INSTITUTION OF RAILWAY SIGNAL ENGINEERS
2010 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

Describe the engineering and ergonomic considerations of designing either:

i) a railway telecoms network management centre OR

ii) a signalling maintainer's terminal.

Your answer should include consideration of asset information, performance, service provision and fault management. [20 marks]

Question 2

Describe either

a trackside system which detects on-train defects which might affect the ability of the train to run safely
OR
a trackside system which detects on-train defects which might cause damage to the infrastructure. [10 marks]

What type of sensor is used to detect the defect in question? [2 marks]

What factors should be taken into account when deciding where to locate one of the systems you have described? [8 marks]

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Question 3

Name three sources of electromagnetic interference which might affect the operation of lineside signalling or telecommunications equipment. [5 marks]

For each source of interference, identify a type of signalling or telecommunications equipment which might be affected by it and explain what measures could be taken to ensure the functional safety of the signalling equipment or reliability of the telecommunications equipment. [15 marks]

Question 4

Explain why signalling systems based on the technology of computers and data transmission generally take longer to respond than systems based on relay technology. [4 marks]

Why is it that for only a few of the functions of a signalling system a longer response time would reduce the level of safety? [6 marks]

Explain two examples of signalling functions where safety would be reduced by a slow response. [10 marks]

Question 5

An existing non-electrified railway is to be electrified using 25kV Over Head Line Equipment (OHLE) without wholesale replacement of existing signalling and telecommunications systems. You are the signalling OR telecommunications engineer responsible for this railway (please select and state your choice of these roles and answer the rest of this question from that perspective).

a) What factors should be considered to ensure that the systems for which you are responsible continue to function in a safe manner following the electrification? [10 marks]

b) What evidence should you produce to support operation of the systems in their original configuration, or to support their upgrade or replacement? [10 marks]

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Question 6

a) Define the terms ‘Hazard’ and ‘Risk’. [4 marks]

b) Identify the primary hazards associated with operation of a high density railway system. [6 marks]

c) Highlight which of these hazards are either partially or fully mitigated by provision of a signalling system that includes continuous track based train location determination (track circuits or axle counters) and briefly explain how this mitigation is achieved. [6 marks]

d) How would the risks associated with the hazards you have identified in part c) be different if the signalling system relied on train based position reporting alone (i.e. no form of trackside train detection)? [4 marks]

Question 7

Sketch a fault tree for loss of ability to control signal route setting from a remote signalling control room. [10 marks]

Explain how such a fault tree could be used to estimate the likelihood of the failure occurring. [4 marks]

Based on your resulting fault tree, identify mitigating methods that could be implemented to reduce the risk of the fault occurring. [6 marks]

Question 8

A railway's rule book is an important document for those operating and maintaining railway equipment.

Describe the key rules which affect the design of either signalling or communications equipment. [8 marks]

Discuss, using examples related to the key rules you have identified, the relationship between the rules in a railway’s rule book and the technology that is implemented on that railway. Ensure that your answer addresses when it may be appropriate to amend the rule book as technology evolves and when it would be best to modify the technology to support existing rules. [12 marks]

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Question 9

List the main phases in the lifecycle of a safety-critical system [6 marks]

How can the continuing safety of a safety critical system be assured through each of these lifecycle stages? [14 marks]

Question 10

Provide an outline functional specification for use in procuring axle-counter equipment for use as the basis of block signalling. [12 marks]

How would you ensure that the procured equipment will be dependable if it has to interface with and use standard voice-frequency telephone circuits for communication through the length of the block section? [8 marks]

End Of Paper.