# COVER SHEET

# FOR VOLUNTEER CORE COURSE APPROVAL

**To Submit:** To submit a proposal, please complete the following application and save it as a single PDF file that also contains your syllabus and a sample of at least one **significant assignment** for the course. Save your PDF file by the course name and category (e.g. engl101WC).

The PDF should be uploaded using this link - <http://tiny.utk.edu/VolCoreProposalDrop> AND emailed to [gened@utk.edu](mailto:gened@utk.edu).

If you are submitting a revision, please also include a brief written “Response to Reviewers” detailing how the requested revisions have been addressed. This “Response to Reviewers” should be included in your single PDF file and the file should be save by course name, category, and the revision and date (e.g. engl101WCrevision050120).

**Date Submitting Proposal: November 2, 2021**

**Is this a revised proposal? \_\_X\_\_ Yes \_\_\_\_\_ No**

**If yes, what dates were previous versions submitted \_October 5, 2021\_\_\_**

**Contact Information (please print or type):**

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**Course information:**

**Provide full catalog entry for the course** including course subject, number, suffix (if any), course title, credit hours, course description, prerequisites/corequisites, credit restrictions, etc.

NOTES:

* *Courses in WC category* ***must*** *have the following prerequisite:*(RE) Prerequisite(s): English 102, 132, 290, or 298 *(plus any others for this course)*
* *Courses in AOC category:* We **strongly encourage** the oral communication general education requirement used in your program serve as a prerequisite for this course (e.g., CMST 210, 240; CE 205; Phil 244)
* Courses may apply for either OC or AOC but not both categories.

Catalog entry for course: Include an indication of any Honors version of this course or other equivalent courses (e.g., cross listed courses, S, N, or R designated courses) to be included with this proposal.

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| **Course Number:** ECE 351  **Course Title:** Digital Systems Design  **Credit Hours:** 3  **Course Description:** Introduction to techniques and strategies for designing digital systems using hardware description languages and industry-standard design tools. Topics include simulation and synthesis of high-level designs, finite state-machine design, digital memory systems, arithmetic circuit design, circuit delay estimation, timing, and power analysis. Laboratory and project activities include the implementation of digital systems using field-programmable gate arrays (FPGAs).  (RE) Prerequisite(s): ECE 255 with a grade of C or better. |

**Frequency of Course Offering (e.g., fall only, spring only):** Fall only

**Course Capacity per Semester *(per course & total if multiple sections):*** 30

**Course format (e.g., lecture, discussion, lab):** Lecture by faculty, hands-on labs as homework, group project

**How is this class to be staffed (i.e., instructor, GTAs, graders etc.):** Instructor, 1 GTA

**Please check all that apply:**

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|  | **Volunteer Core areas in which this course is already approved** | **Applying for inclusion in these categories for Volunteer Core** |
| Written Communication (WC) |  |  |
| Verbal Communication (OC) |  |  |
| Applied Oral Communication (AOC) |  |  |
| Arts & Humanities (AH) |  |  |
| Applied Arts and Humanities (AAH) |  |  |
| Natural Sciences (NS) – Lab |  |  |
| Natural Sciences (NS) – Non-lab |  |  |
| Quantitative Reasoning (QR) |  |  |
| Social Sciences (SS) |  |  |
| Global Citizenship-International (GCI) |  |  |
| Global Citizenship-US (GCUS) |  |  |
| Engaged Inquiries (EI) |  | X |

**Course subject, number, suffix (**S [service], R [research], N [internship]**) and title.** Include an indication of any Honors version of this course or other equivalent courses (e.g., cross listed courses, S, N, or R designated courses) to be included with this proposal.

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| **ECE 351 – Digital Systems Design** |

*NOTE*: Courses with an S (service), R (research), or N (internship) designation will be equivalent to their base course for the Effective Communication and Expanded Perspectives Volunteer Core categories. The base course and suffix courses will be considered as different courses for Engaged Inquiries.

