GX546

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SEMESTER I EXAMINATIONS, 2000

B.E. DEGREE EXAMINATION (ELECTRONIC ENGINEERING)
THIRD YEAR ELECTRONIC AND COMPUTER ENGINEERING

COMMUNICATION SYSTEMS ENGINEERING 1

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Duration of examination: *Two* Hours

Instructions: Answer any *Four* questions.

1. *(a)* A communication system is being proposed to allow live speech signals to be transmitted over a 30km digital radio link with a bit rate of 16 kbps. The transmitter module for the system, firstly, samples the speech signal 8000 times every second and represent each speech sample as an 8 bit digital codeword. These 8 bit samples are fed into a source coder whose output is then fed into an interleaver. Before being fed into radio the transmitter circuitry, the output of this first interleaver is fed into a channel coder and, finally, into a second interleaver.

(i) Explain the role of the ***source coding*** block in this transmission system.
(ii) Explain the purpose of the ***channel coding*** block in this transmission system.
(iii) In your opinion, would this system operate using an ***error detection*** or ***error correction*** code? Justify your answer.
(iv) Explain the role of the two ***interleaving*** block in this transmission system
(v) If a high capacity fibre optic link, with a very low BER, were to be used instead of the proposed radio link in this example, which, if any, of the above three sub-systems (i.e. source coder, channel coder and interleavers) would you suggest using in the design. Justify your answer.

[9 marks]

(b) A source coding subsystem must be designed to allow the transmission of data relating to the performance of a remote piece of equipment. It is decided to examine the data being produced by the system before the source coding module is designed. Over a certain period an automatic logging system counted the number of occurrences, of each of the eight possible symbols, which could be generated by the remote equipment. The results of this log were:

Symbol	1	2	3	4	5	6	7	8
Number of Occurrences	20	10	35	75	5	15	60	40

It was felt that this log accurately represented the long-term behaviour of the system being monitored

Given that the above remote piece of equipment generates 1000 symbols per second:

(i) Determine the minimum bit rate required to transmit this information if **NO** source coding module is used,
(ii) Develop a **Huffman source coding** module for this data,
(iii) Determine the **minimum and maximum instantaneous bit rates** that would be generated by this source coding module,

[pto]

(iv) Determine the **average bit rate**, which would be generated by this source coding module, and, hence, determine its **efficiency**.

[9 marks]

(c) The receiver module for an ODD parity based Hamming coder receives the following 14 bit binary block:

1 1 0 0 1 1 0 0 1 0 1 0 0 1

Determine the block of **information bits ONLY** which were transmitted within this block.

[7 marks]

2. *(a)* Describe, using examples where appropriate, the behaviour of the following **waveform formatting** techniques under the following headings: AMI, HDB3, Manchester Coding

(i) DC drift,
(ii) Synchronisation properties,
(iii) Bandwidth,
(iv) Transparency,
(v) Complexity.

[9 marks]

(b) Figure 1 describes the structure of a convolutional code formed by a three bit shift register and generating two output bits for every input bit. Firstly, draw a state machine and trellis diagram for this particular coder structure. The receiver for this convolutional coder receives the following bit sequence:

10 11 01 10 00 11 10

Determine the most probable binary input sequence which was applied to the transmitter's convolutional encoder. You may assume that this sequence was generated using the standard initial and final state constraints for a convolutional coder of this type.

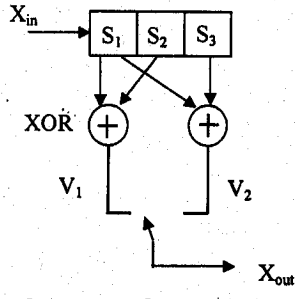

Figure 1 - Structure of Convolutional Encoder

[16 marks]

3. *(a)* Explain, with the aid of a diagrams or examples where appropriate, the difference ***bit, byte*** and ***block synchronisation*** in the physical layer of a data communication system.

[9 marks]

(b) Data is being transmitted in frames of 2 kbytes over a 600km long optical fibre communication link operating at a bit rate of 4 Mbps. An Idle RQ data link layer protocol is operating over the link with an efficiency of 35%. Determine an estimate for the BER of this communication link.

[7 marks]

[pto]

(c) A Continuous RQ protocol, with Go-Back-N, is being used to transmit frames of 2000 bits over a 10 Mbps communication link. The data link layer protocol is observed to execute at a maximum efficiency as long as the window size for the protocol is greater than four. Given that the voltage signal propagates along the serial cable at a velocity of $1.5 \times 10^8 ms^{-1}$:

(i) Determine the **range of lengths** that the serial cable may have,
(ii) Assuming a cable length in the middle of this range, determine an estimate for the efficiency of the protocol with window sizes of 3 and 5, respectively. The serial cable has a BER of 10^{-5}.

[9 marks]

4. *(a)* Distinguish between the roles of **frames, used in a data link layer protocol,** and **packets, used in a network layer protocol.**

[5 marks]

(b) Compare the structure and operation of a **Circuit Switched Data Networks (CSDN)** to that of a **Packet Switched Data Networks (PSDN).**

[12 marks]

(c) Explain what you understand by the terms **connection oriented service** and **connectionless service** in the context of a packet switched data network. Outline ONE advantage and ONE disadvantage of both types of services.

[8 marks]

5. *(a)* "The 802.3 CSMA bus LAN standard is based on a **persistent CSMA\CD MAC protocol.**" Explain what you understand by the terms in bold in this statement.

[8 marks]

(b) Two stations (DTE A and DTE B) are located on the same segment of a CSMA bus type LAN. At time t=0, DTE A starts to transmit a frame. At a subsequent time $t=t_0$, DTE B senses the line, finds it is idle and immediately starts to transmit a frame. At the end of the tenth bit period of its frame, DTE A senses a collision between its frame and the frame transmitted by DTE B. Determine the range of possible distances between DTE A and DTE B based on this information. The signal propagation velocity along the coaxial cable used in the LAN segment is $2 \times 10^8 ms^{-1}$ and the bit rate on the LAN segment is 10Mbps.

For each case, specify the value of t_0, the time at which DTE B starts to transmit onto the segment.

[5 marks]

(c) Explain what you understand by the term **bridged LAN** and describe THREE advantages and THREE disadvantages of using bridges in a LAN.

[6 marks]

(d) Describe the structure and operation of a **transparent bridge** in a bridged LAN.

[6 marks]

6. *(a)* Describe the role of the following bits in the normal operation of an 802.5 Token Ring LAN:

(i) Token (T) bit,
(ii) Priority (P) bits,
(iii) Reservation (R) bits,
(iv) Monitor (M) bit,
(v) A and C bit Frame Status (FS) byte.

[7 marks]

[pto]

(b) A standard 802.5 Token Ring LAN has 12 active stations operating on the ring. On observing the performance of the active monitor, it was noted that the active monitor was inserting 8 **extra** single bit delays into the rotation time of data on the ring in order to maintain the required minimum latency. The velocity of signal propagation on all links forming the ring is 2.75×10^8 ms^{-1}.

Determine the possible range of values for the total physical length of cable forming the ring,

[6 marks]

(c) Describe the use of **source routing bridges** to implement a bridged LAN based solely on 802.5 segments.

[6 marks]

(d) Explain the meaning of the terms **priority mechanism** and **early token release** as implemented on an FDDI LAN.

[6 marks]