UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	COMMUNICATION ENGINEERING
COURSE CODE	:	DEK 3233/ DAE 32603
PROGRAMME	:	3 DEE/DET
EXAMINATION DATE	:	MARCH 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF EIGHT (8) PAGES

Q1 (a) An electromagnetic communication can be summarized as the transmission, reception and processing of information between two or more location using electronic circuits.

(i) List two (2) advantages and two (2) disadvantages of modern electronic communication system.

(ii) Figure Q1(a)(ii) shows a simplified block diagram of an electronic communication system. Briefly describe each element.

(8 marks)

(b) Signal is any time-varying quantity that can carry information. Two main types of signals encountered in practice are analog and digital. Define and sketch appropriate diagram for:

(i) Analog communication system
(ii) Digital communication system

(4 marks)

(c) For telecommunications purposes by Federal Standard 1037C, transmission medium are classified as guided and unguided. An example of guided medium is coaxial cable. Illustrate and label the cutaway view of a coaxial cable.

(4 marks)

(d) The electromagnetic frequency spectrum is divided into segments for the purpose of classification. By referring to Table Q1(d):

(i) State the classification for normal range of human speech.
(ii) Calculate the bandwidth for the answer in Q1(d)(i).
(iii) How many times more bandwidth does the Medium Frequency (MF) have than the answer in Q1(d)(ii)?

(4 marks)

(e) A communication link is using a transmitter of 10W power and noise power of 0.01W is produced. The available bandwidth is 3 kHz. Calculate the:

(i) Channel capacity of this communication system using Shannon's Law, as below:

$$C = 3.32 \times BW \times \log_{10}\left(1 + \frac{S}{N}\right)$$

(ii) Signal-to-Noise Power Ratio (SNR) in dB by using:

$$SNR\ (dB) = 10\ \log_{10}\left(\frac{S}{N}\right)$$

(iii) From your point of view, what happens to the channel capacity if the SNR is reduced to 10dB?

(5 marks)

Q2 (a) Modulation is a process of imposing information contained in a lower frequency onto a higher frequency signal.

(i) Define amplitude modulation (AM).
(ii) Draw the block diagram of amplitude modulation (AM)
(iii) Sketch the modulating signal, carrier signal and amplitude modulation (AM) signal.

(6 marks)

(b) Modulation index (m) is defined as a parameter, which determines the amount of modulation. There are three different types of amplitude modulation (AM):

Under modulated
Ideal
Over modulated

(i) Describe each type of amplitude modulation (AM).
(ii) Illustrate each type of amplitude modulating (AM) signal.

(6 marks)

(c) In an AM transmitter, two types of signals are fed into the modulator resulted an AM output wave as Figure Q2(c). If the given signals below are the carrier and information signals respectively, find the followings:

$$v_c(t) = 42 \sin 942477.8\, t$$
$$v_m(t) = 18 \sin 18849.6\, t$$

(i) Percentage AM modulation index.
(ii) Maximum and minimum voltages of the AM wave.
(iii) Upper and lower frequencies produced by the modulator.
(iv) AM bandwidth.
(v) The total power transmitted if $R = 150\ \Omega$.

(10 marks)

(d) Amplitude modulation (AM) signal can be produced using *non-linear mixing* technique. Diode modulator is the oldest and the simplest modulator of this technique.

(i) Construct the diode modulator circuit.
(ii) State an element in this circuit.

(3 marks)

Q3 (a) Explain the term of *demodulator*.

(1 mark)

(b) List two (2) of amplitude modulation (AM) demodulator circuit.

(2 marks)

(c) In radio communications, a radio receiver is an electronic device that receives radio waves and converts the information carried by them to a usable form.

(i) Sketch the receiver block diagram.
(ii) Describe two (2) parameters that been used to evaluate the ability of a receiver.

(7 marks)

(d) High-Q tuned circuit is used to keep narrow bandwidth to ensure that only desired signal is passed. Assumed that 20μH coil with resistance of 50 Ω is connected in parallel with 101.4pF variable capacitor. Calculate the:

(i) Resonance frequency, f_r
(ii) Inductive reactance, X_L
(iii) Selectivity of the circuit, Q
(iv) Bandwidth of the tuned circuit, BW
(v) Upper cutoff frequencies, f_{upper}
(vi) Lower cutoff frequencies, f_{lower}

(6 marks)

(e) Tuned RF Receiver (TRF) is the earliest and simplest receiver design. TRF consist of RF amplifiers stages, detector and audio amplifier stages.