**Engaged Inquiries**

Truly well-educated citizens should be ready to lead and solve problems, building on their chosen fields of study and personal interests and strengths. Students will benefit from experiences that broaden, extend, apply, and integrate prior learning and promote effective collaboration and self-awareness.

In all Engaged Inquiries courses, students will produce significant **investigative, creative, or practical work(s) relevant to the course topic.**

**Learning Areas and Learning Outcomes**

In addition, El courses must demonstrate that they produce learning outcomes from **at least two** of the following Learning Areas:

1. **Applied Learning**

In applied learning courses, students will engage in a process of proposing, implementing, and assessing the success of strategies, plans, or approaches to addressing questions in applied contexts. Courses in this domain are expected to achieve the following outcome for students:

Students will apply skills and knowledge from the classroom in hands-on situations, real-world settings, or in independent/directed research or creative projects.

1. **Collaborative Learning**

During the semester, students will engage in a process of sharing ideas, making useful contributions, communicating effectively, understanding their roles, planning and implementing the plan to completion. Courses in this domain are expected to achieve the following outcome for students:

Students will demonstrate the ability to engage effectively in a group to complete an investigative, creative, or practical work.

1. **Reflective Learning**

Students will engage in reflective activities such as journal entries, reflective response papers or creative exercises on a regular basis in this course. Students should grapple not only with the major ideas and content of the course, but with the question of what these ideas mean to them within a larger context. Courses in this domain are expected to produce the following outcome for students:

Students will reflect on their own thinking, learning, understanding, and competencies, to draw connections between the subject matter of the course and the students’ own experiences within a larger social or global context.

1. **Integrative or Multidisciplinary Learning**

Courses that address this domain may include team-taught interdisciplinary courses; exploration into adjacent fields; courses on pre-defined interdisciplinary subjects. Courses in this domain are expected to achieve the following outcome for students:

Students will demonstrate the ability to draw on theories, knowledge, tools, and/or methods from at least two fields of study to investigate relevant issues.

**Answer all questions below with respect to the description and learning outcomes given above.**

***Questions:***

1. Relevant Work: What is the “investigative, creative, or practical work(s) relevant to the course topic” that students will produce? How will students typically complete this relevant work? Demonstrate how this will account for a minimum of 35% of the course grade.

The primary practical work for this course is the final group project which itself accounts for 35% of the total grade. For the group project, student groups propose their own digital system design project, often building on examples of smaller systems explored through individual lab assignments. Individual lab and homework assignments account for 15% of the total grade for the course. For the final group projects, the total project grade (35% of course) is broken into four components: proposal (typically 5% of project grade), design review (typically 20% of project grade), final presentation (typically 30% of project grade), and final report (typically 45% of project grade).

1. El courses must demonstrate that they produce learning outcomes from **at least two** of the following areas, as described above. **Select TWO of the FOUR** Engaged Inquiries Learning Areas:

\_\_X\_\_ Applied learning

\_\_X\_\_ Collaborative Learning

\_\_\_\_\_ Reflective Learning

\_\_\_\_\_ Integrative or Multidisciplinary Learning

For each of the TWO LEARNING AREAS indicated above, answer the following questions:

