Entry test	/10
Task1	/13
Task2	/12
Total	/35

System Modelling – 1st mid-term exam
EXAMPLE for 2017

Name: .....
Neptun code: .....

Entry test (10 points)

Question	1				2				3				4				5			
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
Answer																				

Question	6				7	8	9				10			
	a	b	c	d			a	b	c	d	a	b	c	d
Answer														

You have to pass the entry test with at least 5 points out of the 10, otherwise you fail the whole mid-term exam independently of the results of the two main exercises.

Answer the questions by indicating **in the table above** for each answer whether they are **true (T)** or **false (F)**. Correction is accepted as long as it is denoted unambiguously. The number of true answer varies from block to block; it is possible that all answers in a block are true or all are false. Each answer (e.g. 2.c) is worth ¼ point if it is correct, 0 point if it is left blank, and -¼ if it is incorrect. The final score given for the whole quiz, however, is at least 0. Note that due to the scoring system, random guessing is not profitable.

1. What kind of depiction of a real or hypothetic system is the model?

   a) Asynchronous.
   b) Simplified.
   c) Deterministic.
   d) Executable.

2. Which sentence will be definitely valid, if model M_1 refines model M_2?

   a) If M_2 is a valid model of a system, then M_1 is a valid one.
   b) If M_1 is a valid model of a system, then M_2 is a valid one.
   c) M_2 abstracts M_1.
   d) M_2 refines M1.

3. Which graphs are always free of cycles?

   a) The type graphs (containing node types and edge types).
   b) The graphs describing containment hierarchies.
   c) Tree graphs.
   d) The resulting subgraphs of a *filtering by edge labels* operation.

4. What can be written on a label of a state transition?

   a) Output event
   b) Parallel regions
   c) Guard
   d) State

5. What is true for every state space?

a) Hierarchic
b) Complete
c) Mutually exclusive
d) Deterministic

6. What must be true for the state space S of the whole system, if the system is described by the state spaces (S_1 and S_2) of its two components?

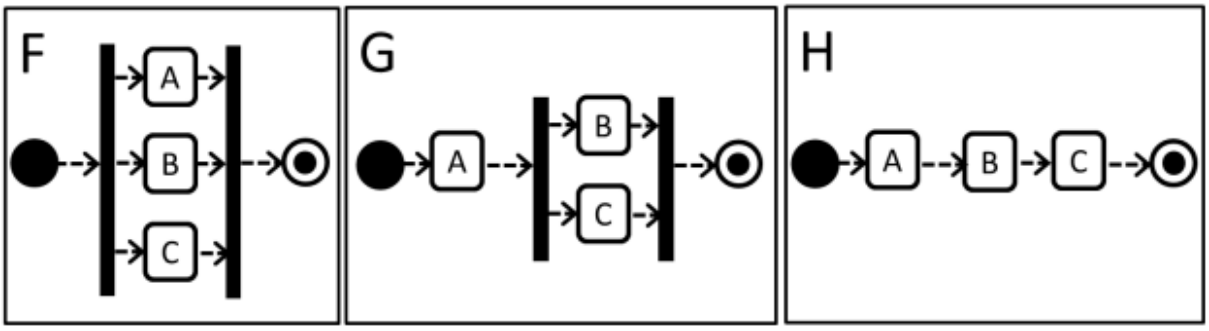
a) S is non-deterministic
b) S is a well-structured process model
c) S is the union of S_1 and S_2
d) S is the intersection of S_1 and S_2

7. At most how many states can have the direct product of two state spaces that have 5 and 3 states, respectively?

(Give a number.)

8. We detected the following event sequence: *A started, A completed, B started, C started, B completed, C completed*. Which process models (from F, G, and H) can be valid models of the observed system?

(Give some letters.)



9. What is true for the control flow of a C program?

a) The control flow is a hierarchical state machine.
b) The control flow may contain a *Decision* node.
c) The control flow may contain a *Merge* node.
d) The control flow may contain a loop.

