WRITTEN EXAMINATION

Course **Business Process Management**

Sub-course

Course code **IT378G**   Credits for written examination **4.5**

Date **2026-01-08**   Examination time **14:15-18:30**

Examination responsible   **Manfred Jeusfeld, Kristens Gudfinnsson**

Teachers concerned   **Manfred Jeusfeld, Kristens Gudfinnsson**

Aid at the exam/appendices

<u>Students are allowed to bring a Swedish-English dictionary to the exam</u>

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: 5 (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.
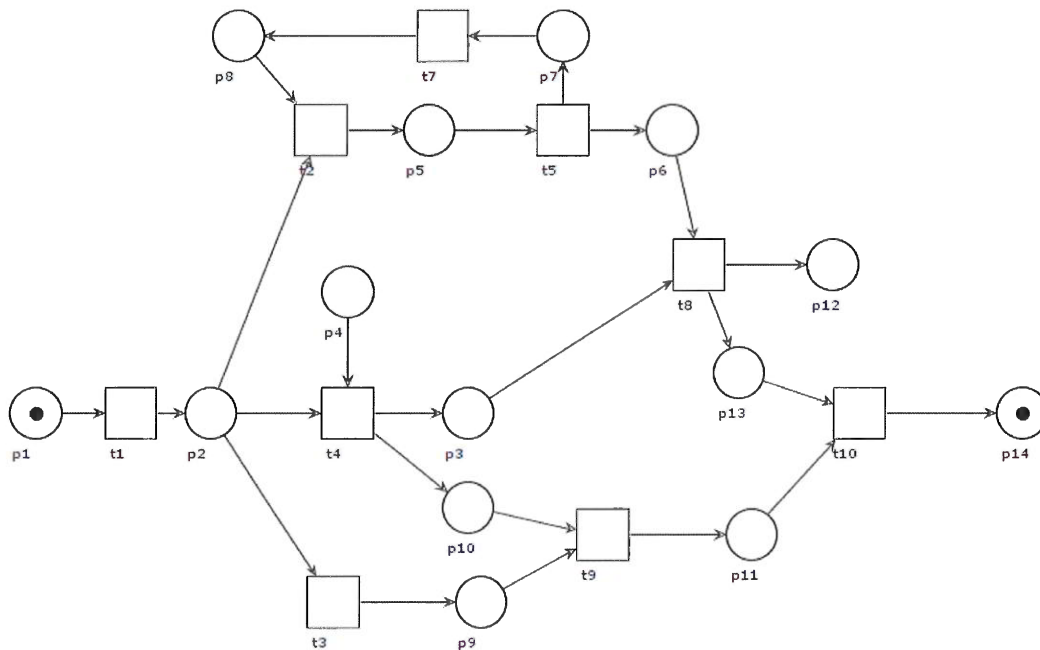
Question 1 (20 points)

Petri nets allow to model business processes and their execution.

a   (10 points) Define the following terms for petri nets

- *Deadlock*
- *Workflow net (WF-net)*
- *Lifelock*
- *And-split*
- *Xor-join*

b   (10 points) Consider the following Petri net, which is supposed to be a WF-net

List the errors in this Petri net and explain each of them in 2-3 sentences.

Question 2 (30 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

- *arrival rate*
- *interarrival time*
- *stable system (or stable process)*
- *M/M/1 waiting queue system*

b   (4 points) Little's Law relates the average number of cases in a system and its average cycle time. Write down Little's Law and explain the formula.

