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OFFICE OF THE  
SENATE COUNCIL**1. General Information**

1a. Submitted by the College of: ENGINEERING

Date Submitted: 9/29/2015

1b. Department/Division: Electrical and Computer Engineering

1c. Contact Person

Name: James Lumpp

Email: jel@uky.edu

Phone: 7-3895

Responsible Faculty ID (if different from Contact)

Name:

Email:

Phone:

1d. Requested Effective Date: Semester following approval

1e. Should this course be a UK Core Course? No

**2. Designation and Description of Proposed Course**

2a. Will this course also be offered through Distance Learning?: No

2b. Prefix and Number: EE 580

2c. Full Title: Embedded System Design

2d. Transcript Title:

2e. Cross-listing: CpE 580

2f. Meeting Patterns

LECTURE: 3

2g. Grading System: Letter (A, B, C, etc.)

2h. Number of credit hours: 3

2i. Is this course repeatable for additional credit? No

If Yes: Maximum number of credit hours:

If Yes: Will this course allow multiple registrations during the same semester?

2j. Course Description for Bulletin: Embedded System Design covers the design and implementation of hardware and software for embedded computer systems. Topics include architectural support for embedded systems, power management, analog and digital I/O, real-time processing design constraints and the design of embedded systems using a real-time operating systems.

- 2k. Prerequisites, if any: EE/CpE 287, EE/CpE 380, and engineering standing or consent of instructor.
- 2l. Supplementary Teaching Component:
3. Will this course taught off campus? No  
If YES, enter the off campus address:
4. Frequency of Course Offering: Spring,  
Will the course be offered every year?: Yes  
If No, explain:
5. Are facilities and personnel necessary for the proposed new course available?: Yes  
If No, explain:
6. What enrollment (per section per semester) may reasonably be expected?: 24
7. Anticipated Student Demand  
Will this course serve students primarily within the degree program?: Yes  
Will it be of interest to a significant number of students outside the degree pgm?: No  
If Yes, explain:
8. Check the category most applicable to this course: Traditional – Offered in Corresponding Departments at Universities Elsewhere,  
If No, explain:
9. Course Relationship to Program(s).  
a. Is this course part of a proposed new program?: No  
If YES, name the proposed new program:  
b. Will this course be a new requirement for ANY program?: No  
If YES, list affected programs:
10. Information to be Placed on Syllabus.  
a. Is the course 400G or 500?: Yes  
b. The syllabus, including course description, student learning outcomes, and grading policies (and 400G-/500-level grading differentiation if applicable, from 10.a above) are attached: Yes

## Distance Learning Form

Instructor Name:

Instructor Email:

Internet/Web-based: No

Interactive Video: No

Hybrid: No

1. How does this course provide for timely and appropriate interaction between students and faculty and among students? Does the course syllabus conform to University Senate Syllabus Guidelines, specifically the Distance Learning Considerations?

2. How do you ensure that the experience for a DL student is comparable to that of a classroom-based student's experience? Aspects to explore: textbooks, course goals, assessment of student learning outcomes, etc.

3. How is the integrity of student work ensured? Please speak to aspects such as password-protected course portals, proctors for exams at interactive video sites; academic offense policy; etc.

4. Will offering this course via DL result in at least 25% or at least 50% (based on total credit hours required for completion) of a degree program being offered via any form of DL, as defined above?

If yes, which percentage, and which program(s)?

5. How are students taking the course via DL assured of equivalent access to student services, similar to that of a student taking the class in a traditional classroom setting?

6. How do course requirements ensure that students make appropriate use of learning resources?

7. Please explain specifically how access is provided to laboratories, facilities, and equipment appropriate to the course or program.

8. How are students informed of procedures for resolving technical complaints? Does the syllabus list the entities available to offer technical help with the delivery and/or receipt of the course, such as the Information Technology Customer Service Center (<http://www.uky.edu/UKIT/>)?

9. Will the course be delivered via services available through the Distance Learning Program (DLP) and the Academic Technology Group (ATL)? NO

If no, explain how student enrolled in DL courses are able to use the technology employed, as well as how students will be provided with assistance in using said technology.

