

The University of Texas at Tyler
Department of Electrical Engineering

EENG 4351.060: Internet of Things (IoT) Systems

Syllabus

Catalog Description:

Internet of Things (IoT) theory; ecosystem, implementation and design cycle; Integration of microcontrollers and sensors; IoT programming; cloud data storage; Sensor interfacing; sensor network architectures; user interface design; Hardware/software integration. Three hours of lecture per week.

Prerequisites:

EENG 4307 – Microprocessors and Embedded Systems, EENG3308 -Programming Languages for Design

Credits:

3 (3 hours lecture, 0 hours laboratory per week)

Text(s):

No Textbook

Required Material :

Text: Documentation and reference materials provided by the Instructor; Research papers on IoT from IEEE Xplore.

Software: Arduino IDE.

Hardware: Arduino Board with Wi-Fi module (<https://store.arduino.cc/usa/arduino-uno-wifi>). USB cable and Sensor bundle. Arduino IDE on Windows 10 computer.

Course Coordinator:

Dr. Prabha Sundaravadivel, Assistant Professor

Topics Covered: (paragraph of topics separated by semicolons)

Internet of Things (IoT) Theory; concepts of ecosystem; C language to program the microcontroller board; build a sustainable IoT design; different types of wireless sensor networks and applications; dataflow and routing protocols in wireless sensor networks; design webhooks and dashboard for the user interface; smart healthcare; smart city.

Evaluation Methods: (only items in dark print apply):

1. Examinations/ Quizzes
2. Homework
3. Report
4. Computer Programming
5. Project
6. Presentation
7. Course Participation
8. Peer Review

Course Learning Outcomes¹: By the end of this course students will be able to:

1. Analyze the key concepts of IoT ecosystem. [1]
2. Use C language to program microcontroller board. [4]
3. Build a sustainable IoT design by integrating different types of sensors to microcontrollers. [2]
4. Implement sensor network architectures for various wireless sensing applications. [1,2]
5. Understand different types of dataflow, routing protocols in wireless sensor networks. [1,2]
6. Design secure IoT applications in the cloud. [2]
7. Apply key programming concepts to build webhooks, and dashboard for user interface. [5]
8. Formulate a business model for a sustainable IoT application. [6, 7]

¹Numbers in brackets refer to method(s) used to evaluate the course learning outcome.

Relationship to Student Outcomes (only items in dark print apply)²: This course supports the following Electrical Engineering Student Outcomes, which state that our students will possess:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics [1,2].
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors [4].
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts. [3,5]
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives [8]
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions [7].
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies. [6].

²Numbers in brackets refer to course learning outcome(s) that address the Program Outcome.

Contribution to Meeting Professional Component: (in semester hours)

| | | |
|----------------------------------|---|-------|
| Mathematics and Basic Sciences: | | hours |
| Engineering Sciences and Design: | 3 | hours |
| General Education Component: | | hours |

Grade Replacement:

If you are repeating this course for a grade replacement, you must file an intent to receive grade forgiveness with the registrar by the 12th day of class. Failure to file an intent to use grade forgiveness will result in both the original and repeated grade being used to calculate your overall grade point average. A student will receive grade forgiveness (grade replacement) for only three (undergraduate student) or two (graduate student) course repeats during his/her career at UT Tyler. (2006-08 Catalog, p. 35)

Prepared By:

Prabha Sundaravadivel, Assistant Professor

Date:

11 August 2021

Edited By:

The University of Texas at Tyler
Department of Electrical Engineering

Course: EENG 4351.060 – Internet of Things (IoT) Systems

COURSE OUTLINE

Course Coordinator:

Dr. Prabha Sundaravadivel
 Assistant Professor, Department of Electrical Engineering
Office: RBN 2015
Email: PSundaravadivel@uttyler.edu
Office Hours: Thursday 4-6 PM, Friday 3- 4 PM
 Email, Canvas Discussion Boards, or Book a meeting @
<https://calendly.com/psundaravadivel/meetme?month=2021-08>
Zoom ID: 92612822987 **Passcode:** Fall2021

Class Location/Time: Recorded Online Lectures

Grading Policy:

| | | |
|-----------------------------|-------------|-----------|
| Case Study reports | 30% | Total - 3 |
| Quizzes | 10% | |
| Mini Projects / Assignments | 20% | Total – 2 |
| Final Project | 40% | |
| Total | 100% | |

