

Indian Institute of Information Technology, Sri City, Chittoor

Name of the Exam: Cyber-Physical Embedded Systems

Duration: 4 hours (1100-1500)

Max. Marks: 75

Roll No.: _____ Room No.: _____ Seat No.: _____

Name: _____ Invigilator's Signature: _____

Instructions:

1. Students are required to write the answers in A4 sheets. Students are required to clearly write their roll number, name in capital letters on top of every page of the answer sheets. Please mention your question paper number in your answer sheet (this is **Question Paper number 2**).
2. At the end of the exam, students are expected to submit the scanned copy of the answer sheets to balaji.r@iiits.in as per the indicated closing time.
3. It is a closed book exam.
4. If there are some values not given in this question paper, kindly assume standard values and state your assumption in the answer sheet. If you don't know the standard values use variable names and derive solutions with unknown variables.
5. If there are some values not given in this question paper, kindly assume standard values and state your assumption in the answer sheet. If you don't know the standard values use variable names and derive solutions with unknown variables.
6. **Students have to clearly give the answers in a step by step mode. If the student answers the questions directly giving an answer then the student may get a small set fraction of the total mark.**

-
1. Answer the following question. This question carries 15 marks.

EMBEDDED PLATFORMS

You are considering a particular small and inexpensive microcontroller for use in a product. The processor used in this microcontroller includes a pipeline. Hardware is included in the processor to detect and mitigate all structural and control hazards. However, to reduce the cost of the processor, there is no detection or mitigation of data hazards.

- a. Would you expect the pipelining to improve the latency, the throughput, or both for this processor over an equivalent sequential processor without pipelining?
- b. The processor does not handle data hazards. What does this imply about your programs?

-
2. Answer the following question. This question carries 30 marks (each question carries 15 marks). For both the below questions draw the finite state machine and present the mathematical model for it. If they are any behavior and/or parameters not defined assume appropriately. Based on the system definition choose if you need a deterministic or non-deterministic state machine.

(ignore the reference to the figure in the text book in the first question)

Define a (possibly extended) state machine (call it FSM_C) that models a timer interrupt service routine. FSM_C outputs a pure periodic signal tick at a desired frequency (say 4 times per second). Assume that you can set up the timer so that the interrupt occurs 1000 times per second; FSM_C could look a lot like what you can see in Figure 9.5 in the text.

Define another state machine (call it FSM_D) that models a data logging system. Every 30 seconds it reads the temperature from an external sensor and records the current temperature and the number of times the button was pressed and released since the last log entry.

-
3. **Actor Models (30 marks):** An actor model for the helicopter is depicted below. For the below-given actor model, do the following:
 - a. Derive the equations for the model; Before deriving your equations, clearly, state the domain and co-domain of every function you use; explain each component in the actor model shown below; state the mapping of the functions for each component in the actor model; and (20 marks)

- b. State if the model is casual or not, and justify your answer (10 marks).

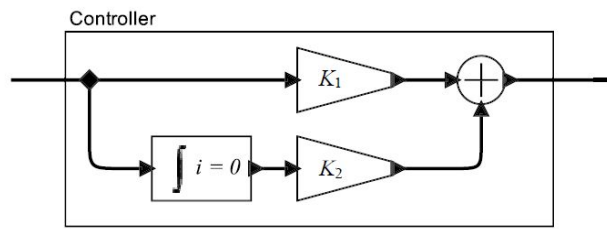


Figure 2.6: A PI controller for the helicopter.