Exam questions for MSc HCI

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You must answer three questions in total.

Question 1 is compulsory

Answer two further questions out of questions 2, 3, 4 and 5

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N.B. I'll give an extra 10 minutes reading time at the beginning of the exam to ensure that the case study is thoroughly understood.

Question 1

Answer all parts

This question draws on your coursework group project.

(i) Describe briefly the product designed during your group coursework
(4 marks)

(ii) Explain what the value of the product is for the user, in other words why should the user invest time/money in the product
(3 marks)

(iii) Choose three out of the following parts of the coursework:

- Scenario
- Initial rough navigation structure
- Hierarchical task analysis
- State transition network
- Architectural design

And for each of your choices give
either an example of a problem which arose in that part and how your group dealt with it,
or an example of a way in which the notation/method gave insight into the application.
(9 marks)

(iv) Describe a user interface/usability issue/problem in the final design for the application and how you would approach finding a solution (you do not need to give a solution)
(4 marks)

Question 2

Answer all parts

(i) Define the following three terms:

- bandwidth
- latency
- jitter

making sure that your definitions clearly demonstrate the differences between them.
(4 marks)

Site X on a network has connections to 4 other sites A, B, C and D
The connections have the following characteristics:

site X – site A	high bandwidth	low latency	low jitter
site X – site B	high bandwidth	high latency	low jitter
site X – site C	low bandwidth	low latency	low jitter
site X – site D	high bandwidth	low latency	high jitter

(ii) Comment on the suitability of these connections for the following media types:

(a) audio-conference (e.g. telephone style chatting)
(b) live interactive video-only connection (e.g. web cam)
(c) streaming HI-FI audio (e.g. Radio 3)
(d) video-on-demand (e.g. hotel pay-per-view video service)

For this part assume that there is not enough memory available to provide any buffering. Make sure your answer clearly states the effects on the users, not just technical effects.
(6 marks)

(iii) Describe how buffering might improve/alter any of the above? **(4 marks)**

(iv) An Internet-based collaborative graphics application includes a shared electronic whiteboard where participants can each annotate and manipulate a high-resolution photograph . Two potential architectural solutions have been proposed

- Sending each user's freehand drawing actions (individual mouse movements) to a central server
- Download an applet and do drawing actions on a local copy of the whiteboard contents

Describe advantages and disadvantages of these solutions with regard to potential deployment on:

- network connections similar to site X–B
- network connections similar to site X-C

(6 marks)

Question 3

Answer all parts

For this question you will need to read the case study labelled "Case study used in Questions 3, 4 and 5"

(i) Figure 3.1 shows the Seeheim model. Treating the Application Interface model and Application together, there are three main layers

Presentation/Lexical
Dialogue/Syntactic
Application/Semantic

For each of these three layers list two different items of the description of the nuclear reactor control panel that is relevant to the level (that is 6 items in total 2 for each level)
(9 marks)

(ii) There are not any items in the description that relate to the switch (rapid feedback) part of the Seeheim model. Why do you think this is the case?
(3 marks)

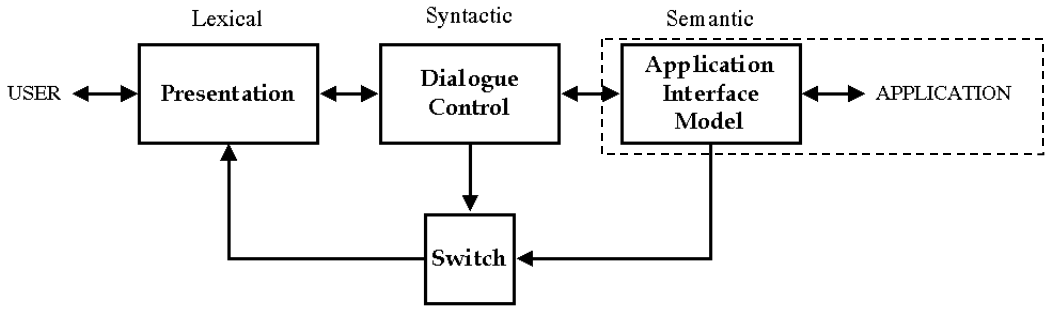

Figure 3.1 Seeheim model

(iii) Looking only at the STN diagrams in figures CS.4 and CS.5 (that is ignoring for now the meaning of the various actions), identify missing elements from the STNs. Taking into account the meaning of the actions, suggest possible corrections.
(5 marks)