Semester Schedule (Tentative):

| Week | Start Date | Topics Covered | Final Project | Mini Project and Case Study | Mode of Delivery |
|------|------------|--|---|-----------------------------|--------------------------------|
| 1 | 23-August | <i>IoT Theory</i> | | | <i>Recorded Online Lecture</i> |
| 2 | 30-August | <i>Introduction to Sensors</i> | | | <i>Recorded Online Lecture</i> |
| 3 | 6-Sept | <i>Introduction to Wireless Sensor Network Architectures</i> | | | <i>Recorded Online Lecture</i> |
| 4 | 13 - Sept | <i>Data Collection and Routing Protocols</i> | | Mini Project-1 | <i>Recorded Online Lecture</i> |
| 5 | 20-Sept | <i>Example Sensor Networks</i> | | | <i>Recorded Online Lecture</i> |
| 6 | 27-Sept | <i>Smart City – Case Study</i> | | Case Study report - 1 | <i>Recorded Online Lecture</i> |
| 7 | 4-Oct | <i>Arduino Programming</i> | Market research, Identifying a need | | <i>Recorded Online Lecture</i> |
| 8 | 11- Oct | <i>IoT Databases and Dashboards</i> | | | <i>Recorded Online Lecture</i> |
| 9 | 18- Oct | <i>Smart Healthcare – Case Study</i> | | Case Study report - 2 | <i>Recorded Online Lecture</i> |
| 10 | 25 - Oct | <i>Arduino IoT Cloud</i> | | | <i>Recorded Online Lecture</i> |
| 11 | 1-Nov | <i>Arduino Cloud Projects - Examples</i> | Generate a business idea, write a business plan | Mini Project-2 | <i>Recorded Online Lecture</i> |

| | | | | | |
|----|--------|---------------------------------------|------------------------------------|-----------------------|--------------------------------|
| 12 | 8-Nov | <i>IFTTT, NodeRED application</i> | | | <i>Recorded Online Lecture</i> |
| 13 | 15-Nov | <i>Emerging research areas in IoT</i> | | Case Study report - 3 | <i>Recorded Online Lecture</i> |
| 14 | 22-Nov | <i>Thanksgiving Break</i> | | | |
| 15 | 29-Nov | | Final prototype and business pitch | | |
| 16 | 6-Dec | | Final project report | | |

Mode of Delivery:

This course is a fully online course. The recorded lectures will be posted online in Canvas under respective modules. Students are expected to watch the lectures, read through the given materials and stay up to date on the course materials for each week. If the student has any concerns or would like to share their feedback on the lectures, email the Instructor anytime.

Flexible Online Office Hours:

This course will have extended office hours. Students can meet with the Instructor during the office hours on Thursdays (4-6 PM) and Fridays (3-4 PM) using the zoom link. However, if students are not available during the mentioned office hours, they are strongly encouraged to schedule a meeting with the Instructor anytime. Students can also schedule a meeting through the following link: <https://calendly.com/psundaravadivel/meetme?month=2021-08>

Quiz:

There will be a total of 4-5 quizzes in the class. The quizzes will be blended as part of the course module for each week. This is to keep the students on track with the course content. Quizzes will be conducted through Canvas.

Mini-Project:

The Mini-Project is to help students evaluate their IoT implementation skills. Students will be given simple challenge statements based on which they are expected to design an IoT ecosystem. The course will contain 2 mini projects.

Case-Study Reports:

As the IoT applications are relevant and growing research, after the discussion of topics such as smart health and smart city, a case study report is required. Students are expected to review the assigned research or white paper and submit a 2-page case study report on their observations.

Final Project:

The final project will be evaluated based on both engineering and entrepreneurial components. Students are required to build a sustainable IoT project that can be deployed in real-time. Students will formulate their final project with an entrepreneurial mindset. This will include market research, identifying the need, writing a business plan. Projects will be based on Arduino boards. Students can either form a group or complete this project individually. A simple working robotics or IoT-based project is expected to be built. However, students are strongly encouraged to be creative and can choose their own project topic. The tentative schedule for project completion is:

Market Research (5%) due on October 4, 2021

Business Plan (5%) due on November 1, 2021

Final showcase - business pitch and prototype (20%) due on Nov 29, 2021

Project report (10%) due on December 6, 2021

Attendance Policy and Class Participation:

Students are expected to complete reviewing all the posted lectures and materials on a weekly basis. By signing up for the class it is understood that the student has checked for ANY significant recurring conflicts that might affect completion of the course requirements. Attendance will be monitored through timely completion of the submissions and quizzes. The progressive nature of the class means that perfect attendance is recommended if a good grade is desired. Class participation is graded based on attendance, involvement of student in the class activities.