10. Does the syllabus contain all the required components? NO

11. I, the instructor of record, have read and understood all of the university-level statements regarding DL.

Instructor Name:

SIGNATURE|HOLLOWAY|Lawrence E Holloway|EE 580 NEW Dept Review|20150930

SIGNATURE|BJSTOK0|Barbara J Brandenburg|EE 580 NEW College Review|20151027

SIGNATURE|JMETT2|Joanie Ett-Mims|EE 580 NEW Undergrad Council Review|20160323

SIGNATURE|ZNNIKO0|Roshan N Nikou|EE 580 NEW Graduate Council Review|20160331

## New Course Form

<https://myuk.uky.edu/sap/bc/soap/rfc?services=>

[Open in full window to print or save](#)

Generate R

Attachments:

Upload File

	ID	Attachment
Delete	6517	EE580syllabusV4.pdf
<input type="button" value="First"/> <input type="button" value="1"/> <input type="button" value="Last"/>		

(\*denotes required fields)

1. General Information

- a. \* Submitted by the College of:  Submission Date:
- b. \* Department/Division:
- c.
- \* Contact Person Name:  Email:  Phone:
- \* Responsible Faculty ID (if different from Contact)  Email:  Phone:
- d. \* Requested Effective Date:  Semester following approval OR  Specific Term/Year<sup>1</sup>
- e.
- Should this course be a UK Core Course?  Yes  No
- If YES, check the areas that apply:
- Inquiry - Arts & Creativity  Composition & Communications - II
- Inquiry - Humanities  Quantitative Foundations
- Inquiry - Nat/Math/Phys Sci  Statistical Inferential Reasoning
- Inquiry - Social Sciences  U.S. Citizenship, Community, Diversity
- Composition & Communications - I  Global Dynamics

2. Designation and Description of Proposed Course.

- a. \* Will this course also be offered through Distance Learning?  Yes<sup>4</sup>  No
- b. \* Prefix and Number:
- c. \* Full Title:
- d. Transcript Title (if full title is more than 40 characters):
- e. To be Cross-Listed<sup>2</sup> with (Prefix and Number):
- f. \* Courses must be described by at least one of the meeting patterns below. Include number of actual contact hours<sup>3</sup> for each meeting pattern type.
- |  |  |                                 |                                 |
|--|--|---------------------------------|---------------------------------|
| <input type="text" value="3"/> Lecture | <input type="text"/> Laboratory <sup>4</sup>   | <input type="text"/> Recitation | <input type="text"/> Discussion |
| <input type="text"/> Indep. Study      | <input type="text"/> Clinical                  | <input type="text"/> Colloquium | <input type="text"/> Practicum  |
| <input type="text"/> Research          | <input type="text"/> Residency                 | <input type="text"/> Seminar    | <input type="text"/> Studio     |
| <input type="text"/> Other             | If Other, Please explain: <input type="text"/> |                                 |                                 |
- g. \* Identify a grading system:
- Letter (A, B, C, etc.)
- Pass/Fail
- Medicine Numeric Grade (Non-medical students will receive a letter grade)
- Graduate School Grade Scale
- h. \* Number of credits:
- i. \* Is this course repeatable for additional credit?  Yes  No
- If YES: Maximum number of credit hours:
- If YES: Will this course allow multiple registrations during the same semester?  Yes  No

## j. \* Course Description for Bulletin:

Embedded System Design covers the design and implementation of hardware and software for embedded computer systems. Topics include architectural support for embedded systems, power management, analog and digital I/O, real-time processing design constraints and the design of embedded systems using a real-time operating systems.

## k. Prerequisites, if any:

EE/CpE 287, EE/CpE 380, and engineering standing or consent of instructor.

l. Supplementary teaching component, if any:  Community-Based Experience  Service Learning  Both3. \* Will this course be taught off campus?  Yes  No

If YES, enter the off campus address:

## 4. Frequency of Course Offering.

a. \* Course will be offered (check all that apply):  Fall  Spring  Summer  Winter

b. \* Will the course be offered every year?  Yes  No

If No, explain:

5. \* Are facilities and personnel necessary for the proposed new course available?  Yes  No

If No, explain:

## 6. \* What enrollment (per section per semester) may reasonably be expected? 24

## 7. Anticipated Student Demand.

a. \* Will this course serve students primarily within the degree program?  Yes  No

b. \* Will it be of interest to a significant number of students outside the degree pgm?  Yes  No

If YES, explain:

## 8. \* Check the category most applicable to this course:

- Traditional – Offered in Corresponding Departments at Universities Elsewhere  
 Relatively New – Now Being Widely Established  
 Not Yet Found in Many (or Any) Other Universities

## 9. Course Relationship to Program(s).

a. \* Is this course part of a proposed new program?  Yes  No

If YES, name the proposed new program:

b. \* Will this course be a new requirement<sup>5</sup> for ANY program?  Yes  No

If YES<sup>5</sup>, list affected programs::

## 10. Information to be Placed on Syllabus.

a. \* Is the course 400G or 500?  Yes  No

If YES, the *differentiation for undergraduate and graduate students must be included* in the information required in 10.b. You must include: (i) identify additional assignments by the graduate students; and/or (ii) establishment of different grading criteria in the course for graduate students. (See SR

b.  \* The syllabus, including course description, student learning outcomes, and grading policies (and 400G-/500-level grading differentiation if applicable above) are attached.

