INSTRUCTIONS TO CANDIDATES

- This is a FIVE (5) hour examination
- Answer all (11) questions
- Questions can be answered in Swedish or English.
- Marks total 50.
- Grade allocation, 0–29 = U, 30–39 = G, 40–50 = VG
Section A : Short Answer Questions

Answers to questions in this section should be maximum a half page of text.

Question 1
For one point each, give a one or two line description of the key features of each of the following.

a). Multi-tasking operating system
b). User space
c). IPC
d). Virtual Memory

Question 2
Write a short (a couple of sentences) definition of the role of an operating system.

Question 3
Explain the concept of ”working set” for a program executing in virtual memory. What happens when a program’s working set does not fit into the number of page frames allocated to that process.

Question 4
Deadlock is a serious concern in operating system resource management. Draw a resource request graph for a system with at least 2 resources and 3 processes which is in a state of deadlock. Show the sequence of resource requests and resource grants made by the OS that lead to the deadlock situation by labeling the diagram and providing short explanations of the order in which resource allocation links were established.

Question 5
Memory management is an example of a service provided by the operating system to user processes. Explain the main issues involved in allocating memory to user processes. Comment on how approaches to memory allocation have evolved as operating systems became more complex.
Section B : Medium Answer Questions

Your answer should be between one half and one full page of written text and diagrams for each question in this section.

Question 6
Response time calculations for tasks in real time schedules depend on the nature of the task itself as well as the effect upon that task of other system activities and tasks. What properties of the task do you need to know, and what properties of other tasks do you need to know in order to prepare a reasonable estimate of the response time of a task? Explain the significance of the factors that you have chosen.

[4]

Question 7
Give a brief description of kernel process management activity. Identify important process states and kernel data structures and explain their role in providing multi-tasking access to the hardware and other system resources.

[6]

Question 8
Draw a state-transition diagram of the states of a process. Indicate by labeling the transitions what types of events are associated with changes of process execution state.

[4]

Question 9
Mutual exclusion is an important concept in operating systems. What do we mean by the term mutual exclusive access when we refer to resources.

[1]

There are two other ideas that are related to the concept of mutual exclusive access to resources, fairness and starvation. For two points each explain what these terms mean in a situation where two executing processes wish to write to the same hard disk.

[4]

Question 10
There is a possibility that deadlock can occur in a system only when all of the following conditions are true:

• there is competition for shared resources
• resources are requested and held during execution
• resources cannot be pre-empted
• resource requests/demands establish a cycle of dependencies on held resources.

Discuss deadlock avoidance based on the list of necessary conditions given above.

[5]

OVER/
Section C : Long Answer Question

Question 11

Given the following system of tasks, resources, and resource allocations explain using the Bankers Algorithm why the system is in a safe state. You should demonstrate that there is a sequence of task executions that allow all tasks to acquire their resources and execute to completion.

<table>
<thead>
<tr>
<th>Allocation</th>
<th>Max</th>
<th>Available</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A B C</td>
<td>A B C</td>
</tr>
<tr>
<td>P_0</td>
<td>0 1 0</td>
<td>7 5 3</td>
</tr>
<tr>
<td>P_1</td>
<td>2 0 0</td>
<td>3 2 2</td>
</tr>
<tr>
<td>P_2</td>
<td>3 0 2</td>
<td></td>
</tr>
<tr>
<td>P_3</td>
<td>2 1 1</td>
<td></td>
</tr>
<tr>
<td>P_4</td>
<td>0 0 2</td>
<td></td>
</tr>
</tbody>
</table>

Propose a request for resources by one of the tasks that would result in an unsafe system state. Use the Banker’s Algorithm again to demonstrate that confirming the allocation you propose places the system in an unsafe state.

[10]