

**INSTITUTION OF RAILWAY SIGNAL ENGINEERS  
2017 EXAMINATION**

**MODULE 7 - SYSTEM MANAGEMENT AND ENGINEERING**

**TIME ALLOWED - 1 1/2 HOURS**

ANSWER **THREE** QUESTIONS, ALL QUESTIONS CARRY EQUAL MARKS

WRITE ON ONE SIDE OF THE PAPER ONLY, AND NUMBER EACH SHEET THAT  
YOU USE CONSECUTIVELY

COMMENCE YOUR ANSWER TO EACH QUESTION ON A NEW SHEET OF PAPER

ANSWER SHEETS WILL BE PHOTOCOPIED – PLEASE USE ONLY BLACK INK

**Question 1**

For each of the following terms:

- |    |       |           |
|----|-------|-----------|
| a) | HAZOP | [5 marks] |
| b) | FMECA | [5 marks] |
| c) | FTA   | [5 marks] |
| d) | QRA   | [5 marks] |
| e) | OSHA  | [5 marks] |

- State the meaning of the term
- Explain how it contributes to the demonstration of system safety
- Describe how the relevant activities should be carried out

**Question 2**

You have been asked to model an upgrade to the existing railway infrastructure running between two large cities. The upgrade includes a significant increase to the line speed beyond its current value of 100 km/h.

Identify the key features of the existing infrastructure that you will require information about in order to develop the model. For each of these features, explain why you need this element of knowledge in your piece of work. [10 marks]

Apart from the information on the existing infrastructure, what other inputs do you need which will help you to build your model. [7 marks]

What purpose do you think your model will serve in terms of progressing the upgrade? Explain in terms of user requirements and system requirements. [8 marks]

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### Question 3

Identify and explain the areas of railway signalling and train control systems where it is important to consider human factors. [10 marks]

Discuss the human factors issues involved when implementing an in-cab signalling system for an existing rolling stock driving cab. [15 marks]

How are human factors relevant to a train designed for Automatic Train Operation? [5 marks]

### Question 4

Explain the precautions which should be taken when restoring normal operation following the complete failure of a computer-based interlocking controlling a complex station area. Describe what people would be involved, in what locations they should be, and what means of communication should be available to them.

Your answer should take all of the following factors into account:

- It was necessary to replace all of the vital computer units in the interlocking with spares taken from stores in order to restart the interlocking.
- Train movements have been taking place using manual point operation and hand signalling while the interlocking was shut down.
- A protection zone for on-track engineering work had been set up prior to the failure of the interlocking.
- Passengers had to be evacuated from a train which was unable to enter a platform due to the interlocking failure.
- The operating and engineering staff who were on duty at the time of the failure have completed their shift and have been replaced by another team.

[25 marks]

### Question 5

Describe three ways in which obsolescence can affect a signalling or telecommunications system. Discuss their possible impact on the long term RAMS performance of the system. [15 marks]

For each of the three ways, explain what measures can be taken to guard against the effects of obsolescence. State at what stage or stages of the system lifecycle these measures should be applied and say what effect they are likely to have on overall system lifecycle costs. [10 marks]

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### **Question 6**

Describe how signal & telecommunications engineering, including both design and maintenance, interacts with rolling stock design and maintenance. [13 marks]

Describe three examples of train borne systems that interact with fixed signalling and/or telecommunications systems, which may be located at the line side or in a control centre. [12 marks]

### **Question 7**

What factors influence the consequences of a derailment? Using an event tree, or a series of event trees, analyse the possible consequences of a train derailment, taking account of the ranges of values which might be taken by the factors you have identified. [25 marks]

### **Question 8**

A new trackside asset is about to be introduced. Explain the impact of the environmental factors and state whether these have a short term or long term effect on the asset. [10 marks]

Describe the consequences of the interaction of these effects. [5 marks]

List five types of trackside assets that are influenced by environmental conditions and explain how the effects can be mitigated. [10 marks]

### **Question 9**

A new project has been set up to meet increasing passenger demand on an existing rural branch line connected to the mainline railway. The rural branch line will be upgraded with new signalling, new telecommunication equipment, enhanced CCTV surveillance, new lineside fencing and new trains longer than those currently operating on the branch line.

With the aid of a diagram, define the system boundaries and the sub systems to be introduced as part of the project. [5 marks]

Explain how you will allocate the system requirements across the sub systems? [5 marks]

Define the key systems engineering deliverables which will be vital to manage the project execution. [5 marks]

What do you think are the key technical challenges in this project? [10 marks]

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### Question 10

Outline a RAMS strategy suitable for the development of

**EITHER** an automatic train control system for a new metro

**OR** an operational telecommunications network for a new metro

Your strategy should include RAMS activities covering all stages of the system lifecycle and you should explain any special techniques or measures adopted.

[25 marks]

End Of Paper.