(iv) Taking into account now the meaning of the various states and actions, explain why you believe the consultant suggested the change from the behaviour in figure CS.4 to that in figure CS.5
(3 marks)

Question 4

Answer all parts

For this question you will need to read the case study labelled "Case study used in Questions 3, 4 and 5"

(i) Comment on the user of colour in the Alarm Control, Emergency Shutdown and Emergency Confirm panels (figure CS.2)
(4 marks)

(ii) Comment on the use of layout and other elements in the control panels (figures CS.1, CS.2 and CS.3), including the way in which various visual elements support or hinder logical grouping and sequence
(4 marks)

(iii) Working through the accident scenario explain why the various problems arise
(8 marks)

(iv) Suggest potential ways of improving the interface to avoid a similar problem recurring
(4 marks)

Question 5

Answer all parts

For this question you will need to read the case study labelled "Case study used in Questions 3, 4 and 5"

Note – you may find it easiest to set aside enough space in your answer book for parts (i), (ii) and (ii) and then complete them in parallel.

Read the partial description of the state of the reactor control panel and partial description of some of the actions at the end of this question.

(i) Complete the state description for the reactor control panel
(4 marks)

(ii) Complete the descriptions of the state changes for confirm and cancel
(4 marks)

(iii) Produce descriptions of the state change for the following actions:
`alarm_higher` – '+' key is pressed on Alarm Control panel
`shutdown` – the IMMEDIATE SHUTDOWN COMMENCE button has been pressed on the Emergency Shutdown panel
`select_target(targ)` – the target pulldown has been used on theManual Override panel. **targ** is one of {Pressure, Temp, Flow}
`set_target_value` – the SET button has been pressed on the Manual Override panel
(8 marks)

(iv) Check your state and actions by running through the scenario and showing annotating each action with the current state. Use the example of the first few steps at the end of this question as a guide to the appropriate level of detail.
(4 marks)

Partial description of the state of the nuclear reactor control panel:

```
Alarm_State:   {Green, Amber, TempRed, Red}
Confirm_Needed:   Boolean        [ that is true or false]
Target_Pressure:  Nat            [ that is { 0, 1, 2, … } ]
Target_Temp:      Nat
Target_Flow:      Nat
Manual_Override_Value:  Nat
...
```

Description of some actions

Here is a description of the state change for two actions: when a digit is pressed on the keypad and when the '–' key is pressed.

`keypad_digit(d)`

```
add d to the right-hand end of Manual_Override_Value
```

`alarm_lower` [minus key is pressed]

```
if ( Alarm_State is Red or Alarm State is TempRed )
then set Alarm_State to Amber

if ( Alarm_State is Amber or Alarm_State is Green)
then set Alarm_State to Green
```

And partial descriptions of the state changes for the CONFIRM and CANCEL buttons on the Emergency Confirm control panel

`confirm`

```
set Confirm_Needed to false

if ( Alarm_State is TempRed )
then set Alarm_State to Red

...  something about emergency shutdown too
...
```

`cancel`

```
set Confirm_Needed to false

if ( Alarm_State is TempRed )
then set Alarm_State to Amber

...  something about emergency shutdown too
...
```

Example of annotated scenario:

Initial state: `Alarm_State is Green`
`Confirm_Needed is false`
`etc. …`

Steps 1, 2 – no system actions

Step 3 – press '+' twice

`alarm_higher:`
`Alarm_State = Amber`

```
                alarm_higher:
                        Alarm_State = TempRed
                        Confirm_Needed = True
```

Step 4 – button glows because `Confirm_Needed = True`

Step 5 – no system action

etc.

etc.

