

**INSTITUTION OF RAILWAY SIGNAL ENGINEERS
2008 EXAMINATION**

MODULE 5 - SIGNALLING APPLICATIONS

TIME ALLOWED - 1 1/2 HOURS

10 MINUTES WILL BE ALLOWED BEFORE THE START TO READ THE PAPER

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

Discuss the advantages and disadvantages of separate and combined detection for each end of a multi-ended set of points. Include in your answer consideration of:

- a) Interlocking logic design; and [5 marks]
- b) Testing and commissioning; and [5 marks]
- c) Maintenance and fault clearance; and [5 marks]
- d) Train operations; and [3 marks]
- e) Indications given to the signaller. [2 marks]

Question 2

A double track rural railway is about 50km in length and has several stations and level crossings. The signalling assets are in need of renewal. It is intended that the whole railway will be controlled from one control centre. The train service is 3 passenger trains each way per hour with an occasional freight train in each direction.

Describe, with the assistance of diagrams, a suitable signalling system architecture for this railway which will be economical, reliable and safe. Your answer must include the power supply requirements and how your system will take advantage of modern telecommunication transmission techniques.

[20 marks]

Paper continued on next page.

Question 3

An automatic level crossing, i.e. one where the approach of a train activates the warning equipment at the crossing, is located on a double track, and is equipped with flashing road lights, barriers and an audible warning for pedestrians.

Describe, with the aid of diagrams, the key features of the automatic level crossing, explain the configuration and the sequence of operation, and describe suitable timings. Be sure to include why the crossing is configured in the way that you describe and state how this contributes toward the safety of the system. [15 marks]

If trains occasionally start from rest on the approach to the level crossing, how could the road closure time be optimised? [5 marks]

Question 4

A railway is to be re-signalled, with axle counters being used to replace conventional track circuits. Describe the advantages and disadvantages of axle counter technology over track circuits. Your answer should consider:

- a) the design of interlocking and lineside apparatus; and [5 marks]
- b) the maintenance, including activities that may disturb an axle counter section; and [10 marks]
- c) railway operational practices during both normal and degraded situations. [5 marks]

Question 5

A major through station is to be fully re-signalled using lineside signals.

The railway authorities are discussing two strategies of bringing the new signalling into service. The first is to commission the system in a number of small parts over an extended period of time. The second is to commission the whole system during one extended line closure.

Explain the advantages and disadvantages of both of these strategies on:

- a) the design process; and [5 marks]
- b) the installation process; and [5 marks]
- c) the testing and commissioning process; and [5 marks]
- d) railway operations; and [3 marks]
- e) project costs. [2 marks]

Be sure to state any assumptions that you have made.

Paper continues on next page

Question 6

Describe a methodology that can be employed during scheme design to evaluate the risk of a signal being passed at danger. You should comment on opportunities that could be taken during scheme design to reduce the likelihood of a signal being passed at danger as well as those that could be taken to reduce the consequences of signals being passed at danger.

[15 marks]

An existing signal has a history of being passed at danger. What steps could be taken to reduce the risk of this signal being passed at danger again?

[5 marks]

Question 7

Lineside signals and indicators can be illuminated with conventional filament lamps or with LED technology.

Describe the relative advantages and disadvantages of each of these technologies. As a minimum you should consider:

- a) design considerations; and [5 marks]
- b) installation and maintenance; and [5 marks]
- c) reliability. [5 marks]

If the technologies were to be intermixed in a localised area, describe what technical and operational considerations might have to be made. [5 marks]

Question 8

Discuss how the application of a Competence Management System (CMS) can contribute to improvements in the management and execution of safety critical work.

[15 marks]

Describe a process by which a new worker can have his/her existing competencies assessed.

[5 marks]

Paper continues on next page

Question 9

A double rail d.c. track circuit has a fixed feed end resistor and a track circuit relay at the relay end. The parameters are:

Feed voltage:	5V
Feed resistance:	12Ω
Relay resistance:	9Ω
Relay pick-up current:	40mA
Minimum ballast resistance:	2.5Ω.km

Neglecting the tail cable resistance, calculate the maximum length of the track circuit for reliable operation. Explain any assumptions you have made.

For the maximum length track circuit that you have calculated, calculate the minimum drop shunt of the track circuit.

[20 marks]

Question 10

Describe, with the aid of diagrams, the layout and operation of a Signallers' control panel OR VDU system. Your answer must include the following:

- a) considerations with respect to ergonomics and layout; and [4 marks]
- b) the method employed to set, indicate and cancel routes; and [4 marks]
- c) methods for moving and indicating points; and [4 marks]
- d) the method of interface with level crossings; and [3 marks]
- e) aids used by the Signaller to manage engineering work, failures and possessions; and, [4 marks]
- f) the management of critical and non-critical alarms. [1 mark]

End of paper.