INSTITUTION OF RAILWAY SIGNAL ENGINEERS
2010 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

Draw a system architecture for an electronic interlocking system suitable for controlling either

i) a large station area, or
ii) a rapid transit system.

Your system architecture should include the means of communicating with a control and operating system and the method of communication with trackside equipment. [10 marks]

Describe the advantages and disadvantages of your chosen architecture. [10 marks]

Describe how the interlocking system provides both safety and availability. [5 marks]

Question 2

Describe the key differences between a level crossing using barriers which partially close the road and one which completely closes the road from the railway. Your answer should cover both differences in operation and the different safety features for each type of crossing. [15 marks]

What factors might influence a railway's decision to provide one crossing type over another? [10 marks]

Paper continued on next page.

Question 3

Describe the operation of an axle counter head, including how the following functions are achieved:

- Detection of an axle
- Detection of the direction of travel
- Accounting for a change of direction of an axle over the counter head

[15 marks]

Describe how an axle counter evaluator uses the information provided from axle counter heads to determine the status of a track section. [10 marks]

Question 4

Some point operating mechanisms use a stretcher bar to fix the switch rails together, however other systems use switch rails which are independently driven. Compare the two systems, detailing the advantages and disadvantages of each. [15 marks]

What factors should be considered when producing a point machine which can be trailed in the wrong direction and restored back to service without intervention of a maintenance technician? [10 marks]

Question 5

Describe a maintenance regime which may be chosen for each of the following items of equipment, including details of the activities to be undertaken:

i) a filament type signal head with fibre optic route indicator; and
ii) a point machine; and
iii) a track circuit.

Include in your answer methods which may reduce the cost of maintenance. [25 marks]

Question 6

A transmission based signalling system is to be gradually introduced on an existing line which currently uses a fixed signalling system, with trains being converted in stages.

Describe how this might be achieved, including the equipment and operational considerations required when interfacing the two systems. [15 marks]

Describe the hazards introduced by the interface of the two systems and possible means to mitigate the resulting risk. [10 marks]

Paper continues on next page

Question 7

What use can be made of train-borne monitoring equipment to provide diagnostics of a signalling system? Your answer should include each of the following:

- details of the kind of data which may be gathered; and
- the means of gathering the data; and
- the use to which the data can be put.

[25 marks]

Question 8

A railway authority has a number of large relay interlockings controlled from local signal boxes, but for operational reasons now wishes to centralise the control system to a single remote signalling centre.

Describe a methodology for converting these interlockings to remote control. Include in your answer the details of the transmission system including provision for failure of part, or of all of the transmission system. [10 marks]

What issues may be introduced by bringing interlockings of differing ages into a single control centre and how might they be addressed? [5 marks]

Provide a brief outline of the testing requirements to bring such a system into operation, including the impact on existing operations. [10 marks]

Question 9

Describe the components of a train stop system, including both trackside and train-borne equipment. Include in your answer the features of the equipment which make the system fail safe. [15 marks]

Which components might bring about a wrong side failure and how can this be mitigated against? [10 marks]

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Question 10

A double rail d.c. track circuit has a fixed feed end resistor connected to the rails and has the following properties:

Relay resistance:	9 ohm
Track relay pick up current:	50 mA
Ballast resistance:	2.5 ohm/km
Feed end resistance:	6 ohm
Feed voltage:	5 V

a) Draw a physical representation of the track circuit and an electrical equivalent circuit;

b) Calculate the maximum length of track circuit for reliable operation (state any assumptions that you make);

c) For this maximum length calculate the drop shunt value.

[20 marks]

If the ballast resistance subsequently changes to 1.5 ohm/km what is the new drop shunt value?

[5 marks]

End of paper.