INSTITUTION OF RAILWAY SIGNAL ENGINEERS
2009 EXAMINATION

MODULE 4 – COMMUNICATION PRINCIPLES

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

a) With the aid of a suitable diagram, outline the design and identify the component parts of a maintenance-free battery (switch / transmission type). [9 marks]

b) What tests would you undertake to prove that the battery is "fit for purpose"?
   i) at the manufacturing stage. [4 marks]
   ii) whilst in service. [4 marks]

c) List the test equipment you would use. [4 marks]

d) With the aid of a circuit diagram, design a suitable charger and explain the purpose of the key components. [9 marks]

Question 2

a) What factors must be considered when designing radio coverage within railway tunnels? [10 marks]

b) With the aid of diagrams, describe different options for providing radio coverage within a railway tunnel, clearly identifying the advantages and disadvantages of each option, including operations and maintenance implications. [15 marks]

c) Describe how the coverage can be verified, both before and after installation. [5 marks]

Paper continued on next page.

Question 3

a) With the aid of a diagram, explain the principle of the autotransformer feed system associated with a main line railway that is electrified at 25kV. [10 marks]

b) Outline the testing you would undertake on lineside copper cables and associated screening to prove that an immunisation system associated with the system described in a) is functioning correctly. [10 marks]

c) Where the results of the tests on the immunisation system are found to be outside specification, outline possible causes and suggest improvements. [10 marks]

Question 4

Fibre optic communications form the backbone of the world's telecommunication network.

a) Describe two different types of optical light sources currently in operation and outline their main characteristics. [15 marks]

b) What is the role of an optical detector? Outline the requirements to ensure optimum performance and compatibility. [15 marks]

Question 5

a) When considering the transmission of CCTV pictures from a level crossing, what safety principles must be considered when choosing the telecommunications transmission system? [15 marks]

b) Describe a number of different transmission system options which could deliver high availability at lowest whole life cost. [15 marks]

Question 6

a) With the aid of a drawing, outline the design of a suitable copper cable for use on a LAN / WAN CIS (customer information system) type network associated with an underground metro station on an electrified railway. [15 marks]

b) What are the electrical characteristics associated with the cable described and what testing would you undertake to prove its integrity? List the equipment used. [15 marks]

Paper continued on next page.

Question 7

A level crossing telephone system is required to be self monitoring, so that any equipment failure will be detected and alarmed. The system is required to operate over an open transmission system.

a) With the aid of diagrams describe the principle of operation of such a system.

[20 marks]

b) What types of equipment failure must be considered?

[10 marks]

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