INSTITUTION OF RAILWAY SIGNAL ENGINEERS
2009 EXAMINATION

MODULE 5 - SIGNALLING APPLICATIONS

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 railway administration is considering the introduction of a moving block signalling system onto their high-capacity two-track suburban railway, which currently has a fixed block signalling system with colour light signals.

The train service will be in excess of 24 trains per hour in each direction and the line features a number of intermediate stations.

Describe the main features of a moving block signalling system. Include in your description details of the advantages and disadvantages of a moving block system when compared to a conventional fixed block system. [15 marks]

What are the problems faced when implementing a transmission based signalling system on an existing trackside signal based infrastructure and how can these be overcome?
[5 marks]

Question 2

A relay interlocking system interfaces across a boundary with a computer based interlocking system. The railway employs track circuits for train detection across the interface.

Describe and explain any hazards that might arise when trains pass from the relay interlocking area into the area controlled by the electronic interlocking. [15 marks]

Describe what action could be taken to reduce the risks to an acceptable level.
[5 marks]

Paper continued on next page.

Question 3

Modern electronic equipment can provide data regarding its health and status.

Describe the types of information that could be recorded onboard a train, within an interlocking system, and within any other elements of the signalling or control system. [10 marks]

Describe the primary and secondary purposes that the railway authority could use the data for. [5 marks]

If there was an incident involving a train movement, where might data be retrieved from in order to aid the incident investigation? What difficulties might be encountered in interpreting data retrieved from different sources? [5 marks]

Question 4

A set of points is to be operated by an electric motor machine. The points feature a number of mechanical supplementary drives due to the length of the switches. The supplementary drives also feature electrical detection of the switch position.

Describe a maintenance regime for the points and its associated fittings. You should consider all electrical and mechanical components. Also consider within your answer the management of the interface with other railway disciplines. [15 marks]

What additional risk does the addition of supplementary drives and detection introduce to the maintenance regime? [5 marks]

Question 5

Describe what hazards would need to be considered for an automatic level crossing that is initiated by:

i) track circuits;
ii) axle counters;
iii) a level crossing predictor;
iv) treadles.

For each of the above, describe ways in which the hazards identified could be eliminated through either system design or operational rules. [20 marks]

Paper continues on next page

Question 6

Describe how electric traction supply faults and lightning can affect each of the following lineside signalling and telecommunications equipment:

i) dc line circuits;
ii) analogue or digital datalinks;
iii) track circuits;
iv) signals;
v) point machines. [10 marks]

With the aid of diagrams and/or sketches, describe methods of mitigation for the effects identified. [10 marks]

Question 7

Describe a signalling maintenance regime that will ensure that maintenance of signalling assets is adequate to ensure safe and reliable operation. [10 marks]

Provide an outline of the maintenance regime appropriate to each of the following assets:

i) a signal (please specify type);
ii) a signalling power supply;
iii) a train detection element (e.g. track circuit or axle counter).

[10 marks]

Question 8

A railway authority is seeking to reduce operational costs on a lightly used line. The line is 50 kilometres long and features a significant number of minor stations and level crossings that are operated locally. There are also some crossovers and sidings that are used only occasionally.

The line is in need of resignalling due to the condition of the existing infrastructure.

Describe, with the aid of sketches, your proposal for the resignalling of this line. [10 marks]

Detail the advantages and disadvantages of your chosen solution, including the technology, and describe how this will meet the needs of the railway authority. [10 marks]

Paper continues on next page

Question 9

A dc track circuit has the following parameters:

Drop Shunt Resistance	12 Ohm
Feed Resistance	100 Ohm
Rail Resistance	33 Ohm / km
Feed Voltage	50V
Track circuit length	2400m
Relay pick up current	500mA

a) Calculate the ballast resistance per kilometre. [10 marks]

b) Describe how the maximum length of a track circuit can be realistically increased including details of any limitations. [5 marks]

c) What issues are faced when using dc track circuits in a dc electrified area? Suggest two possible solutions for overcoming these issues. [5 marks]

Question 10

A railway junction is to be amended in a manner that requires alterations to the interlocking and lineside equipment.

The approved design has been installed and now requires testing before being brought into service.

Describe the processes and testing techniques that should be employed to ensure that the design and installation meets the railway authority's signalling principles and quality requirements. Identify any specific hazards that the testing process introduces and the mitigations required to overcome the associated risks.

[20 marks]

End of paper.