

**INSTITUTION OF RAILWAY SIGNAL ENGINEERS
2009 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

Standard EN50129 recommends that a safety case should include chapters with the following titles:

- Quality management report
- Safety management report
- Technical safety report

Explain how each of these contributes to making the overall case for safety. [12 marks]

In which chapter(s) should each of the following topics be covered? In each instance you should say why you consider this to be the appropriate chapter.

- Project organisation
- System testing
- Configuration control
- Hazard log

[8 marks]

Question 2

What factors relating to the layout of the railway and its surroundings might contribute to a train driver either failing to observe a signal or reading the wrong signal? You should suggest a mitigation measure for each of the factors that you have mentioned and explain how effective it is likely to be.

[20 marks]

Paper continued on next page

Question 3

Explain the difference between rheostatic and regenerative braking of electric trains. [5 marks]

How might the introduction of electric trains with regenerative braking affect the safety and reliability of the signalling system of an existing electrified railway? [10 marks]

Explain how signal spacing and overlap lengths might be affected by the introduction of trains with regenerative braking? [5 marks]

Question 4

How do the reliability, availability and maintainability of signalling, control and communications systems affect the safety of people using an underground mass transit railway under normal, degraded and emergency conditions?

Your answer should explain how the physical design of the railway influences the safety of the systems. [20 marks]

Question 5

What types of electric traction drives on trains are capable of producing interference at frequencies which are not harmonics of the supply voltage? [3 marks]

What measures can be adopted in the design of motive power units employing such drives to prevent and / or suppress the generation of interference at frequencies used by signalling systems? [5 marks]

What measures can be adopted in the design of track circuits to make them immune to interference at frequencies which are not harmonics of the supply voltage? [7 marks]

Compare the advantages and disadvantages of imposing design constraints on the motive power units or replacing existing track circuits when new trains are introduced on to an existing railway. [5 marks]

Paper continued on next page

Question 6

Compare and contrast the whole life-cycle environmental impact of building a new inter-city high speed passenger railway versus investment in additional infrastructure for air travel along the same corridor. [8 marks]

Assuming that a new high speed railway is to be built, identify the four aspects of the railway's design and operation that you believe would most significantly influence the level of environmental impact. For each of these identify:

- i) The approach that should be adopted in order to achieve minimum environmental impact [4 marks]
- ii) Other factors that should be considered alongside environmental issues when determining the most appropriate approach to design and operation. Highlight the significance of each of these factors within your answer. [8 marks]

Question 7

Resignalling of a railway line has been proposed. The existing signalling uses track circuits, colour light signals and relay interlockings.

You have been asked to assess the relative merits of the train detection being based on track circuits or axle counters.

- a) Outline the main advantages and disadvantages of adopting an axle counter based solution, addressing within your answer their whole life impact (from installation to decommissioning) [10 marks]
- b) What techniques or processes should you use to develop your outline list further to make it complete? [7 marks]
- c) How should you determine the preferred technical solution? [3 marks]

Question 8

What operational communications, remote control, SCADA monitoring and alarm functions need to be provided in the control centre of a modern railway system to support normal, degraded and emergency operations? [10 marks]

It has been proposed that all of the communications, remote control, SCADA monitoring and alarm functions within a new control centre should be integrated for use with a single graphical user interface, single keyboard / mouse control and single communications handset. Discuss the advantages and disadvantages of such a high level of integration. [10 marks]

Paper continued on next page

Question 9

A railway is proposing to introduce new trains that have more restrictive sighting lines than those that they replace. It is thought that this will result in a significant number of station starting signals no longer having adequate sighting whilst the train is at a stand in the station. Four solutions have been proposed to enable the introduction of these new trains:

- i) Moving the starting signals 3m further from the platform stopping position
- ii) Installation of new 'co-acting' signals that can be seen through the cab side window from the train's normal stopping position;
- iii) Use of platform CCTV cameras to display a view of the starting signal on platform based One Person Operation monitors;
- iv) Instruction to the drivers to stand up and lean out of the window in order to see the aspect.

You are the signalling engineer responsible for evaluating the scope of works required, as well as the feasibility and impact of the proposed solutions. How should you determine the scope of the problem (number of signals affected)? [4 marks]

Provide an analysis of the advantages, disadvantages and concerns that each of the four proposed solutions raises. Your answer should include consideration of safety, cost, time to implement and human factors. [16 marks]

Question 10

Copper and metal theft is a major problem for railway control, communications, and power systems.

- a) Describe how the vulnerability to such theft can be minimised in the design stage of a resignalling scheme. [10 marks]
- b) Describe various systems which can be used to detect and deter copper cable theft. [10 marks]

End Of Paper.