Final Exam:

There is no final exam for this course.

How to be successful in this course:

This course is targeted for beginner-level IoT materials. As this is a relevant topic and is one of high-demand job market, the course materials are designed with blended entrepreneurial components. To be successful in this course, complete all the materials on time, so that any concerns or questions can be discussed with the instructor during the week. Though there are no high expectations for students to be an expert in programming in beginning of this course active involvement in the class and taking the initiative to learn/ advance programming and IoT implementation skills beyond the scheduled classes is strongly encouraged to complete the course successfully.

Students Rights and Responsibilities

To know and understand the policies that affect your rights and responsibilities as a student at UT Tyler, please follow this link: <http://www.uttyler.edu/wellness/rightsresponsibilities.php>

Grade Replacement/Forgiveness and Census Date Policies:

Students repeating a course for grade forgiveness (grade replacement) must file a Grade Replacement Contract with the Enrollment Services Center (ADM 230) on or before the Census Date of the semester in which the course will be repeated. Grade Replacement Contracts are available in the Enrollment Services Center or at <http://www.uttyler.edu/registrar>. Each semester's Census Date can be found on the Contract itself, on the Academic Calendar, or in the information pamphlets published each semester by the Office of the Registrar.

Failure to file a Grade Replacement Contract will result in both the original and repeated grade being used to calculate your overall grade point average. Undergraduates are eligible to exercise grade replacement for only three course repeats during their career at UT Tyler; graduates are eligible for two grade replacements. Full policy details are printed on each Grade Replacement Contract.

The Census Date is the deadline for many forms and enrollment actions that students need to be aware of. These include:

- Submitting Grade Replacement Contracts, Transient Forms, requests to withhold directory information, approvals for taking courses as Audit, Pass/Fail or Credit/No Credit.
- Receiving 100% refunds for partial withdrawals. (There is no refund for these after the Census Date)
- Schedule adjustments (section changes, adding a new class, dropping without a "W" grade)

- Being reinstated or re-enrolled in classes after being dropped for non-payment
- Completing the process for tuition exemptions or waivers through Financial Aid

State-Mandated Course Drop Policy

Texas law prohibits a student who began college for the first time in Fall 2007 or thereafter from dropping more than six courses during their entire undergraduate career. This includes courses dropped at another 2-year or 4-year Texas public college or university. For purposes of this rule, a dropped course is any course that is dropped after the census date (See Academic Calendar for the specific date). Exceptions to the 6-drop rule may be found in the catalog. Petitions for exemptions must be submitted to the Enrollment Services Center and must be accompanied by documentation of the extenuating circumstance. Please contact the Enrollment Services Center if you have any questions.

Disability Services

In accordance with federal law, a student requesting accommodation must provide documentation of his/her disability to the Disability Services counselor. If you have a disability, including a learning disability, for which you request an accommodation, please contact the Disability Services office in UC 3150, or call (903) 566-7079.

Student Absence due to Religious Observance

Students who anticipate being absent from class due to a religious observance are requested to inform the instructor of such absences by the second class meeting of the semester.

Student Absence for University-Sponsored Events and Activities

If you intend to be absent for a university-sponsored event or activity, you (or the event sponsor) must notify the instructor at least two weeks prior to the date of the planned absence. At that time the instructor will set a date and time when make-up assignments will be completed.

Social Security and FERPA Statement:

It is the policy of The University of Texas at Tyler to protect the confidential nature of social security numbers. The University has changed its computer programming so that all students have an identification number. The electronic transmission of grades (e.g., via e-mail) risks violation of the Family Educational Rights and Privacy Act; grades will not be transmitted electronically.

Emergency Exits and Evacuation:

Everyone is required to exit the building when a fire alarm goes off. Follow your instructor's directions regarding the appropriate exit. If you require assistance during an evacuation, inform your instructor in the first week of class. Do not re-enter the building unless given permission by University Police, Fire department, or Fire Prevention Services.

Happy Learning!