<sup>5</sup> Courses are typically made effective for the semester following approval. No course will be made effective until all approvals are received.  
<sup>6</sup> The chair of the cross-listing department must sign off on the Signature Routing Log.

- Ⓜ In general, undergraduate courses are developed on the principle that one semester hour of credit represents one hour of classroom meeting per week for a semester, exclusive of any laboratory meeting. Laboratory meeting, generally, is two hours per week for a semester for one credit hour. (from SR 5.2.1)
- Ⓜ You must also submit the Distance Learning Form in order for the proposed course to be considered for DL delivery.
- Ⓜ In order to change a program, a program change form must also be submitted.

Rev 8/09

EE 580  
Embedded System Design

**Instructor:** Dr. James Lumpp  
**Office Address:** 467C F. Paul Anderson Tower, 0046  
**Email:** [jel@uky.edu](mailto:jel@uky.edu)  
**Office Phone:** 257-3895

**Office hours:** Monday and Wednesday, 2 to 3:30 PM

**Course Description:** Embedded System Design covers the design and implementation of hardware and software for embedded computer systems. Topics include architectural support for embedded systems, power management, analog and digital I/O, real-time processing design constraints and the design of embedded systems using a real-time operating systems.

**Prerequisites:** Prerequisites: EE/CpE 287, EE/CpE 380, and engineering standing or consent of instructor.

**Student Learning Outcomes:**

Students who fulfill the requirements for this course will be able to:

1. design embedded systems to solve practical problems.
2. design and implement programs in a high-level language to control a modern microcontroller
3. design interfaces between embedded systems and a variety of popular serial and parallel standards
4. design embedded solutions with real-time, continuous voltage, size, mass and power consumption constraints
5. design embedded systems utilizing a modern real-time operating systems

**Required Materials:**

Embedded Systems: Real-Time Interfacing to Arm® Cortex(TM)-M Microcontrollers, 2nd Edition, Jonathan W. Valvano, 2011, ISBN-13: 978-1463590154, ISBN-10: 1463590156

Lab Supplies: Microcontroller Development Kit: STM32FDiscovery development kit with STM32F407VG MCU

A personal computer capable of running software available through UK Downloads and freeware software specified by the instructor.

**Description of Course Activities and Assignments**

**Course Assignments**

Homework, quizzes, lab and project reports will be submitted and graded via Canvas.

Midterm exams will be given in class and the final exam will be given during finals week.

Homework:	30%	15 homework assignments, 20 points each
Quizzes:	10%	10 In-Class Quizzes, 20 points each
Exam 1:	20%	100 points
Exam 2:	20%	100 points
Final Exam:	20%	Comprehensive Final, 100 points

### **Summary Description of Course Assignments**

Homework Problems and Quizzes will evaluate student's knowledge of embedded computing concepts. The first mid-term exam will evaluate student's understanding of microcontroller architecture and real-time programming in C. The second mid-term exam will evaluate student's understanding of designing embedded systems with real-time constraints. The final exam will be comprehensive.

### **Course Grading**

#### **Grading Scale for Undergraduates**

90 - 100% = A

80 - 89% = B

70 - 79% = C

60 - 69% = D

< 60% = E

#### **Grading Scale for Graduate Students**

92 - 100% = A

84 - 91% = B

76 - 83% = C

< 75% = E

### Tentative Course Schedule

Q = weekly quiz on reading and technical content

E = exam

HW = homework problems, drawings, calculations, etc

L = Laboratory Experiment

Week	Topics	Assignments
1	Welcome, Review Syllabus, Introduction to Canvas, Embedded Systems Introduction	HW1
2	The ARM architecture, IDE, and Development boards	HW2
3	ARM Memory and Peripheral Interface Design	Q1 HW3
4	Architectural Support for Embedded Systems	HW4
5	Serial Busses and implementation of serial protocols	Q2 HW5
6	Analog Interfaces, sampling rates and digital signal processing	E1 HW6
7	Mutual Exclusion, Embedded Programming Models	HW7 Q3
8	Real-Time Operating Systems	HW8 Q4
9	Commercial RTOSs	HW9 Q5
10	Timer/Counter Subsystems	HW10 Q6
11	Requirements, Design, Verification and Validation	E2 HW11
12	Safety Critical Systems	Q7 HW12
13	Power Management in Embedded Systems	HW13 Q8
14	Embedded Networking	Q9 HW14
15	Advanced Topics (Embedded Networking)	Q10 HW15
<b>Finals</b>	Final Exam	E3

### Final Exam Information

The final Exam will be Tuesday May 6, 2016 in FPAT 265.