Case study used in Questions 3, 4 and 5

Figure 1 shows a sketch of the control panel of a nuclear power plant. The actual panel is very large covering the whole wall of the control room and contains many sub-panels and controls. The locations of some controls at the two ends of the panel are shown in figure CS.1, although it should be noted that the panel is much wider than the illustration.

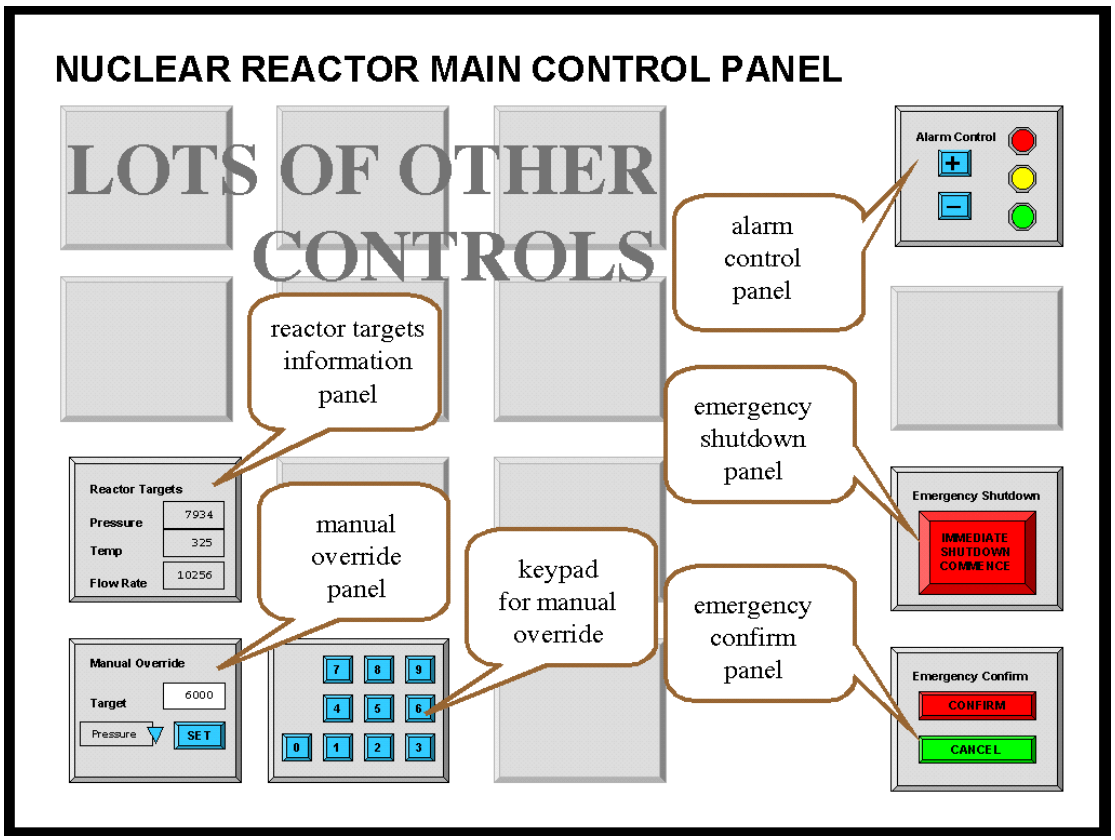

Figure CS.1 – nuclear reactor main control panel

A few of the sub-panels are important for this case study:

Alarm Control panel
Emergency Shutdown panel
Emergency Confirm panel

Reactor Targets display
Manual Override panel
Numeric Keypad for the **Manual Override** panel

Details of the first three of these are shown in figure CS.2 and details of the last three in figure CS.3.