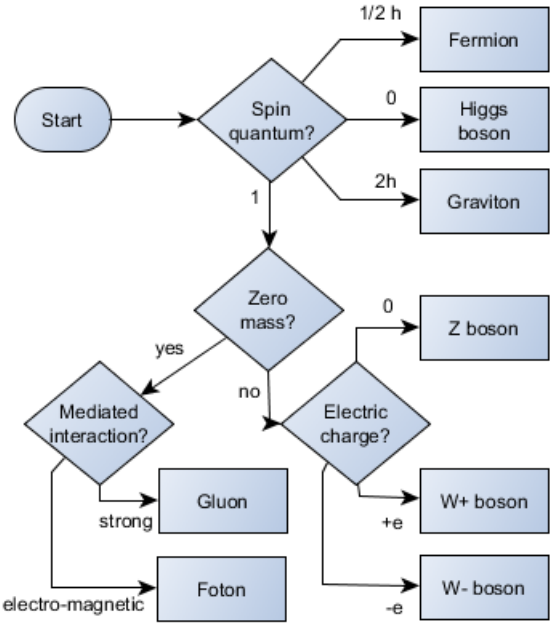
10. What is true for a well-structured process?

a) It has as many exit points, as many states the state space has.
b) It cannot contain multiple branches.
c) It may contain loops.
d) It cannot describe an endless loop.

The first exercise can be found on next page.

1st Exercise – Structural Modelling (13 points)

In our laboratory of physics, the colleagues classify the detected elementary particles with the help of the following decision diagram.



a) Create a property model for the classes of the elementary particles. In your model, show all properties that are required when evaluating the decision diagram. In a table, give all property values, where they are clear from the diagram. (4 points)

b) Show a filtering and a projection on the above property model. (Define your operations, and show the results, as well.) (3 points)

c) Some of the above elementary particles are called bosons, because their spin quantum is an integer multiple of *h*. From these, the Z boson, the W^+ boson and the W^- boson mediate the "weak" interaction.

We distinguish two kinds of (elementary) fermions: quarks and leptons. Leptons are e.g. the electron and the anti-electron (positron) which are anti-particles of each other. The W+ and W- bosons are also anti-particles of each other. All the other bosons are anti-particles of themselves.

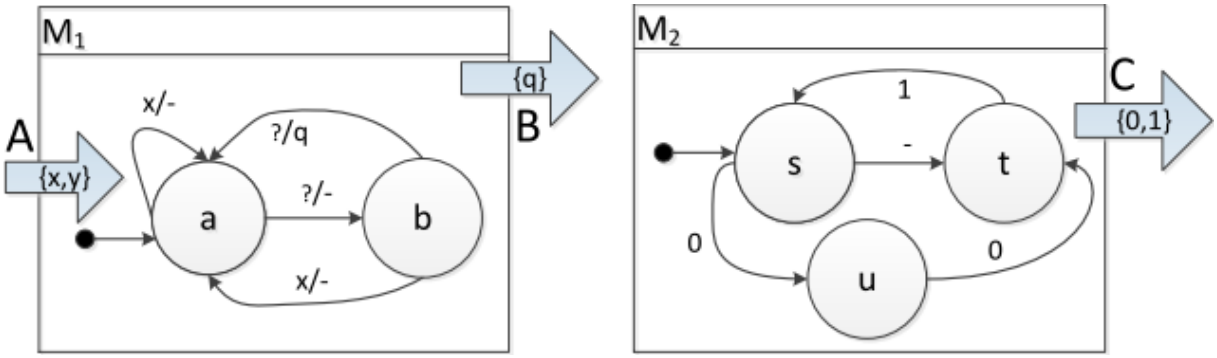
Draw a graph that describes the above-told knowledge about the relations among the elementary particles. (3 points)

d) Create a type graph for your graph. (3 points)

The second task/exercise can be found on next page.

2nd Exercise – State Based Modelling (12 points)

Below you can see two state machines: M_1 has one input and one output channel, M_2 has no input and one output channel. (The "-" sign in the labels means: no output is emitted.)



a) The preconditions of two transitions of M_1 are lost, they are replaced by a "?". Fill the missing preconditions in a way that makes the automaton deterministic. (2 points)
b) Is the now completed M_1 state machine fully specified? (1 point)
c) Create the asynchronous product of M_1 and M_2. (4 points)
d) What is the relation between the state space of the product state machine and the one of M_1? (2 points)
e) Create a third state machine that reads channel C, detects the changes on the output of M_2, and gives its output on the input of M_1. (M_3 must emit a "y", if it detects a 0→1 or 1→0 change on channel C, and it must emit an "x" if there is no change on channel C.) (3 points)