Project Approvals:

Approval	Function	Signature	Date
Dr. Alan Nye	PRP Focus Group – ME		
Dr. Daniel Phillips	PRP Focus Group – EE		
Dr. Reddy Pratapa	PRP Focus Group – CE		
Dr. Marcos Esterman	PRP Focus Group – ISE		
Prof. George Slack Dr. Daniel Phillips	Guide		

INTRODUCTION:

This document describes and serves as a template for preparation of a Project Readiness Package. The objective of the Project Readiness Package is to document customer needs and expectations, project deliverables (including time frame), budget, and personnel / organizations affiliated with the project. It will serve as the primary source of information for students necessary during Phase 0 (Planning) to develop a SD I plan and schedule including specific deliverables and due dates. The Project Readiness Package will also support Faculty evaluation of project suitability in terms of depth, scope, and student / faculty resources by discipline.

In this document, italicized text provides explanatory information regarding the desired content of the sections indicated by non-italicized, bold, capitalized headings. If a particular aspect of a section is not applicable for a given project, it is only necessary to indicate that by entering N/A (not applicable).

ADMINISTRATIVE INFORMATION:

Information regarding contacts, budgets, facilities, resources, regulatory or legal considerations, proprietary or specialized components, technologies or intellectual property associated with the project.

- Proposal Number: P09222
- Project Name: FSAE Engine Control Unit III
- Project Number: P09222
- Track: Vehicle
- Start Term: 2008-1
- End Term: 2008-3
- Faculty Consultant: Dr. Phillips
- Faculty Guide: Prof. Slack/ Dr. Phillips
- Customer organization and primary contact (name, phone, e-mail):
  RIT Formula SAE Racing team
  Dr. Alan Nye, Mechanical Engineering Associate Dept. Head, Team Manager
  Work: 475-6121
  ahneme@rit.edu

- Project Overview (*1 Paragraph that provides a general description of the project in terms of background, motivation(s), customer(s), and overall objective(s).*):
  Did you ever see the Formula cars around campus and think "wow, those are cool, I wonder what goes into them"? If you are answering yes to any of these questions then now is your chance to be a part of the making the fastest vehicle on campus even faster.

  http://en.wikipedia.org/wiki/Engine_control_unit

  This is the third year in development of the Engine Control Unit (ECU) with the goal to put an RIT ECU on the Formula Car this year. The motivations are to showcase RIT's student engineering talent, enable the Formula team to custom tune their engine and replace the high cost purchased ECU units in the future. The current ECU (MoTeC's M400) though programmable is basically a black box and dictates engine component interfaces and devices.

- Staffing Requirements:

Discipline (*number*)	Skills required (*concise*)
ME 1	Formula engine dynamics including but not limited to fuel mixture, O_2 sensor, spark advance, fuel injection characteristics. Interpretation of test results. Customer enclosure case and car attachments. DAQ Test Bench.
EE 4	Microprocessor electronics, sensors, PCB layout, PCB build, programming and rigorous test cycles.
ISE 1	DAQ Test Bench. Comprehensive Test Plan and interpretation of test results.

- Continuation, Platform, or Building Block project information (*Include prior project number and title and to what extent previous results are being incorporated*):
  Previous ECU Projects:
  2007 - P08221 ECU Continuation Team https://edge.rit.edu/content/P08221/public/Home
  2006 - P07222 FSAE Engine Management System https://edge.rit.edu/content/P07222/public/Home
  This year related Project:

- Principle sponsor or sponsoring organization:

  Dr. Nye and RIT Formula SAE Racing team.

DETAILED PROJECT DESCRIPTION:

- Customer needs:
  Fully functional and reliable ECU and ECU Test Stand for the RIT Formula Car. Formula Car demonstration in parking lot under all driving conditions. Technical archive (for follow-on ECU projects) and FSAE "how to use" documentation completed.

  ME: Create an oncoming dialogue with the help of the Formula Team to validate last year's requirements and specifications relating to engine dynamics. Capture engine dynamics such as fuel mixture, O_2 sensor, spark advance, fuel injection characteristics. Update ECU enclosure and car attachments, as required. Interpretation of test results. Continue with a test bench that can be used to test the circuit board and the software that is running it. Develop an intuitive graphical user interface to facilitate engine testing and define requirements for a graphics user interface for next year's ECU team.

  EE: Refine last year's design. This includes but not limited to microprocessor electronics, O_2 sensor, signal processing, PCB layout, PCB build, programming and rigorous test cycles.

  ISE: Work with the ME and EEs to continue with a test bench development for circuit board and the software test. Develop an intuitive graphical user interface to facilitate engine testing and define requirements for a graphics user interface for next year's ECU team.

  ME/ISE/EE: Test Stand includes a quick and safe connect/ disconnect. The Test Stand will simulate input engine sensor signals over their complete range, supply power, capture inputs to and outputs from the ECU. Develop GUIs that will capture and display real time and archive data.

