 6/30/25

Sponsor Address: «Sponsor_Address»

Monetary sponsorship contributions by check should be payable to "Purdue University" with the following information in the check memo line: «Instructor» «Course_Number» Sponsored Class Project. The check should be sent to the department business office as follows: «Department», «Departmentss_Business_Office_Address», Attn.: «Departments_Business_Manager_Name», Business Manager. Wire transfer instructions and invoices can be provided by the Business Manager upon request. **Please return this form by email to legalcounsel@purdue.edu or by mail to Hovde Hall, Room 230, 610 Purdue Mall, West Lafayette, IN 47907, with a copy to the Course Instructor.**

Your support impacts the future of Purdue students in so many ways. Because of your support, we are able to enhance the student experience and equip the next generation of leaders with the resources needed to move our world forward.

Purdue Approval: _____ Approved _____ Declined

Printed Name:_____

Title:_____

Date:_____