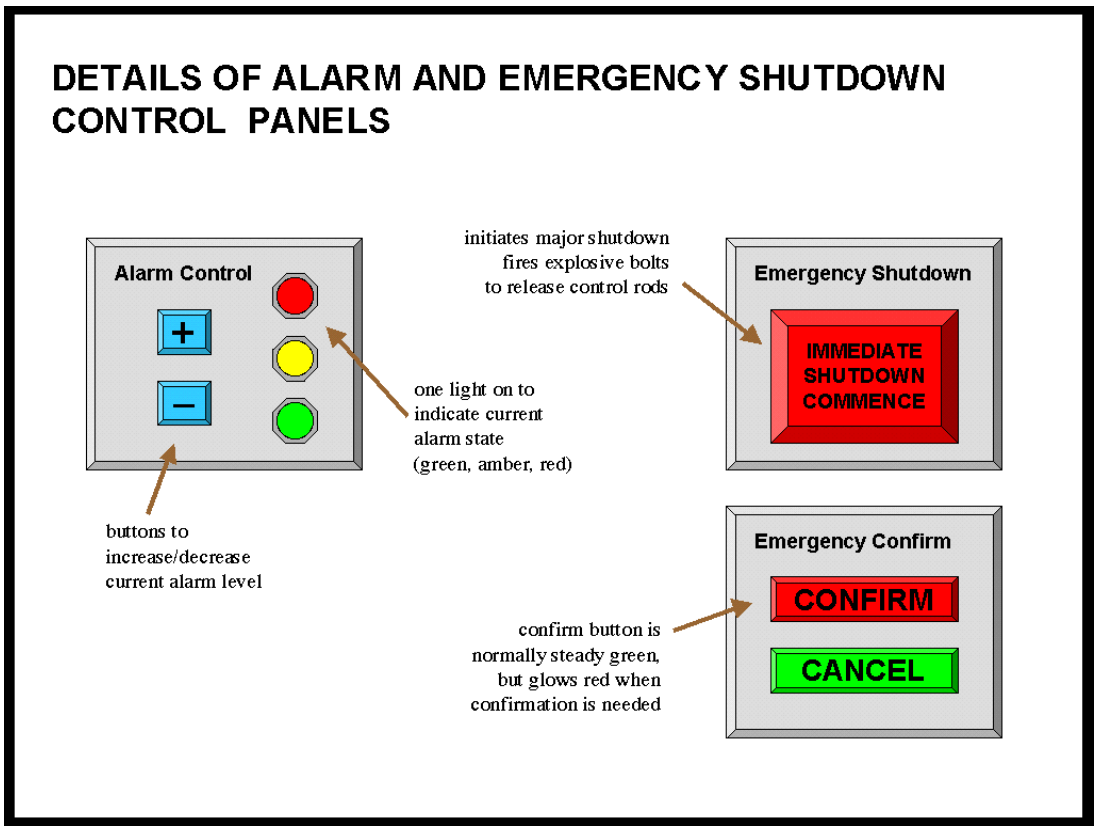

Figure CS.2 – alarm and emergency sub-panels

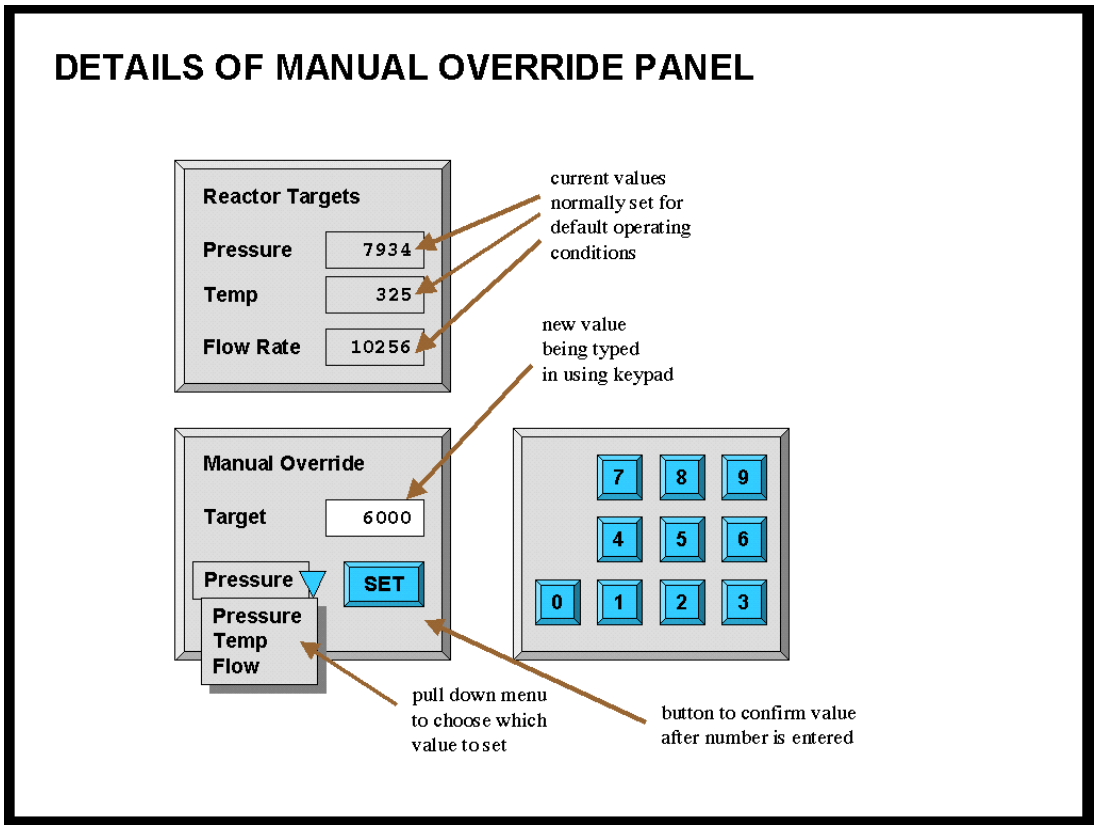

Figure CS.3 – reactor targets display and manual override

How it works

Alarm State

The system can be in one of three alarm states: GREEN, AMBER or RED.

(v) GREEN alarm state means everything is operating normally

(vi) AMBER alarm state is for when there is a minor problem with reactor operation. Workers in the reactor area are warned and take additional precautions, but no external services are involved.

(vii) RED alarm state is raised when the reactor is operating outside normal parameters and there is a possibility of external contamination. The police and other emergency services are alerted.

Typically AMBER state is raised once or twice a week and red state only a few times a year (so far only false alarms!). Raising a RED alarm unnecessarily causes significant inconvenience and cost both to the station staff and the external emergency services.

Original design of the alarm control panel

When the plant was commissioned, the alarm system controls worked as follows.