- Customer deliverables (*Customer requested milestones, progress reports, and expected product*):
  - For MSD I - As per https://edge.rit.edu/content/Senior%20Design%20I/public/Course%20Deliverables
  - For MSD II - https://edge.rit.edu/content/Senior%20Design%20II/public/Course%20Deliverables%20and%20Grading

- Customer and Sponsor Involvement (*Describe role of customer and sponsor in the project, planned participation in design and project reviews, etc.*):
  Consulting, participate in Design Reviews, participate in Formula preliminary demo and full use Formula demo.

- Regulatory requirements (*i.e. UL, IEEE, FDA, FCC, RIT*):
  FSAE Regulations? Discuss with Dr. Nye.

- Project Budget and Special Procurement Processes (*Provide all budget details and processes associated with expenditures*):
  Components (Bill of Materials) and any testing and development tools.

- Intellectual property (IP) considerations (*Describe any IP concerns or limitations associated with the project*):
  None.

- Other (*Describe potential benefits and liabilities, known project risks, etc.*):

DETAILED COURSE DELIVERABLES:

From the Course Deliverables document, extract general and discipline specific deliverables that are appropriate to the project. This should provide clear guidance to the students on what it expected.

Phase 0 Planning:

- Review MyCourses and EDGE websites for course expectations.

- Define Team norms and values. Discuss each other's talents and interests in digital, signal processing, programming and robust testing techniques. Define the role of the Team Lead and each engineer. Also, if a Lead Engineer is desired by the team, then define that role.
- List and briefly describe the major tasks needed. This may be short term technology exploration including reviewing last year's shortfalls for the purpose of defining focus tasks and associated team actions.
- Meet with Dr. Nye, Consultant(s) and Guide for project background and needs. Review and update last year's course documents. There such not be a need to start from scratch.
- Refine Customer Needs document. SDI project plan / schedule including specific deliverables.

Phase 1 Concept Development: Review last year's Design and Project Reviews, target specifications, Customer Needs, development tools, IAR Development Board to focus on. Focus on what is needed to improve ECU. (wks 1-3)

Phase 1 Concept development for new or heavily redesigned tasks. For these areas, develop multiple concepts and select a limited number of feasible concepts. Update specifications. Customer Feedback. Phase 1 (wks 3-4)

Phase 2 System-Level Design: Review last year's system design including architecture (block diagrams indicating interfaces), sub-system definition, interface definition, and more detailed specifications. Focus on development needs for this project. Appropriate engineering analysis including hand calculations and simulation / modeling. Determine greatest challenges / risks to project. Concept/System Design Review (partial). (wk 4)

Phase 2 System-Level Design: Evaluate last years design and this year's new concepts through use of concept breadboard, brassboard, or simulation of high risk technologies. This includes integrated device sketches, OS, API, development software development board and graphics. Use appropriate discipline specific methods to demonstrate confidence in selected architecture / design approach. Risk assessment for technology / cost / schedule. Concept/System Design Review (completed). Develop test needs in a comprehensive Test Plan. (wks 5)

Phase 3 Detail Design: Detailed design to meet all customer needs. All long lead items should be identified for ordering. Detail Design Review. (wks 6).

Phase 3 Detail Design: Project Review (wk 6). PCB and parts ordered based on BOM.

Phase 3 Detail Design: Design Documentation: update Design History File on EDGE (all design documents, final drawings, design review materials); BOM completed. Define source, cost, and lead time; Test Plan; Project Plan for SDII. (wk 7).

Phase 4 Testing and Refinement. Add components to PCB and start debugging and testing. Document successes and needed development work. Begin working on second phase of design and layout needs. (Wk 9-10)

Update BOM and reorder components and new PCB. (Wk 11)

PRELIMINARY WORK BREAKDOWN:

Describe the anticipated distribution of general tasks to be accomplished by project participants based on perceived skill set requirements. This should justify the requested skills and number of students from each discipline.

Refine last year's design through hands-on testing of their PCB, design Oxygen (0_2) sensor interface electronics, design microprocessor support electronics, design and build new PCB through two full design cycles, continue debug and test cycles and then perform full test cycles on a finished ECU ready for the RIT Formula Car. Work with the ECU Test Bench Team to better define or refine programming needs and ability to enable testing and refinement.

- Gain general knowledge of 4 cycle internal combustion engine. Basic spark ignition and fuel injection closed loop technologies for a four cylinder engine. Gain specific knowledge of Formula engine sensors, ignition and fuel injector solenoids.
- Gain familiarity with last year's design (their assumptions, schematics, PCB files, code architecture and gain knowledge of existing code, test results, PCB Artist application and READ ME FIRST file).
- Review EDU enclosure CAD drawings.
- Gain familiarity with the IAR Development Board and its development tools.
- Gain familiarity with National Instruments LabView Tool.
- Review component specifications documents.
- Review code architecture diagrams and review code in detail.