### Mid-term Grade

Mid-term grades will be posted in myUK by the deadline established in the Academic Calendar (<http://www.uky.edu/registrar/content/academic-calendar>)

### Course Policies:

#### Submission of Assignments:

UK Canvas ([uk.instructure.com](http://uk.instructure.com)) will be used for posting class announcements and assignments. Use your Link Blue login and password to access Canvas based courses. Canvas is also accessible through a smartphone app. Students are responsible for regularly checking the class Canvas site and checking email.

### **Attendance Policy:**

Attendance may be taken at all class and lab meetings. Students are expected to withdraw from the class if more than 20% of the classes scheduled for the semester are missed (excused absences) per university policy.

### **Excused Absences**

Students need to notify the professor of absences prior to class when possible. *Senate Rules 5.2.4.2* defines the following as acceptable reasons for excused absences: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit "reasonable cause for nonattendance" by the professor.

Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing of anticipated absences due to their observance of such holidays no later than the last day in the semester to add a class. Two weeks prior to the absence is reasonable, but should not be given any later. Information regarding major religious holidays may be obtained through the Ombud (859-257-3737, [http://www.uky.edu/Ombud/ForStudents\\_ExcusedAbsences.php](http://www.uky.edu/Ombud/ForStudents_ExcusedAbsences.php)).

Students are expected to withdraw from the class if more than 20% of the classes scheduled for the semester are missed (excused) per University policy.

Per *Senate Rule 5.2.4.2*, students missing any graded work due to an excused absence are responsible: for informing the Instructor of Record about their excused absence within one week following the period of the excused absence (except where prior notification is required); and for making up the missed work. The professor must give the student an opportunity to make up the work and/or the exams missed due to an excused absence, and shall do so, if feasible, during the semester in which the absence occurred.

### **Verification of Absences**

Students may be asked to verify their absences in order for them to be considered excused. *Senate Rule 5.2.4.2* states that faculty have the right to request "appropriate verification" when students claim an excused absence because of illness, or death in the family. Appropriate notification of absences due to University-related trips is required prior to the absence when feasible and in no case more than one week after the absence.

### **Academic Integrity**

Per University policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to

suspension from the University may be imposed.

Plagiarism and cheating are serious breaches of academic conduct. Each student is advised to become familiar with the various forms of academic dishonesty as explained in the Code of Student Rights and Responsibilities. Complete information can be found at the following website: <http://www.uky.edu/Ombud>. A plea of ignorance is not acceptable as a defense against the charge of academic dishonesty. It is important that you review this information as all ideas borrowed from others need to be properly credited.

*Senate Rules 6.3.1* (see <http://www.uky.edu/Faculty/Senate/> for the current set of *Senate Rules*) states that all academic work, written or otherwise, submitted by students to their instructors or other academic supervisors, is expected to be the result of their own thought, research, or self-expression. In cases where students feel unsure about a question of plagiarism involving their work, they are obliged to consult their instructors on the matter before submission.

When students submit work purporting to be their own, but which in any way borrows ideas, organization, wording, or content from another source without appropriate acknowledgment of the fact, the students are guilty of plagiarism.

Plagiarism includes reproducing someone else's work (including, but not limited to a published article, a book, a website, computer code, or a paper from a friend) without clear attribution. Plagiarism also includes the practice of employing or allowing another person to alter or revise the work, which a student submits as his/her own, whoever that other person may be. Students may discuss assignments among themselves or with an instructor or tutor, but when the actual work is done, it must be done by the student, and the student alone.

When a student's assignment involves research in outside sources or information, the student must carefully acknowledge exactly what, where and how he/she has employed them. If the words of someone else are used, the student must put quotation marks around the passage in question and add an appropriate indication of its origin. Making simple changes while leaving the organization, content, and phraseology intact is plagiaristic. However, nothing in these Rules shall apply to those ideas, which are so generally and freely circulated as to be a part of the public domain.

Please note: Any assignment you turn in may be submitted to an electronic database to check for plagiarism.

#### **Accommodations due to disability**

If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (DRC). The DRC coordinates campus disability services available to students with disabilities. It is located on the corner of Rose Street and Huguelet Drive in the Multidisciplinary Science Building, Suite 407. You can reach them via phone at (859) 257-2754 and via email at [drc@uky.edu](mailto:drc@uky.edu). Their web address is <http://www.uky.edu/StudentAffairs/DisabilityResourceCenter/>.