-SQA-SCOTTISH QUALIFICATIONS AUTHORITY

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NATIONAL CERTIFICATE MODULE DESCRIPTOR

-Module Number- **0064209** **-Session-1986-87**

-Superclass- **XM**

-Title- **TELECOMMUNICATIONS: DIGITAL TRANSMISSION TECHNIQUES**

-DESCRIPTION-

Type and Purpose

A specialist module which enables the student to extend his/her knowledge of the acquired basic principles in earlier modules and apply these principles to digital techniques and transmission.

Preferred Entry Level

04201 Principles of Telecommunication Systems.

Learning Outcomes

The student should:

1. know the types of networks used for data transmission;
2. know the terminology used in modulation, transmission and multiplexing;
3. know the facilities offered by data terminals;
4. know transmission protocols and methods of interfacing transmission systems to terminal systems;
5. know data link testing methods;
6. know the elements of pulse code modulation (PCM);
7. know the elements of time division multiplexing (TDM).

Content/ Context

Corresponding to the Learning Outcomes:

1. the meaning of a point to point circuit. Application of the following types of data network:

(a) multipoint, single star;

(b) multipoint, multi star;

(c) loop system;

(d) two tier system;

(e) packet network;

(f) wideband systems;

(g) Public Switch Telephone Network (PSTN) single and double dial up;

(h) digital data service.

2. the use of modems. Frequency Shift Keying (FSK) as related to data transmission at different transmission speeds. Phase Shift Keying (PSK). Advantages over FSK.

Meaning of:

(a) constant carrier;

(b) switched carrier;

(c) supervisory channel;

(d) forward and backward channels.

Quadrature Amplitude Modulation (QAM) Meaning of the terms in relation to data transmission:

(a) attenuation;

(b) group delay;

(c) phase jitter;

(d) cross talk;

(e) random noise;

(f) impulse noise;

(g) mismatch;

Methods of multiplexing. Classical and Statistical systems.

Meaning of the terms:

(a) concentrator system;

(b) multimode modems;

(c) extended port working;

(d) multiple site.

3. differences between asynchronous and synchronous transmission. Operation of parallel-serial and serial-parallel converters. The features of the Front End Processor (FEP) and the mainframe processor.

Meaning and use of the terms 'non-intelligent terminal' and 'intelligent terminal'. Advantages and disadvantages. Differences between the following types of terminal:

(a) receive only (RO);

(b) keyboard send receive (KSR);

(c) automatic send receive (ASR);

(d) electronic send receive (ESR);

Description of a distributed processing system and an auto calling system using PSTN.

4. identification of the two levels of protocol used for data transmission as a physical and dataline. The meaning of the following interface control terms:

(a) connect data set to line (CDSL);

(b) data terminal ready (DTR);

(c) data set ready (DSR);

(d) request to send (RTS);

(e) ready for sending (RFS);

(f) received line signal detector (RLSD) (carrier detector);

(g) calling indicator (CI).

Safeguards afforded by "constant carrier" working. Reasons for overriding echo suppression in intercontinental working. Use of binary code to represent alphanumerical characters. American Standard Code for Information Interchange (ASCII) as an example. Coding of characters from a given table of ASCII codes.

Error checking techniques:

(a) parity check;

(b) vertical redundancy check (VRC);

(c) longitudinal redundancy check (LRC).

Examples of the use of level 2 protocol in binary synchronous control (BSC).

Polling methods:

(a) roll call;

(b) drop;

(c) hub.

5. data link testing methods; meaning of bit error rate testing (BERT) and block error rate testing (BLERT); types of distortion:

(a) bias;

(b) peak;

(c) start stop.

Level 2 protocol testing methods for the following:

(a) protocol (hand shaking) timing problems;

(b) wrong protocol;

(c) garbled messages.

6. Pulse Amplitude Modulation (PAM); conversion of an analogue signal into amplitude samples. Minimum (2) samples per cycle to describe the original signal. Use of a low pass filter to reconstitute a PAM signal. Human ear compensations for missing sections of waveform. Transmission of all original waveform amplitudes in PAM.

Pulse Code Modulation (PCM); encodation of PAM samples to PCM. Operation of crystal controlled clock circuits. Operation of Sample and Hold circuit. The Quantisation Process (limited to a sign bit plus three bits). Use of 256 quantisation levels in practical systems, i.e. a sign bit plus quantisation encoding bits. Operation of a successive approximation analogue to digital (A to D) converter (limited to a sign bit plus 3 bit code). Quantisation noise, and noise reduction. Use of non linear quantisation. Operation of digital to analogue (D to A) converter (R-2R network or switched weighted currents).

D-A output as a PAM signal. Advantages of PCM over PAM. Operation of a PCM system using block diagrams showing:

(a) analogue input;

(b) clock;

(c) sample and hold;

(d) encoder;

(e) line;

(f) decoder;

(g) low pass filter;

(h) synchronisation.

7. Time Division Multiplex (TDM); multiplexing of several PCM channels (max, 4 channels). Practical system with 30 speech plus 2 signalling channels. A 4 channel multiplex system showing time slots and frames. Synchronisation of the receive system to the transmit. Use of a frame alignment code word for synchronisation. Transmission of alarm signals and signalling information as binary coded words. Need for separate transmit and receive path. Use of regenerators as a line transmission TDM system. The use of alternate mark inversion (AMI), alternate digit inversion (ADI) and higher density bipolar (HDB3) in practical PCM systems. Description of the signals carried in channels 16 and 31 of 32 channel PCM system. Methods of determining 'bit rate' from necessary data.

Suggested Learning and Teaching Approaches

This module encompasses the knowledge of specialised techniques in digital transmission systems and a didactic approach is recommended. This should be supplemented by the use of demonstrations, slides, films and videos where appropriate. The specialist systems and techniques described in this module should be used in the student's work place. Computer simulations should be developed to enhance the student's understanding of the systems.

Assessment Procedures

All Learning Outcomes must be validly assessed.

The student must be informed of the tasks which contribute to summative assessment. Any unsatisfactory aspects should be discussed with the student as and when they arise.

Acceptable performance in the module will be satisfactory achievement of the performance criteria for each Learning Outcome.

The following abbreviations are used below:

LO Learning Outcome
IA Instrument of Assessment
PC Performance Criteria

LO1 IA Written short answer test.

PC The student correctly describes the following types of network:

(I) multipoint, single star,
(ii) multipoint multi star,
(iii) loop system,
(iv) two tier system,
(v) packet network,
(vi) wideband system,
(vii) Public Switch Telephone Network (PSTN) single and double dial up,
(viii) digital data service.

LO2 IA Written short answer test.

PC The student correctly describes the meaning of the terms listed in the content.

LO3 IA Written short answer test.

PC The student correctly lists the facilities offered by data terminals.

LO4 IA Written short answer test.

PC The student correctly:

(a) states transmission protocols;

(b describes methods of interfacing transmission systems to terminal systems.

LO5 IA Written short answer test.

PC The student correctly describes data link testing methods.

LO6 IA Written short answer test.

PC The student correctly describes the elements of pulse code modulation.

LO7 IA Written short answer test.

PC The student correctly describes the elements of time division multiplexing.