TECHNISCHE UNIVERSITÄT ILMENAU

Technical University of Ilmenau

Department of Automation Engineering

AT.504.EN

Discrete Event Systems

Date: Monday, July 16th, 2018

Duration: 2 hours

Time: 10:00 am

Version: AT.504.EN.2018.SAMPLE

Location: HU 211/12

Instructor: Prof. Yuri A.W. Shardt

Student's Name: _____SAMPLE FINAL_____

Student's ID Number: _____

Degree Programme: _____

Student's Signature: _____

General Instructions

1) Address all inquiries to the supervisor. Do not communicate with other candidates.
2) Please write your ID number on each page.
3) Please write all answers in the allocated space.
4) Should you need additional paper, please ask the invigilators for it. Please place your ID number on all pages.
5) Should you feel ill, please inform the supervisor **before the start of the examination** and leave the examination room immediately.
6) Please do not cheat.
7) A regular calculator is permitted. All other electronic devices (including cell phones, smart watches, and computers) are strictly forbidden.
8) The examination is open book, that means that you are permitted to use your own course notes, a dictionary, and a copy of the textbook.
9) The date and time when you can review your examination will be posted on the departmental website: http://tu-ilmenau.de/en/dept-automation/.

Total Pages: 4 (including this cover page)

Department of Automation Engineering

AT.504.EN Discrete Event Systems

ID Number: _____

Final Mark: _____/## Marks

Question 1 (45 marks): True or False

Please write for each of the following statements "true" or "false" with justifications. Please only use the words "true" or "false". (One point for true/false and 2 points for the justification.)

a) The capital city of Canada is Montréal.

b) In a time-invariant system, the values of the parameters can depend on the time.

c) A SISO system has only one input and one output.

d) In continuous-state systems, the state variable can take only discrete values, for example, only natural numbers.

e) A clock-driven system is an example of a discrete event system.

f) A nondeterministic automaton can be converted to a deterministic automaton.

g) The empty set is denoted by ε.

h) An automaton that is both accessible and co-accessible is called a trim automaton.

i) $G_1 \| G_2$ denotes composition by product.

j) Livelocking occurs when a system is stuck switching between a series of states, none of which are marked.

k) Blocking constraints cannot be enforced by a supervisor of a discrete event system.

l) It is possible to design a supervisor that can handle a specified switching between 3 events.

m) A supervisor can be realised as an automaton.

n) If K_1 and K_2 are controllable, then $K_1 \cup K_2$ is controllable.

o) If a prefix-closed language K is regular and M is regular, then $K^{\uparrow C}$ is not regular.

ID Number: _____

Question 2 (50 marks): Automata

2.19 A workcell consists of two machines M_1 and M_2 and an automated guided vehicle AGV.[6] The automata modeling these three components are shown in Fig. 2.40. The complete system is $G = M_1||M_2||AGV$.

(a) Find G.

(b) Is G blocking or nonblocking?

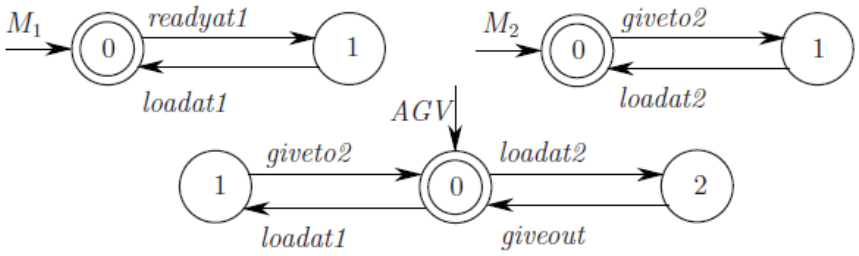

Figure 2.40: Problem 2.19.

ID Number: _____

Question 3: Supervisors

You are given an automaton G with event set $E = \{a_1, a_2, b_1, b_2, g_1, g_2\}$. Build another automaton that will generate the sublanguage of $\mathscr{L}(G)$, where all the strings in $\mathscr{L}(G)$ that contain the substrings $a_1a_2b_2$ or $a_1a_2g_2$ have been removed.