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| **APPLIED LEARNING:** Students will apply skills and knowledge from the classroom in hands-on situations, real-world settings, or in independent/directed research or creative projects. |
| 1. How does the course meet this learning outcome?   Lectures emphasize the design and implementation of digital systems through the use of a hardware description language, such as VHDL. Throughout the semester, students leverage skills learned in the classroom through several individual lab/homework assignments where they implement small design problems on field-programmable gate arrays (FPGAs) distributed at the beginning of the semester for hands-on learning. The second half of the semester includes a group project, where small student groups work together on the implementation of a digital system, again using their FPGAs. In consultation with the instructor, student teams will determine a specific application and corresponding digital system design topic. Example system applications/designs include: alarm systems, video game implementations with an FPGA, and GPS tracking systems. Project designs should include an FPGA-based digital system design and may include integration of various sensors and/or actuators. For their digital system design projects, students are required to identify an application of interest, propose how they will design a digital system for that application, and work together on the final implementation. |
| 1. For the course itself, how are students evaluated regarding this learning outcome? (Provide information on course grading and examples of evaluation criteria, grading rubrics, scorecards, feedback given to students, or other relevant information.)   For each individual lab assignment, students submit reports detailing how they approached the problem, evidence of their solution (e.g. VHDL code snippets), simulations alongside expected results, and conclusions detailing what was learned from the assignment. They must also demonstrate their working system on the FPGA with the GTA or instructor.  Group projects consist of four major graded components: project proposal, mid-project presentation or design review, final project presentation, and final report. As part of the final project presentation, student groups will demonstrate their working design. These four items contribute to a total project grade, with the report and final presentation accounting for most weight while proposal accounts for the least. |
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| **COLLABORATIVE LEARNING:** Students will demonstrate the ability to engage effectively in a group to complete an investigative, creative, or practical work |
| * 1. How does the course meet this learning outcome?   The group project requires students to work together toward a proposed digital system application that they then implement as a team. Student groups must also present their project work to the class twice during the semester: once as part of a mid-project design review and then for the final project presentation where they demonstrate their working system. As part of the design effort, students are encouraged to take a divide and conquer approach, where the system is partitioned as evenly as possible for each team member to focus on specific design elements. They must then work as a team integrating these design elements into the full system implementation. Finally, students work as a team to write a project report detailing their application, design decisions made along the way, and their final results. |
| 1. For the course itself, how are students evaluated regarding this learning outcome? (Provide information on course grading and examples of evaluation criteria, grading rubrics, scorecards, feedback given to students, **peer-assessment,** **and/or** other relevant information.) **Note that this kind of feedback (not necessarily grading) on collaborative learning is different than simply grading the collaborative project or assignment.**   As detailed in the course syllabus, students submit a project proposal that provides a collaboration plan, including how they will divide the work requirements and collaborate through the duration of the project. This proposal is a graded assignment and is graded by the instructor with feedback provided to students on how they might adjust their collaboration plans and division of labor. This early planning is expected to evolve and is considered when students present their mid-project design reviews and again when they present their final projects. The mid-project design review is another graded assignment that comes with feedback from the instructor, including for how well the team members are collaborating. For both presentations, the evolution of design strategies are presented, including how group members work together to accomplish specific design goals. Further detail of design partitioning and final system integration, including how team members interact, is provided in the final report. |

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| **REFLECTIVE LEARNING:** Students will reflect on their own thinking, learning, understanding, and competencies, to draw connections between the subject matter of the course and the students’ own experiences within a larger social or global context. |
| 1. How does the course meet this learning outcome? |
| 1. For the course itself, how are students evaluated regarding this learning outcome? (Provide information on course grading and examples of evaluation criteria, grading rubrics, scorecards, feedback given to students, or other relevant information.) |

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| **INTEGRATIVE OR MULTIDISCIPLINARY LEARNING:** Students will demonstrate the ability to draw on theories, knowledge, tools, and/or methods from at least two fields of study to investigate relevant issues. |
| 1. How does the course meet this learning outcome? |
| 1. For the course itself, how are students evaluated regarding this learning outcome? (Provide information on course grading and examples of evaluation criteria, grading rubrics, scorecards, feedback given to students, or other relevant information.) |

1. What process is used to monitor/oversee that each section of this course is meeting the learning outcomes if multiple sections are taught to ensure consistency semester to semester?
2. Course Assessment

Provide a short description of how this course will be assessed for the Volunteer Core outcomes. According to the revised General Education guidelines, all approved Volunteer Core courses must be assessed according to the guidelines and timeline set by the General Education Committee. For the review, this course will need to provide quantifiable data and results regarding how successful the students were in mastering the learning outcomes chosen above. With that in mind, please be as specific as possible in your plan to measure both of the chosen learning outcomes\*. (You can refer to the Volunteer Core assessment document and rubrics on the [Volunteer Core website](https://ugcouncil.utk.edu/volunteer-core/).)

