

Association of Professional Engineers of Ontario

Annual Examinations - 2002 (Fall)
98-Elec-A3

Communications

3 hours duration

Notes:

- 1) If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper a clear statement of any assumption made.
- 2) "Closed-Book" - no aids other than a calculator (Casio FX-991 or Sharp EL-540) are permitted.
- 3) Any five questions constitute a complete paper. Only the first five questions as they appear in your answer book will be marked.
- 4) All questions are of equal value.

- 4) A VCO is used as a frequency modulator. If the input is zero volts then the output is a sinusoidal signal of frequency $f_c = 80$ MHz and amplitude 5 volts. If the VCO input signal is 2 volts then the output signal is a sinusoid with frequency 80.1 MHz. We apply a message input $m(t)$ to the modulator, equal to the sum of two sinusoids of amplitude 1 and frequencies 5 KHz and 10 KHz respectively.
- Give an expression for the output of the FM modulator.
 - What is the average power of the FM signal?
 - What is the approximate bandwidth of the FM signal?
- 5) A speech signal has a bandwidth of 8 KHz. It is to be transmitted using PCM with uniform quantization and binary baseband transmission. The required signal to noise ratio at the receiver is 33 dB. Determine the bandwidth of the baseband channel required to transmit the signal. Show all the calculations and intermediate results.
- 6) An AM signal has a carrier frequency equal to 2 MHz and a baseband message signal bandwidth equal to 15 KHz. It is desirable to change the carrier frequency of this AM signal to 2.005 MHz.
- Give the block diagram of a system that will achieve this frequency conversion.
 - Give the diagram of a circuit to demodulate the signal based on envelope detection.