c   (10 points) Consider a fast food restaurant with an average arrival rate is 20 customers per hour. The average cycle time is 25 minutes, i.e. the time between a new customer arriving at the restaurant and leaving the restaurant. How many seats should the res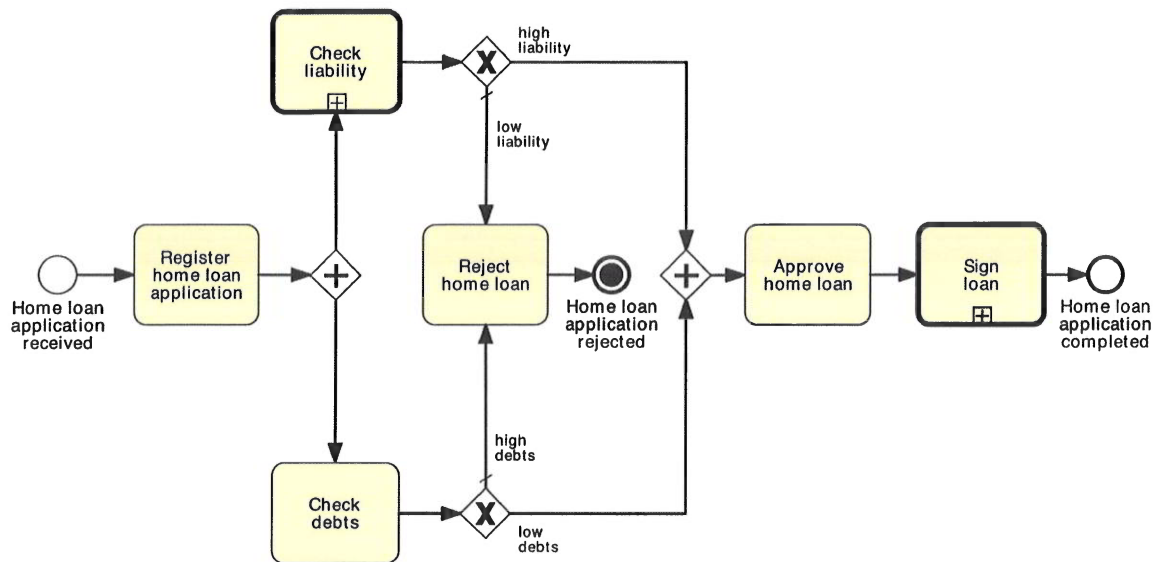taurant have so that each customer can sit. Tip: Use Little's Law. Explain your solution. Could there still be peak times when customers do not get a seat?

d   (4 points) Explain the characteristic of the triangular *distribution*. How is it specified (i.e. which parameters have to be supplied to specify a triangular distribution resp. its probability density function? In which situations is the triangular distribution the right choice?

e   (4 points) Instead of a mathematical distribution, one can also use a histogram to specify the distribution of inter-arrival times and task times. Give an example for a histogram for the inter-arrival time. Is a histogram a preferred way to specify the distribution of a variable like the interarrival time?

Question 3 (20 points)

Consider the following BPMN process model:

a   (6 points) What is the difference between message flows and sequence flows. Create a variant of the above process model with three pools: One for the task "Check liability", one for the task "Check dept" and the third one for the rest of the elements in the middle. The first pool is for the external organisation "Liability Inc", the 2nd one is for the organisation "Dept Inc", and the 3rd for the organisation "Bank". Note that some of the sequence flows shall need to be realised with message flows.

b   (10 points) Convert the above BPMN model into an equivalent petri net, more precisely a workflow net (WFnet). You can treat the sub-process "Sign loan" like a simple task.

c   (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?

Remarks: The end event "Home loan application rejected" has a black marker. You can ignore this.

Question 5 (30 points)

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

a   (5 points) What are the main goals of process mining (also called process intelligence)? List at least **three** such goals!

b   (10 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 5 entries (rows).

c   (5 points) The **start time** of an activity is not a mandatory field. What are the advantages if the start time is included in the event log in addition to the mandatory fields?

d   (10 points) Manually create a directly-follows graph (process map) for the following event log

Case ID	Activity	End time	Resource (Attribute)	
C-101	Claim Registered	2025-12-01 09:00	Web Portal	
C-101	Document Verification	2025-12-01 14:30	System Automate	|
C-102	Claim Registered	2025-12-01 10:15	Mobile App	
C-101	Claim Assessment	2025-12-02 11:00	Adjuster_Alpha	
C-103	Claim Registered	2025-12-02 13:00	Phone Support	
C-102	Document Verification	2025-12-02 15:45	System Automate	|
C-101	Claim Approved	2025-12-03 09:15	Manager_Smith	
C-102	Claim Assessment	2025-12-03 16:20	Adjuster_Beta	
C-101	Payment Issued	2025-12-04 10:00	Finance_Dept	
C-103	Document Verification	2025-12-04 11:30	System Automate	|
C-104	Claim Registered	2025-12-05 08:30	Web Portal	
C-102	Claim Rejected	2025-12-05 14:00	Manager_Smith	
C-103	Claim Assessment	2025-12-06 10:45	Adjuster_Alpha	
C-104	Document Verification	2025-12-06 13:00	System Automate	|
C-103	Claim Approved	2025-12-07 09:00	Manager_Jones	

Note: There are 5 activity types (Claim Registered, Document Verification, Claim Assessment, Claim Approved, and Payment Issued) and 4 cases C-101 to C104 in this event log. Tip: First create sequences of activities per case and then integrate them into a process map.