ADANA ALPARSLAN TÜRKEŞ
SCIENCE AND TECHNOLOGY UNIVERSITY

EEE423 - Embedded Systems
Midterm Exam
Prepared by Dr Kasım Zor

20th Nov 2023, 16:00–17:30

Full Name : _____ Student ID: _____

Grade Table (for Lecturer use only)

Question	Points	Score
1	50	
2	50	
Total:	100	

Instructions for Midterm Exam

Welcome to the midterm exam of EEE423 - Embedded Systems and good luck!

Please read the following rules and confirm by signing that you have read and understood the rules before you receive your exam:

- The midterm exam shall be conducted between 16:00 and 17:30. Exam duration is 90 minutes. Students must finalise the exam by delivering it before 17:30. Students are not allowed to leave the exam in the first 30 minutes.
- Student ID cards shall visibly be on the edge of desks till the end of the exam. Students without the student ID cards or Turkish identity cards shall not be participated into the exam.
- This is a closed-book exam which means that students are not allowed to take notes, books, or any other reference material into the exam. Throughout the exam, students shall not possess mobile phones and electronic devices that are capable of storing, receiving or transmitting information or electronic signals, such as computerised watches.
- Students are not allowed to take a glance at the exam questions until told to do so. Students shall not communicate with any other student under any circumstances during the exam period. A student, who cheats, tries to cheat during the exam, or is identified to be cheating after investigating exam documents, is given 0 (zero) for that exam and a disciplinary investigation is opened against the student.
- An incorrect answer to a question is awarded no marks with no consideration of any partial credit. Therefore, no partial credit will be given.

In recognition of and in the spirit of the above rules which constitute Adana Alparslan Türkeş Science and Technology University Honour Code, I certify that I will neither give nor receive unpermitted aid on this examination.

Signature: _____

1. Answer the following questions.
   (a) **(5 points)** What were your motivations for selecting EEE423 Embedded Systems course at the beginning of 2023 Fall term?

   (b) **(5 points)** List five typical characteristics of an embedded system briefly.
      1.
      2.
      3.
      4.
      5.

   (c) **(5 points)** Describe the relationship between the internet of things (IoT) and embedded systems.

   (d) **(5 points)** What do RISC and CISC stand for?
   RISC:
   CISC:

   (e) **(10 points)** What are the names and models of the embedded system set and the processor that are used throughout this course?
   Embedded System Set
      - Name:
      - Model:

   Processor
      - Name:
      - Model:

   (f) **(10 points)** What is the importance of assembly language for embedded systems?

   (g) **(10 points)** List the types of memory devices in the embedded systems along with giving one example per type.
   1.
      - Example:

   2.
      - Example:

2. Answer the following questions.

   (a) **(10 points)** What are the names of the programming language and integrated development environment (IDE) used for the embedded system set in this course?

   - Programming Language:
   - IDE:

   (b) **(15 points)** Design a program that takes height (in m) or time (in s) values from the user and calculates either time or height in the state of free fall.

   - Case 1: User types findTime as string, program asks user to enter height value in order to find time value.
   - Case 2: User similarly types findHeight as string, program asks user to enter time value in order to find height value.
   - Case 3: Program otherwise displays Syntax error for input command.

   Hint: $h = \frac{1}{2}gt^2$, $t = \sqrt{\frac{2h}{g}}$, and $g = 9.81$ m/s^2.

(c) **(25 points)** Electrical energy production from wind power is one of the fastest growing technologies and an economically viable option among renewable energy resources. Basically, E_{annual} which corresponds to the annual electrical energy (in Wh) generation from wind power is calculated as follows

$$E_{annual} = 8760 C_F P_{wind} c_p$$

where C_F, P_{wind}, and c_p stand for capacity factor, wind power (in W), and power coefficient respectively. Subsequently, P_{wind} can be yielded as

$$P_{wind} = \frac{1}{2}\rho\pi(\frac{D}{2})^2 v^3$$

where ρ is the density of air (in kg/m^3), D is the rotor diameter (in m), and v is the average wind speed (in m/s).

According to the aforementioned formulae, design a program that separately computes annual energy production of a wind turbine within two different auxiliary function named as *Onshore* and *Offshore* by considering the followings:

- Auxiliary functions shall be developed as
  - Return-type functions for students with odd student IDs,
  - Void functions for students with even student IDs.
- The density of air ρ and the average wind speed v shall be declared as *global constants* and sequentially equals to 1.2 kg/m^3 and 10 m/s.
- User shall be initially informed to select and call either *Onshore* or *Offshore* auxiliary function wherein all computations shall be performed.
- The user shall enter D, C_F, and c_p values in both *Onshore* and *Offshore* auxiliary functions.
- The conditions for the capacity factor C_F
  - For onshore wind turbines: $0.20 \leq C_F \leq 0.35$,
  - For offshore wind turbines: $0.35 \leq C_F \leq 0.50$,

  shall be validated against erroneous entries by employing
  - *while* loops for students with odd student IDs,
  - *do-while* loops for students with even student IDs.
- The condition for the power coefficient c_p is $0 < c_p \leq 0.593^*$ which shall be validated against erroneous entries by employing
  - *do-while* loops for students with odd student IDs,
  - *while* loops for students with even student IDs.

  *Please note that $\frac{16}{27} \approx 0.593$ corresponds to the Betz limit which is the theoretical maximum power extraction efficiency for a wind turbine.