

**INSTITUTION OF RAILWAY SIGNAL ENGINEERS
2018 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

Cybersecurity is becoming more and more critical to the security of information and both the reliability and availability of network services.

- a) Describe five different types of malicious software. Your answer should explain how these work and impact security. [10 marks]
- b) State and explain three additional types of internet security threats. [6 marks]
- c) State and explain the main features and handshake of the Transport Layer Security protocol. [9 marks]

Question 2

- a) Describe the advantages of SDH or SONET over PDH transmission systems [4 marks]
- b) Describe how SDH or SONET transmission systems work. Your answer should include diagrams showing the frame and multiplex structure. [13 marks]
- c) Describe the protection schemes that can be implemented in SDH systems. [8 marks]

Question 3

The internet protocol suite is often described using layered models.

- a) Using a model of your choice explain the function of each layer, citing typical protocols and their uses. [12 marks]
- b) What are the differences between TCP and UDP? [5 marks]
- c) What applications are best suited to UDP and why? [5 marks]
- d) What is SNMP and what is it used for? [3 marks]

Paper continued on next page.

Question 4

- a) With the aid of diagrams describe the principles of operation of a mobile digital radio system used for train to shore communications (e.g. GSM-R, LTE or Tetra). [15 marks]
- b) Describe how you would ensure each base station has sufficient capacity to serve the railway. [10 marks]

Question 5

- a) What is protective earthing? [2 marks]
- b) What is functional earthing? [2 marks]
- c) With the aid of diagrams explain the differences between typical TN, TT & IT earthing arrangements. [15 marks]
- d) Explain the role of surge protectors and their key specifications. [6 marks]

Question 6

- a) Describe the principles and characteristic of optical propagation in fibre. Your answer should include diagrams and consider different types of optical fibre. [11 marks]
- b) Describe the principle of operation of CWDM or DWDM including drawings. [8 marks]
- c) Describe how an optical fibre cable should be tested and include details of the results you would expect. [6 marks]

Question 7

Radio systems used by the rail industry typically use radio frequencies in the VHF or UHF range.

- a) Describe the methods of radio propagation used at these frequencies. [12 marks]
- b) Describe how a radio system's coverage can be designed and validated when a system is built. [5 marks]
- c) Describe how radio coverage could be provided in a tunnel environment. [8 marks]

Paper continued on next page.

Question 8

- a) Explain, with the aid of diagrams, the operation of each of the following:-
- i) Analogue, digital and IP network cameras
 - ii) Video encoder
 - iii) Digital video recorder
 - iv) Network video recorder. [10 marks]
- b) Describe the advantages that a full IP network CCTV system offers over an analogue CCTV system. [5 marks]
- c) Describe the design process you would use in order to calculate the required hard disk storage capacities of a network video recorder to ensure that each camera has recorded images maintained for a nominal 30 days at 1080p at 15fps. [3 marks]
- d) State and explain how you could reduce the hard disk storage requirements. [2 marks]

End of paper