The current alarm state is indicated by which of the coloured lights on the **Alarm Control** panel is lit.. The '+' and '–' buttons on this panel increase or decrease the alarm state. Figure 4 shows a state transition network of the effects of the '+' and '–' buttons on the state as the system was initially installed.

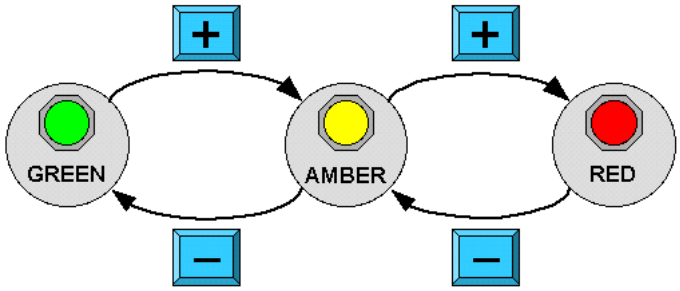

Figure CS.4 – STN for alarm state

Emergency Shutdown

When there is a very serious problem the operator can press the large red button labelled **IMMEDIATE SHUTDOWN COMMENCE** on the **Emergency Shutdown** panel, which initiates an emergency shutdown. This needs to be confirmed by pressing the **CONFIRM** button on the **Emergency Confirm** panel. (This is to prevent accidental shutdown of the plant.) The **CONFIRM** button is normally green, but glows red after the **IMMEDIATE SHUTDOWN COMMENCE** button has been pressed to remind the operator.

Emergency shutdown causes explosive bolts to blow that drive control rods into the reactor completely stopping the nuclear reaction. Restarting the reactor after

emergency shutdown may take several weeks and costs many millions of pounds in lost production and replacement of parts damaged during the shutdown procedure.