GRADING AND ASSESSMENT SCHEME:

Describe how the grading rubric relates to expectations and deliverables. The impact of project enhancements and improvements from baseline should be clearly articulated.

A

Thoroughly designed, robust and tested ECU and Test Stand. Concepts were generated, reviewed with faculty and refined early in the project development. Critical technologies and devices were defined and prototypes of major subsystems were built at the system and subsystem level and evaluated against customer-oriented criteria and competing products. Project successfully built, debugged and tested (evaluated) through two complete development cycles.

Thorough and in-depth understanding is evident of the design (system & relevant subsystems) and rationale for design decisions and tradeoffs. Sufficient evidence is presented to demonstrate that customer needs and design specs will be met. Throughout the life of the project, key analytical processes (i.e. Concept Review and various Design Reviews, Guide status meetings) were very well planned and executed with appropriate attendees. All subsystems addressed and clearly documented key issues, notes and action items.

B

Valid concepts were developed but some customer criteria were not addressed. Majority of technologies and devices were defined and prototypes of major subsystems were built at the system and subsystem level, and evaluated against customer-oriented criteria and competing products. Project successfully built, debugged and tested (evaluated).

Good individual team member understanding is evident of the design and rationale for most design decisions and tradeoffs. Team demonstrated that most customer needs and design specs will be met. Design Review execution was acceptable but was weak in one or more areas: breadth of participants, preparation, thoroughness, documentation or follow-up closure.

C

Key customer needs were addressed but many were left unaddressed, or evaluation process was not followed. General comprehension of the design is evident but rationale for decisions is not solid and tradeoffs are not well understood. Technologies and devices were defined but limited or no prototypes of subsystems were built to evaluate customer-oriented criteria and competing products. Project was not fully functional in all subsystems. The built, debugged and tested (evaluated) was complete but marginal data.

Team demonstrated that some needs and specs will be met, but others require significant further analysis. Design Review execution was acceptable but was weak in one or more areas: breadth of participants, preparation, thoroughness, or documentation.

D/ F
Minimal concept development or key customer needs were unaddressed. Reliance of project based on a few ideas. Evaluation process not defined or followed. Superficial understanding of the design is evident at either the system or subsystem level. Rationale for specific design decisions and tradeoffs is poorly understood, if at all. Many questions remain as to whether needs and specs will be met. Design Review was not held or was poorly executed: key subsystems were not reviewed, key issues were not addressed, little/no preparation or documentation.

THREE WEEK SDI SCHEDULE:

List expected activities in the first three weeks. Highlight any project specific activities that may not be part of the generic course syllabus (e.g. customer visits).

Wk 1.

Review Handouts specific to project tasks and deliverables.
Gain familiarity with last year's design.

- Review the document titled READ ME FIRST- IMPORTANT DOCUMENT.doc.
- IAR (http://www.iar.com/website1/1.0.1.0/3/1/index.php) development board.
- Schematics and CAD drawings.
- PCB Layout Application Software and project files.
- National Instruments LabView application tool.

Develop an implementation Plan with a breakdown of each engineer's tasks.

WK 2

- Review Handouts specific to project tasks and deliverables.
- Learn Engine Theory. Refer suggested website and set up time with Dr. Nye and Prof. Slack with specific questions.
- Continue with familiarity with last year's design.
- All software applications should be loaded on Senior Design Lab PC.
- Between to gain experience with National Instruments LabView application tool.

Wk 3

- Review Handouts specific to project tasks and deliverables.
- If not already, power on IAR Development Board/ ECU.
- Neatly organize input power and signals using lab equipment.
- Examine spark and fuel injection output signals.
- If necessary, download code to IAR Development Board/ ECU.
- Begin working on LabView GUI design.
- Develop a 10 week schedule.

REQUIRED FACULTY / ENVIRONMENT / EQUIPMENT:

Describe resources necessary to support successful Development, Implementation and Utilization of the project. This would include specific faculty expertise for consulting, required laboratory space and equipment, outside services, customer facilities, etc. Indicate if required resources are available.

Category	Source	Description	Resource Available (*mark with X*)
Faculty			
George Slack	**EE**	**Guide.** *Will work closely with the team on an on-going basis to facilitate success.*	**X**
Daniel Phillips	**EE**	**Consultant.** *Will provide EE discipline technical support on as needed basis.*	**X**
Alan Nye	**ME**	**Consultant.** *Will provide ME discipline technical support on as needed basis. If necessary, provide team with engine knowledge and a focus on important functions that need development and testing.*	**X**
Environment	**EE**	**EE Senior Design Lab.**	**X**
Engine Knowledge	**Formula Team Members**	**Consultant.** Will provide team with engine knowledge and a focus on important functions that need development and testing.	**X**
Test Equipment		**EE Senior Design Lab.**	**X**
Materials		Last year's materials as a starting point.	**X**
Other			