UNIVERSITY OF ABERDEEN   SESSION 2012-2013

Degree Examination in EG40GD Communications Engineering 2

Day Date January 2013 –Strikethrough indicates topic that will not be examined in 2014

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

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

      (iii) *Data sheets are attached to the paper*

Candidate must answer ALL FOUR questions. – All questions carry 25 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.
(a)   The DMX-512 bus uses *asynchronous character framing*. Sketch the signal waveform that is received when the hexadecimal value 0x0E was sent.   [8 marks]

(b)   If the transmission *baud rate* is 250 kbps, what is the minimum duration of each *slot*?   [4 marks]

(c)   How does a DMX-enabled fixture identify the start of a multiplexed frame?   [4 marks]

(d)   A DMX fixture controls the output power supplied to a mains lamp. Sketch the waveform for the voltage across the lamp for a slot value of 25 and 100.   [9 marks]

2.
(a)   Why is the *slew rate* important when specifying the line driver to be used in a circuit?   [4 marks]

(b)   Why is a *bias circuit* needed for the Remote Device Management (RDM) protocol   [2 marks]

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

(d)   Suggest some advantages to using RDM compared to DMX.   [4 marks]

(e)   Provide a set of diagrams and detailed explanation on **one** of the following topics, either:
    • explain how a controller using the RDM protocol may identify the nodes connected to the bus
    or
    • explain how a receiver may be programmed to receive a particular set of DMX data slots.
    [10 marks]

3.
(a) Describe the use of *Quadrature Phase Shift Keying (QPSK)* to modulate the data {0011}.
Your answer must include appropriate diagrams. [6 marks]

(b) Use a **constellation diagram** to explain how errors may be introduced during demodulation,
and why *Gray Coding* is used to encode these symbols. [5 marks]

(c) Use diagrams to explain the operation of *Time Division Multiplexing* in a ~~DVB Transport Stream.~~
[5 marks]

(d) ~~Explain how a *Transport Stream* maintains a constant bit rate, even when the aggregate bit~~
~~rate from all the sources varies as a function of time.~~ ~~[5 marks]~~

(e) ~~The following Transport Stream packet is received:~~

~~47 40 10 1B 00 40 F0 2D 00 01 FD 00 00~~
~~F0 08 40 06 53 61 74 4C 61 62 F0 18 00 01~~
~~00 01 F0 12 44 0B 01 13 00 00 FF F1 03 06~~
~~90 00 0F 41 03 00 01 01 F9 03 DF BF FF FF~~

~~(i) What is the purpose of the first byte of this packet?~~ ~~[2 marks]~~
~~(ii) What is the *Packet Identifier* value of the packet payload?~~ ~~[2 marks]~~

4.
(a) ~~The output signal from a satellite modem uses an *Intermediate Frequency* (e.g. 70 MHz) and is up-~~
~~converted to a high power microwave signal (e.g. 14 GHz) for transmission via the feed and~~
~~antenna to the satellite. Describe how this up-conversion is performed.~~ ~~[10 marks]~~

(b) ~~A satellite terminal receives a signal at 11 GHz, and has an antenna diameter of 0.3 m, what is the~~
~~gain of this antenna?~~ ~~[5 marks]~~

(c) Provide a set of diagrams and detailed explanation on **one** of the following topics, either:
• explain how a system generates a signal for transmission on the synchronous Controller Area
Network (CAN) bus
or
~~• explain how a Low Noise Block (LNB) processes a DVB-S transmission prior to reception by~~
~~a set top box.~~
[10 marks]

Appendix: Definitions of MPEG-2 TS Protocol Control Information

Definition of a TS Packet (ISO 13818)   **No. of bits**

```
transport_packet(){
        sync_byte                                                   8
        transport_error_indicator                                   1
        payload_unit_start_indicator                                1
        transport_priority                                          1
        PID                                                         13
        transport_scrambling_control                                2
        adaptation_field_control                                    2
        continuity_counter                                          4
        if(adaptation_field_control=='10' || adaptation_field_control=='11'){
                adaptation_field()
        }
        if(adaptation_field_control=='01' || adaptation_field_control=='11') {
            for (i=0;i<N;i++){
                        data_byte                                   8
                }
        }
}
```

Definition of a PES Packet (ISO 13818)   **No. of bits**

```
PES_packet() {
        packet_start_code_prefix                                   24
        stream_id                                                   8
        PES_packet_length                                          16
        for (i=0;i< PES_packet_length;i++){
                data_byte                                           8
        }
}
```