Reactor targets and manual override

The **Reactor Targets** panel shows the current target state of several reactor operating parameters. These are normally set by an automatic control system to values that ensure optimal energy production.

In an extreme emergency the operator may need to control these targets. The **Manual Override** panel allows this.

Manual override is only enabled in RED alarm state.

To override a particular target the operator selects the desired target (Pressure, Temperature or Flow Rate) from a dropdown menu, types in the desired value using a numeric keypad and then confirms the value using the SET button. (The SET button is necessary to prevent part-typed numbers being treated as the new value.)

Revised Alarm Control Operation

Some while after the plant was running a consultant suggested changing the operation of the Alarm Control panel and the software and hardware was revised in line with his recommendations. The current design works as follows.

Raising the alarm state from Green to Amber and back uses the '+' and '–' buttons as before. However now to raise the state from Amber to Red it is necessary to both press '+' and also confirm this by pressing the **CONFIRM** button on the **Emergency Confirm** panel.

Figure 5 shows the state transition network of the revised system.

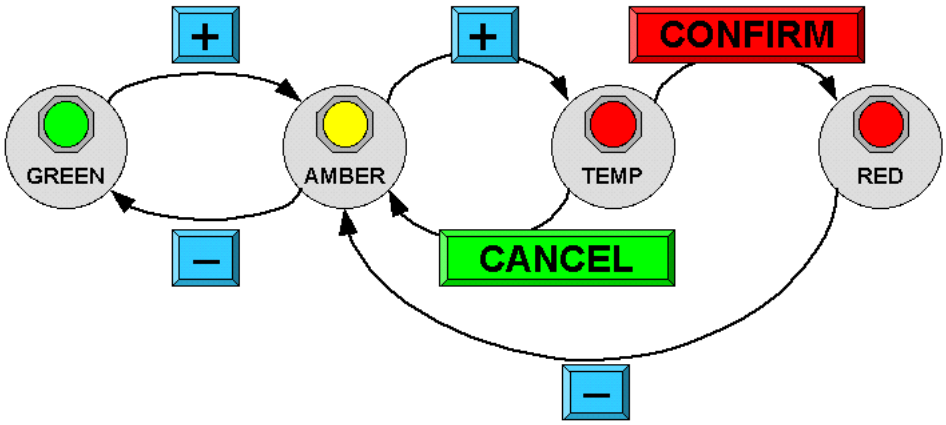

Figure CS.5 – STN for revised alarm state

Emergency Scenario

Jenny, the Nuclear Power Plant operator has normal sight and no physical or perceptual impairments. Her shift started at 11pm and it is now 5am in the morning. So far the plant has been operating within normal parameters and the current alarm state is therefore green

1 Jenny notices the core reaction rate has risen very rapidly
2. she realises she must immediately change the reactor target pressure to correct this
3. she goes to the Alarm Control Panel on the far right of the main reactor control panel and presses '+' twice (as it is starting off in green state)
4. the Emergency Confirm button glows red
5. she moves across to the Manual Override panel on the far left of the main reactor control panel
6. she selects 'Pressure' from the pull down on the Manual Override panel
7. she types the new value '6000' using the keypad
8. she notices that the number on the Reactor Targets panel has not changed
9. she realises she forgot to press the SET button on the Manual Override panel
10. she presses the SET button
11. the value still doesn't change
12. an automatic audio warning sounds "60 seconds to core meltdown"
13. she presses the SET button repeatedly
14. still the value doesn't change
15. she starts again, selects 'Pressure' from the pulldown, types 6000 and presses SET
16. still the value doesn't change
17. the audio warning says "30 seconds to core meltdown"
18. Jenny runs across the room to the Emergency Shutdown panel
19. "20 seconds to core meltdown"
20. she presses "Immediate Emergency Commence" button
21. the emergency conform button glows red
22. "10 seconds to core meltdown"
23. she presses the " Emergency Confirm" button
24. she hears the crash of the explosive bolts sending the control rods into the reactor"
25. the audio system announces "reactor shutdown successful"