UNIVERSITY OF ABERDEEN SESSION 2013-14

Degree Examination in Communications Engineering

Date: Exam Paper, May 2014.

Notes: (i) Candidates ARE permitted to use an approved calculator

(ii) Candidates ARE NOT permitted to use the Engineering Mathematics Handbook

Candidate must answer ALL FIVE questions. – All questions carry 20 marks

PLEASE NOTE THE FOLLOWING

(i) You **must not** have in your possession any material other than that expressly permitted in the rules appropriate to this examination. Where this is permitted, such material **must not** be amended, annotated or modified in any way.

(ii) You **must not** have in your possession any material that could be determined as giving you an advantage in the examination.

(iii) You **must not** attempt to communicate with any candidate during the exam, either orally or by passing written material, or by showing material to another candidate, nor must you attempt to view another candidate's work.

Failure to comply with the above will be regarded as cheating and may lead to disciplinary action as indicated in the Academic Quality Handbook (www.abdn.ac.uk/registry/quality/appendix7x1.pdf) Section 4.14 and 5.

1. Asynchronous Transmission

(a) A bus uses ***asynchronous character framing*** based on ***EIA-432***. Sketch the signal waveform that is received when the hexadecimal value 0x05 was sent. [5 marks]

(b) A sender transmits data at 1200 bytes/sec. What is the minimum baud rate that is needed to transmit this signal using asynchronous transmission? [2 marks]

(c) Why is the ***slew rate*** important when specifying the line driver to be used in a circuit? [4 marks]

(d) Use diagrams to show how it is possible for an ***asynchronous*** receiver to work with a clock that is 2% lower than the nominal receive clock of 250 kbaud. Show also that the receiver can not reliably work at a 10% lower baud rate. [7 marks]

(e) How does a NMEA GPS receiver validate the integrity of the received data? [2 marks]

[Continued]

2. Digital Multiplex (DMX)

(a) Provide notes comparing the methods used for frame synchronisation in ***NMEA GPS*** transmission and transmission using ***Digital Multiplex (DMX).*** [5 marks]

(b) Explain how ***balanced*** cables may be used improve the performance of a transmission system. [5 marks]

(c) Provide a set of diagrams and detailed explanation on **one** of the following topics.

Either:

A DMX-enabled fixture is used to control the output power output supplied to a mains-powered lamp. The output is set to either 20% or 75% illumination. In each case, determine the value of the slot transmitted to the fixture using the DMX bus and sketch the corresponding waveform for the voltage across the lamp at the fixture.

or:

Provide a fully-labelled diagram that shows the sequence of signals that are sent on the A and B wires of a DMX-512 Bus when it sends a break followed by Start Code with the hexadecimal value 0x55. [10 marks]

3. Remote Device Management (RDM)

(a) Calculate suitable component values for the ***bias circuit***, given that RDM uses a cable with a nominal impedance of 120 Ω. [5 marks]

(b) Explain how a RDM controller uses tri-state logic to communicate using ***Half-Duplex***. [5 marks]

(c) Draw a block diagram showing the design of a ***DMX Splitter*** and use this diagram to explain how the device works. How would this device need to be updated to support ***RDM?*** [10 marks]

4. Microcontroller-based Control

(a) Many microcontroller designs use a ***Watchdog Timer***, what is the purpose of this timer? [5 marks]

(b) Provide a labelled diagram showing how a line-driver can enable a microcontroller to receive control information from a ***balanced communications bus***. [5 marks]

(c) Provide a set of diagrams and detailed explanation of how a DMX receiver may use a software state machine receive a set of 4 DMX slot values at a pre-selected base address. Your example must include a description of the processing performing in each state and should include a state diagram and/or a flow chart. [10 marks]

[Continued]

5. Other Control Busses

(a) What are the main differences between a ***synchronous*** communication system and one that uses ***asynchronous*** communication system? [3 marks]

(b) Explain how a ***Controller Area Network (CAN)*** uses bit-stuffing to enable any byte value to be sent within a CAN frame. [5 marks]

(c) Provide two examples of systems that use a CAN bus. [2 marks]

(d) Provide a set of diagrams and detailed explanation on **one** of the following topics.

Either:

Consider two CAN nodes A, B with respective message IDs: 415 and 454. Sketch the waveform representing the first 12 bits if each transmits individually. Also sketch the resulting arbitration when the two messages are sent simultaneously.

or

Explain what is meant by the ***RDM Unique ID (UID)*** and how an RDM controller may use this to identify the set of fixtures connected to the RDM bus.

[10 marks]