Assessment plans for EI courses should feature direct assessment of student learning using the [IE Course Rubric](https://ugcouncil.utk.edu/wp-content/uploads/sites/64/2019/08/EI-rubric-final-for-proposals.pdf) to answer the following:

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| **First Learning Area:** (please check one)  \_\_X\_\_ Applied learning  \_\_\_\_\_ Collaborative Learning  \_\_\_\_\_ Reflective Learning  \_\_\_\_\_ Integrative or Multidisciplinary Learning |
| 1. Provide a description of the (most likely one example of) student work that will be used to assess the learning outcome required by the EI designation in this course.   Students will provide reports for their lab assignments that detail how they considered a specific digital design problem and implemented a solution using a hardware description language, such as VHDL. The report will also provide evidence of their work in implementing their design on an FPGA. It is worth noting, that this course must also satisfy ABET outcomes for computer engineering. Thus, the EECS assessment committee regularly collects assessment data to ensure that the course is providing for the necessary learning outcomes for ABET. A process similar to the collection of data for ABET will be used to collect data for the EI learning outcomes. When the course is complete, samples of lab and project reports will be used for assessment by the EECS assessment committee. |
| 1. Provide a description of how you will obtain the sample of student work.   Students are required to submit lab and project reports on specified due dates throughout the semester. Additionally, for the project, student design teams submit written project proposals that detail in part their design topic choice and plans for completing the technical work. Presentation slides for the mid-project design reviews and final presentations will also be collected. These are required assignments that will be graded and returned to the students with constructive feedback from the instructor. |

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| **Second Learning Area:** (please check one)  \_\_\_\_\_ Applied learning  \_\_X\_\_ Collaborative Learning  \_\_\_\_\_ Reflective Learning  \_\_\_\_\_ Integrative or Multidisciplinary Learning |
| 1. Provide a description of the (most likely one example of) student work that will be used to assess the learning outcome required by the EI designation in this course.   Final project reports will include a methodology section that details how the project groups complete the design as a team. The final project report itself is collected for final grading and assessment. For assessment purposes for this particular outcome, the sections detailing design methodology and student engagement will be specifically assessed by the instructor in consultation with the EECS assessment committee. It is worth noting, that this course must also satisfy ABET outcomes for computer engineering. Thus, the EECS assessment committee regularly collects assessment data to ensure that the course is providing for the necessary learning outcomes for ABET. A process similar to the collection of data for ABET will be used to collect data for the EI learning outcomes. When the course is complete, samples of lab and project reports will be used for assessment by the EECS assessment committee. |
| 1. Provide a description of how you will obtain the sample of student work.   Students are required to submit lab and project reports on specified due dates throughout the semester. Additionally, for the project, student design teams submit written project proposals that detail their collaboration plans. Presentation slides for the mid-project design reviews and final presentations will also be collected. These are required assignments that will be graded and returned to the students with constructive feedback from the instructor. |

**\***The answer to the assessment question should include:

1. A **description of the student work** that will be used to assess each learning objective. The student work may be an exam, an essay, a lab report, a reaction paper, a set of homework problems, a short-answer response provided on a mid-term exam, selected multiple-choice questions from a quiz, etc. More than one learning outcome can be assessed by the same student work. The assignment/ exam/paper/etc. does not have to be made specifically for the purpose of this assessment. In fact, it is *preferable* that the student work be an assignment or test that is a normal part of the course.
2. **The sampling method to be used for the assessment**. If it is expected that there will be multiple sections of the course, you may choose to sample 20% of the sections of the course or 20% of the students in each section. This 20% should be at least 50 students. If the course is expected to have one section or a total of 50 students or less, you should collect work from all students.

**ADDITIONAL MATERIALS**

Please include:

* a representative **course syllabus** (including a clear indication that the course is a Volunteer Core course and course objectives that include the Volunteer Core student learning outcomes) and
* a sample of at least one **significant assignment** for the course.