



UNIVERSITY  
OF SKÖVDE

School of Informatics (IIT)

## WRITTEN EXAMINATION

Course **Business Process Management**

Sub-course

Course code **IT378G**

Credits for written examination **4.5**

Date **2024-03-01**

Examination time **8:15-12:30**

Examination responsible **Manfred Jeusfeld, Kristens Gudfinnsson**

Teachers concerned **Manfred Jeusfeld, Kristens Gudfinnsson**

Aid at the exam/appendices

Students are allowed to bring a Swedish-English dictionary to the exam

- Instructions
- Take a new sheet of paper for each exam part.
  - Take a new sheet of paper when starting a new question.
  - Write only on one side of the paper.
  - Write your name and personal ID No. on all pages you hand in.
  - Use page numbering.
  - Don't use a red pen.
  - Mark answered questions with a cross on the cover sheet.

Grade points: 100

Answer in Swedish or English.

Answer all the questions

**Examination results should be made public within 18 working days**

*Good luck!*

**Total number of pages: 6 (incl. this title page)**

The maximum number of points is 100. The grade is calculated from the sum of points achieved for the questions. You need 50 points or more to pass the exam.



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**Question 1 (15 points)**

Petri nets allow to model business processes and their execution.

a (8 points) Explain the following terms

- *Start state*
- *AND join*
- *Workflow net (WFnet)*
- *Deadlock*

b (7 points) Provide a WFnet with at least **8 transitions** that has a **loop** and an **AND-split** that runs into a **deadlock** (i.e., it is not sound).

**Question 2 (20 points)**

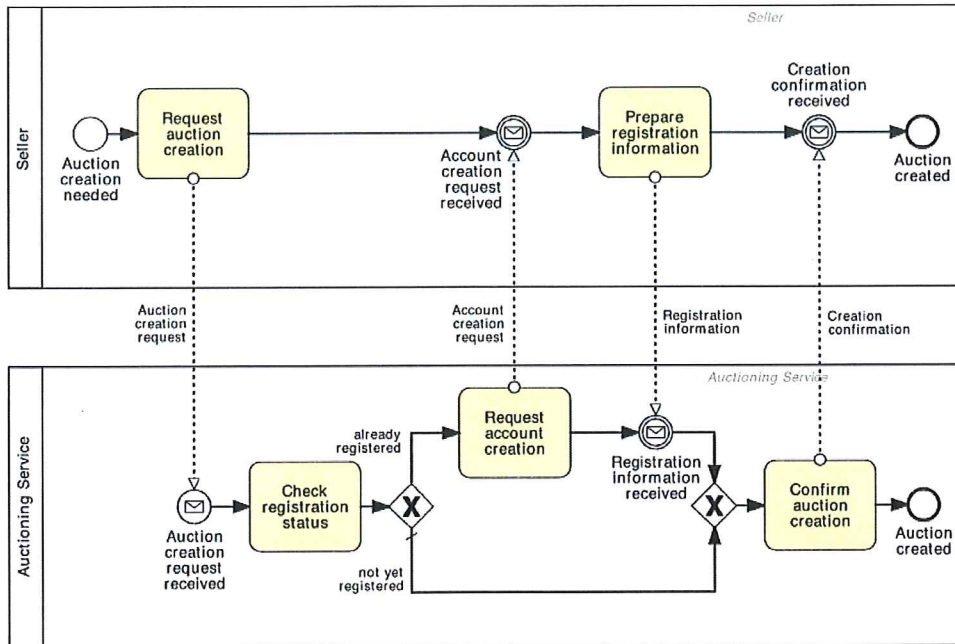
Business process models can be simulated to measure the cycle time and resource utilization. The terms cycle time and resource utilization were introduced using waiting queue theory.

- a (8 points) Define the following terms in 1-2 sentences
- *inter-arrival time*
  - *waiting time*
  - *cycle time*
  - *resource utilization*
- b (4 points) The average cycle time will grow to infinity if the “service time” for a case is longer than the inter-arrival time. Why is this true? What do we understand by a “Little’s Law”?
- c (4 points) We used the *exponential distribution* for the arrival process in waiting queue theory. What is the characteristic of the exponential distribution? What distinguishes it from the *normal distribution*?
- d (2 points) Explain the characteristic of the *triangular distribution*. How is it specified? In which situations is the uniform distribution the right choice?
- e (2 points) Instead of a mathematical distribution, one can also use a histogram to specify the distribution of inter-arrival time. Give an example for a histogram for inter-arrival time.



**Question 3 (20 points)**

Consider the following BPMN process model:



- (4 points) What is the difference between message flows and sequence flows. Show an example of a message flow in the above diagram.
- (12 points) Convert the above BPMN model into an equivalent petri net, more precisely a workflow net (WFnet).
- (4 points) Is the resulting WFnet sound? How can the soundness be checked? Are there manual ways to check the soundness? Are the automated methods to check the soundness?



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**Question 4 (30 points)**

Consider the following example for a process model: A wholesale company has two warehouses for spare parts and tools used in the construction business, one in Malmö, the other in Linköping. When an order (usually containing several products) is received from a construction company, it is sent to the warehouse closest to the construction company. If some parts are not currently maintained in the warehouse, a suborder is sent to the other warehouse for the missing parts. The order is then suspended until the parts from the other warehouse arrive. When all parts are available, the order is fulfilled and the parts are sent to the construction company.

- a (20 points) Write a BPMN model with at least three swimlanes (construction company, warehouse Malmö, warehouse Linköping) for this example.
- b (10 points) Instead of waiting for the missing parts of the other warehouse, the available parts could be sent directly to the construction company from the one warehouse and the other warehouse could do the same for the other parts. How would the BPMN model for this scenario look like?



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**Question 5 (15 points)**

Process mining is about extracting knowledge from the execution of business processes.

- a (4 points) What are the main goals of process mining (also called process intelligence)? What types of knowledge (insights) can be gained from process mining? List at least 4 goals.
- b (8 points) The source for process mining are so-called *event log files* storing details of the execution of a process. Which fields are mandatory in such an event log file to be usable for process mining? Give an example of an event log file with at least 5 entries (rows).
- c (3 points) Some event logs also contain more fields than the mandatory ones. How could these fields be used to get more insights into the process?