

**INSTITUTION OF RAILWAY SIGNAL ENGINEERS
2017 EXAMINATION**

**MODULE 1 - SAFETY OF RAILWAY SIGNALLING AND
COMMUNICATIONS**

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

Weather, climate and environmental conditions can have a significant impact upon railway operations.

- a) List **four** different naturally-occurring conditions that might affect operation of the signalling or be of concern to railway operators. [4 marks]
- b) For **each** of the four conditions you have listed, discuss:
- What safety impact it could have;
 - How the signalling system could be designed to mitigate the impact; and
 - What operational procedures might become necessary in extreme circumstances.
- [21 marks]

Question 2

For **both** of the following, describe a scenario where human error may contribute to a hazardous condition on an operational railway:

- i) an error made by a person operating the signalling system
- ii) an error made by a maintenance technician [10 marks]

For **each** of the scenarios you have described, what methods should be used to mitigate the risks which might lead to an accident? [15 marks]

Paper continued on next page

Question 3

Consider a signalling or operational telecommunications project relating to the introduction of a new computer based interlocking system.

For **both** of the following, describe a scenario that could lead to a wrong side failure of the system

- i) an error in the wiring design
- ii) an error in the data design [6 marks]

For **each** of the scenarios you have described, what processes should be put in place to deliver an error-free design? [8 marks]

Describe how an error could be discovered during the installation and testing phase of the project. [5 marks]

What action should be taken to enable the commissioning to go ahead? [6 marks]

Question 4

Obtaining safety approval for new products in the railway environment can be time-consuming and expensive.

- a) Describe the concept of cross acceptance. [3 marks]
- b) How is cross-acceptance beneficial for suppliers? [5 marks]
- c) How is cross-acceptance beneficial for end users? [5 marks]
- d) What are the limitations of cross-acceptance? [6 marks]
- e) How may these limitations be reduced or overcome? [6 marks]

Question 5

A new train control system is being specified for a mixed-traffic railway. The safety authority requires that some form of automatic train protection is provided, but the railway has not yet decided if the signalling will be multiple aspect colour light signalling, in-cab signalling, or some combination.

- a) Briefly describe a suitable system design. [5 marks]
- b) For the system you have described, explain the most significant risks that may lead to an unsafe event during normal operation. [8 marks]
- c) For each of the significant risks you have explained, describe how the system may be designed to mitigate their effects. [12 marks]

Paper continued on next page

Question 6

An automatic half barrier level crossing on a light traffic suburban road is life expired and requires renewal.

- a) Describe the process that should be used to determine what options are available. [15 marks]
- b) Describe how the preferred option should be selected; taking into account the views of stakeholders. [10 marks]

Question 7

- a) Describe **two** signalling or telecommunication wrong side failures (WSFs) that could occur on railway infrastructure. [6 marks]
- b) Explain the possible consequences of **both** of the WSFs that you have described. [6 marks]
- c) Describe procedures or equipment that could be adopted to minimise future occurrences or the consequences of **both** of the WSFs you have described. [13 marks]

Question 8

There are different methods of determining the position of a train for a signalling system. Here are three examples:

- i) Continuous detection by trackside equipment using the running rails as a conductor (e.g. track circuits)
- ii) Intermittent detection by trackside equipment (e.g. axle counters)
- iii) Automatic reporting by the train of its position via radio; determined from satellite positioning, trackside transponders or other means

Considering the safety implications of each of these methods, describe the advantages and disadvantages of **each** method in its simplest form and decide what additional control measures may be required to mitigate risk. How should you decide whether the additional control measures should be provided? [25 marks]

Question 9

- a) What are the risks that are controlled by signal sighting? [5 marks]
- b) Describe the parameters that need to be considered when sighting a signal. [10 marks]
- c) A new design of signal is being considered for a route. What characteristics need to be considered to determine if the signal is suitable? [10 marks]

Paper continued on next page

Question 10

Data plays an important role in the design, configuration and operation of modern train control systems.

For **each** of the following, describe how safety can be assured through the acquisition, use, management and modification of the data through the whole of its life:

- i) Railway asset geographical information
- ii) Interlocking design data
- iii) Real-time train running information

[25 marks]

End of paper