Ollscoil na hÉireann, Gaillimh GX_____
National University of Ireland, Galway

Semester II Examinations, 2002/2003

Exam Code(s)	3BN121
	3BP121
Exam(s)	Third Year Electronic Engineering
	Third Year Electronic and Computer Engineering
Module Code(s)	EE308
Module(s)	Signals and Communications
Paper No.	2
Repeat Paper	_____ Special Paper _____
External Examiner(s)	Professor S. McLaughlin
Internal Examiner(s)	Professor D.J. Wilcox
	Dr. J. Breslin

Instructions: Answer 3 questions.
All questions carry equal marks.

Duration	2hrs
No. of Answer books	1
Requirements:	
Handout	
MCQ	
Statistical Tables	
Graph Paper	
Log Graph Paper	
Other Material	Yes Standard Mathematics Tables
No. of Pages	3
Department(s)	Electronic Engineering

OLLSCOIL NA hÉIREANN, GAILLIMH
NATIONAL UNIVERSITY OF IRELAND, GALWAY

SEMESTER II EXAMINATIONS 2002/2003

THIRD YEAR ELECTRONIC ENGINEERING
THIRD YEAR ELECTRONIC AND COMPUTER ENGINEERING

EE308 SIGNALS AND COMMUNICATIONS

Professor S. McLaughlin
Professor D.J. Wilcox
Dr. J. Breslin

Duration of Examination: **TWO** hours
Instructions: Answer **THREE** questions

1.

(a) Define a normal amplitude-modulated bandpass signal, the modulation index m, and the efficiency η for normal AM (DSB-LC) **[4 marks]**.

(b) Fig. 1 shows a typical spectrum for a message signal m(t). Sketch the spectrum of the corresponding normal AM signal $s_c(t)$, and derive the *general* expression for the spectrum of $s_c(t)$ **[4 marks]**.

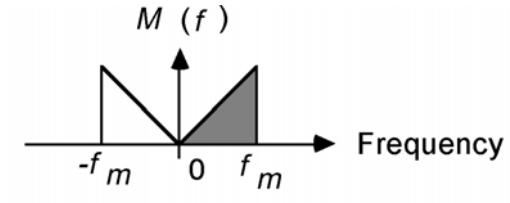

Fig. 1

(c) Sketch a block diagram showing the generation of a normal AM signal, and then describe the operation of a normal amplitude modulator using a diode **[8 marks]**.

(d) Draw the circuit for a normal AM envelope detector, and explain with the aid of a waveform diagram how a message signal would be recovered from a modulated signal using this circuit **[4 marks]**.

2.

(a) Why are envelope detectors not suitable for demodulating DSB-SC, SSB or VSB signals **[3 marks]**?

(b) Describe with the aid of diagrams the use of a synchronous detector for DSB-SC demodulation **[6 marks]**.

(c) Define QAM, and compare its transmission bandwidth efficiency to DSB-SC signals **[3 marks]**.

(d) Describe, using block diagrams and spectra where necessary, a typical 5-user FDM system **[8 marks]**.

[cont'd]

3.

(a) Define each of the following terms for either PM or FM where specified:

(i) Instantaneous phase deviation for PM **[1 mark]**.
(ii) Peak phase deviation for PM **[1 mark]**.
(iii) Instantaneous frequency for both PM and FM **[2 marks]**.
(iv) Instantaneous frequency deviation for FM **[1 mark]**.
(v) Peak frequency deviation for FM **[1 mark]**.

(b) If PM and FM differ only by a possible integration of the modulating signal, prove mathematically that it is possible to generate a PM signal using a frequency modulator and an FM signal using a phase modulator **[8 marks]**.

(c) Define narrowband angle modulated signals for both PM and FM, and illustrate the generation of both types of signal using block diagrams **[4 marks]**.

(d) What is the relationship between narrowband angle modulated signals and double sideband amplitude modulated signals **[2 marks]**?

4.

(a) Define a wideband frequency modulated signal $s_c(t)$ in terms of Bessel functions **[2 marks]**.

(b) An angle modulated signal using FM has an angular carrier frequency $\omega_c = 3000$ rad/s, and a peak frequency deviation of 600 Hz. If the message signal is given by the equation $f(t) = 30\cos(160\pi t)$, determine the bandwidth of the FM signal using Carson's rule **[3 marks]**.

(c) With the aid of a block diagram, describe the steps involved in the indirect method for generating a wideband FM signal **[5 marks]**.

(d) Draw a block diagram showing the direct method of generating a wideband FM signal with frequency stabilisation **[3 marks]**.

(e) Explain using diagrams how the frequency discrimination method can be used to demodulate a phase modulated signal $s_c(t) = A\cos\theta(t)$, where $\theta(t) = 2\pi f_c t + \phi(t)$ **[7 marks]**.

5.

(a) Define each of the following terms in relation to discrete signals:

(i) Sampling period **[1 mark]**.
(ii) Band-limited signal **[1 mark]**.
(iii) Aliasing **[1 mark]**.
(iv) Nyquist sampling rate **[1 mark]**.
(v) Interpolation **[1 mark]**.
(vi) PAM **[1 mark]**.

(b) State and prove the sampling theorem **[8 marks]**.

(c) Explain using diagrams what TDM is and how it can be used to solve the problem of allowing signals from many users to be transmitted simultaneously over a single communication channel **[6 marks]**.