



PRIFYSGOL CYMRU

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UNIVERSITY OF WALES

Trinity Saint David

## Examination Answer Book

24 Pages

### Instructions to candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right and seal to hide your name.
3. The answers must be **legibly** written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

|   |                              |                        |
|---|------------------------------|------------------------|
| 1 | Student Number               | P144275                |
| 2 | Title of Examination Paper   | SYSTEMS<br>ENGINEERING |
| 3 | Module Code                  | M6X00947               |
| 4 | Date and Time of Examination | 30/06/17               |
| 5 | Examination Venue            | MT 102                 |
| 6 | Seat Number                  | /                      |

|   |                                  |   |
|---|----------------------------------|---|
| 7 | Number of Answer Books handed in | 1 |
|---|----------------------------------|---|

| List the numbers of the questions you have attempted | Office Use |
|------------------------------------------------------|------------|
| 2                                                    |            |
| 3                                                    |            |
| 2(a)                                                 | 23 / 40    |
| 2(b)                                                 | 8 / 30     |
| 2(c)                                                 | 23 / 30    |
| 3(a)                                                 | 14 / 30    |
| 3(b)                                                 | 25 / 70    |
|                                                      |            |
|                                                      | 93 / 200   |
|                                                      | 46.5 / 100 |
|                                                      |            |
|                                                      |            |
|                                                      |            |
|                                                      |            |
|                                                      |            |
| Total                                                | 46.5 %     |

Please complete this section and SEAL before the examination starts.

(Block Capitals) Forename(s)

Surname

PETER PLOT

PULLIN

3

3

2

1

1

2

1

1

2

0

2. a) A lean system engineering approach is one where the amount of waste is reduced to the bare minimum, adding value at every stage for the customer / client.

3

Lean systems also require a just-in-time approach to supply using the pull through from the customer / demands to optimise the flow of material and the optimum use of resources and facilities.

3

The 5 principles of lean are:

1. DEFINE THE VALUE FROM CUSTOMER PERSPECTIVE.

2

- understand what the customer requires (needs)
- define processes to carry out these requirements.

1

1

2. MAP THE VALUE STREAM

2

- consider the non-value added and value added.
- document the end-to-end process.

1

1

3. MAKE THE PROCESS FLOW

2

- develop tools and processes to optimise performance

0

4. FULL THROUGH FROM CUSTOMER

2

- JIT operation

5. WORK TOWARDS PERFECTION.

2

- empowers staff to make small incremental changes to improve efficiency / ways of working.
- document changes to processes.
- KAIZEN principle.

The KAIZEN principle of lean systems engineering is that perfection is sought by continuous, small, incremental changes.

1

23

2b) Value adding activities are those which the customer is willing to pay for and they must: 2

- change the product / process to be closer to the finished product.
- add components to the product to increase value
- be perceived to have added worth / value to the product. 3

Non-Value adding activities are those activities that the customer would not be willing to pay for. There could include things like:

- reworking or modifying parts
- non-essential documentation 3

8

2) c) There are 'muda' or waste in a systems engineering lean process is anything that costs time, space, or money and is not value-adding.

Eight examples of waste are:

1. OVERPRODUCTION

- manufacturing at a faster rate than required, and therefore needing storage, or using more material than necessary.

2. INVENTORY

- holding more material or finished components than necessary, requiring larger storage facilities.

3. WAITING

- either people or parts waiting while another part of the process is undertaken.

4. MOTION

- the unnecessary movement of people between jobs, or lifting, bending, reaching etc, due to inefficient workspace layout.

- the unnecessary movement of parts between processes.

5. TRANSPORT

- the unnecessary or unavoidable movement of parts between sites. More movement could result in more potential to cause damage.

## 6. Rework

2

- The carrying out of remedial actions on work which has already been completed, albeit incorrectly.

1

## 7. OVERPROCESSING.

2

- Wasting time and resources on manufacturing components to a higher tolerance, or tighter specification than required.

1

## 8. TALENT

2

- not utilizing your people to their full potential

1

(23)

3)a) The benefits that may be achieved by undertaking an FMEA exercise are numerous.

International (ISO) standards often require it. Safety issues can be resolved early in the design process, reducing costs.

Alternative methods of achieving the desired outcome can be considered earlier, before manufacturing begins.

All possible failures can be avoided early in the design process.

Identifying as many potential problems and solutions earlier ~~in~~ in the design process reduces cost improves safety, and makes for a better product.

3/b) An FMEA exercise is carried out in order to reduce as much as possible safety issues, potential faults and failures.

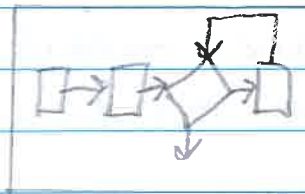
2

The form requires that for every possible event (which will have a number of possible solutions) there needs to be a RPN number which is calculated as the product of the occurrence, severity and ~~likelihood~~ <sup>detectability</sup> of each event.

5

The flowchart shows the FMEA process, which would be applied to each individual element.

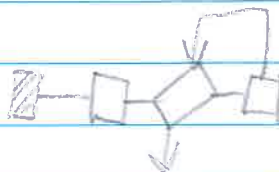
①



PROCESS CHART

② CONSIDER ALL POSSIBLE ISSUES FOR EACH INDIVIDUAL ELEMENT

③



DEFINE SEVERITY

④



DEFINE LIKELIHOOD OR OCCURRENCE

⑤

CONSIDER DETECTABILITY

⑥

CALCULATE RPN NO.

$$RPN = \text{OCCURRENCE} \times \text{SEVERITY} \times \text{DETECTABILITY}$$

6

The occurrence value is how often the problem is likely to arise, the severity is how much of an effect it will have and the detectability is how effective the current control measures are.

4

There are three failure modes.

SAFETY - will stop because unsafe to carry on.

MINOR - aka SOFT, where one small part is not met or degradation (wear) has occurred over time. i.e. machine tools.

MAJOR - aka HARD, where immediate shutdown and repair would be required.

5

If possible consideration should be given to mitigating problems and the last half of the form is the calculation when extra controls are in place.

3

(25)