

**FIRST SEMESTER EXAMINATIONS 2005
CAMPUS: Townsville**

This paper MUST be handed
in at the end of the examination

Yes No

Release to the Library

Yes No

STUDENT NAME:

(block letters)

STUDENT NUMBER:

SUBJECT CODE: EE3700

SUBJECT NAME: Communications System Principles

**EXAMINER: A/Prof Keith Kikkert
Dr Graham Woods**

DURATION OF EXAMINATION (hours): 2 Hours

PERUSAL TIME (minutes): 10 minutes

TOTAL NUMBER OF QUESTIONS: Three (3) questions

INSTRUCTIONS TO STUDENTS:

Attempt **ALL** questions

All questions are of equal value. The total marks indicated on the exam paper are 120.

MATERIALS TO BE SUPPLIED BY EXAMINATION SECTION:

Examination Booklets required

Tables for Electrical Engineers

Graph Paper (mm natural scale) supplied on request

MATERIALS STUDENTS MAY USE:

Faculty approved calculators and drawing instruments.

One A4 size handwritten or printed formula sheet (both sides).

ACCESS TO AN ENGLISH DICTIONARY

Yes

No

Question 1

- (a) Compare Amplitude Modulation, Double Sideband Modulation, Single Sideband Modulation and Vestigial Sideband Modulation. In your discussion show the time waveforms and spectra and mention critical issues such as transmission efficiency, bandwidth usage and circuit complexity. (15 marks)
- (b) For an FM signal calculate the number of spectral components which are greater than 1% of the unmodulated carrier amplitude if $F_d = 75$ kHz and the audio frequency is 7.5 kHz. How does the resulting bandwidth compare with Carson's Rule. (8 marks)
- (c) Explain the principles of stereo coding as is used in FM Broadcasting. In your discussion show how this system is compatible with mono transmission? In which way does adding the stereo components degrade the FM transmission? (12 marks)
- (d) What is pre-emphasis and de-emphasis and why are they often used in FM radio systems? (5 marks)

Question 2

Define the meaning of the following Communications Engineering terms. Use examples, figures and possible applications wherever possible to illustrate usage.

- (a) Anti-aliasing filter
- (b) Matched filter
- (c) Differential Pulse Code Modulation (Δ PCM)
- (d) Delta Modulation (Δ M)
- (e) A-Law companding
- (f) Raised cosine pulse shaping
- (g) Partial response signaling
- (h) Equalizer (eg Tapped Delay Equalizer)
- (i) Manchester encoding
- (j) Amplitude Shift Keying (ASK)
- (k) Quadrature Phase Shift Keying (QPSK)
- (l) 64 QAM
- (m) Eye diagram

(40 Marks, 3 marks for each part plus an extra 1)

Question 3

- (a) Briefly describe and compare the following error correcting techniques:

- I Hamming Coding
- II Trellis Coding
- III Convolutional Coding

Illustrate the operation of Hamming Error correcting coding by showing that by adding error correcting bits to a 4 bit data word 0101, the error can be corrected if the received data is 0100 and the error correcting bits are received without error. (15 marks)

(b) A set of data symbols is to be transmitted. The symbols have a probability of occurrence of:

- A 0.30
- B 0.25
- C 0.20
- D 0.12
- E 0.08
- F 0.03
- G 0.02

Calculate the entropy of this set of symbols and design an efficient binary transmission scheme. Calculate the efficiency of your code. (10 marks)

(c) Compare and contrast the CDMA, OFDM and Frequency Hopping Spread Spectrum techniques. In your discussion describe the modulation principles, multi-path propagation properties, channel efficiency, noise and interference tolerance, security and any other relevant properties, such as single frequency networks and rake receivers. Mention operational systems which use each of the techniques and the reason why that modulation system is used for that particular system. (15 marks)