(i) State two (2) disadvantages of Tuned RF Receiver (TRF).
(ii) Name the receiver that designed to overcome the problems in Tuned RF Receiver (TRF).
(iii) Explain three (3) of the stages in Q3(e)(ii) receiver.

(9 marks)

Q4 (a) Sketch and briefly explain the terms of frequency modulation (FM).

(3 marks)

(b) List two (2) advantages and two (2) disadvantages of Frequency Modulation (FM).

(4 marks)

(c) A carrier signal of $V_c(t) = 4 \cos (628.4 \times 10^3 t)$ is frequency modulated by a modulating signal $V_m(t) = 2 \cos (3.142 \times 10^3 t)$. The deviation sensitivity of the modulator is 750 Hz/V. By referring to Table Q4(c):

(i) Find the frequency deviation, Δf
(ii) Number of sets of significant sideband and their amplitude.
(iii) Find the modulation index, β
(iv) Find the carrier swing.
(v) What is the bandwidth in the FM signal using Carson's Rule?
(vi) What is the bandwidth according to Bessel Table?
(vii) Express the FM signal mathematically for the carrier and modulating signal given.
(viii) Draw the frequency spectrum showing their relative amplitudes.

(15 marks)

(d) List three (3) types of FM demodulator circuits that you know.

(3 marks)

Q5 (a) Electrical noise is defined as any undesirable electrical energy that falls within the passband of the signal. Explain the different between correlated and uncorrelated noise.

(2 marks)

(b) An intermediate frequency (IF) amplification has 3 cascaded stages of amplifier. The input signal to the first stage amplifier is made up of 10 dBm input power and 1.7 μW of noise power. The first amplifier has a 22.67 dB of power gain and contributes an additional 231.5 μW of noise power. The second amplifier has an attenuation factor of 0.75 with 48 μW of input noise power and thermal noise internally. If the bandwidth of the signal is 50 MHz and operating temperature is 19 °C, determine:

(i) Thermal noise generated by 2nd amplifier.
(ii) Noise figure of 1st amplifier.
(iii) Power output from 2nd stage amplifier.
(iv) Input SNR in dB for 2nd amplifier.
(v) If the final output power from 3rd amplifier is set to 30dBm, what gain or attenuation factor (in dB) that the 3rd amplifier must have?

(12 marks)

(c) State three (3) types of losses in transmission line.

(3 marks)

(d) There are two types of commonly used transmission line. Briefly explain and list two (2) examples for each type.

(4 mark)

(e) A lossless coaxial cable at a frequency of 10 MHz has the following primary constants:

$L = 234$ nH/m
$C = 93.5$ pF/m
$R = 0.568\ \Omega$/m
$G \approx 0$

Determine:

(i) Characteristic impedance, Z_0
(ii) Propagation constant, γ

(4 marks)

Q6 (a) List the advantages and the disadvantages of ground wave propagation.

(2 marks)

(b) Sketch the diagrams of the normal propagation modes, ground wave, sky wave and space wave.

(4 marks)

(c) Explain the characteristics of a basic antenna array with its elements. Sketch and label the antenna array.

(7 marks)

(d) An antenna is to be installed to receive a LOS wave transmitted from a 0.15 km in height antenna located at a distance of 80,000 m from this installation. Determine the necessary height of the receiving antenna in km.

(3 marks)

(e) For a dielectric ratio $\sqrt{\varepsilon_{r2}/\varepsilon_{r1}} = 0.4$ and an angle of incident is 18°, determine the angle of refraction. Then find its critical angle.

(4 marks)

(f) Ground wave is one of the basic propagation modes in getting radio waves from the transmitting antenna to the receiving antenna.

(i) State two (2) applications of ground wave.
(ii) List three (3) disadvantages of ground wave propagation.

(5 marks)

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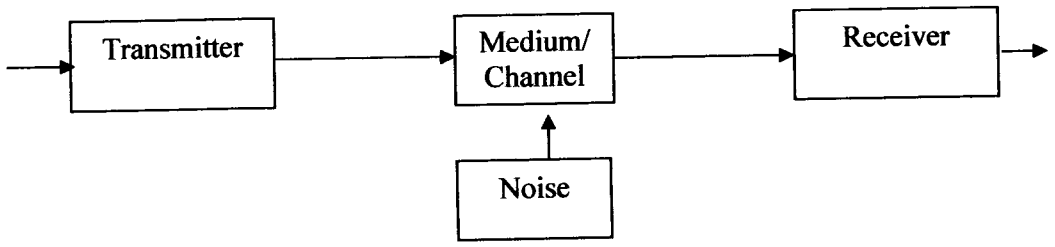

FIGURE Q1(a)(ii): Block Diagram of an Electronic Communication System

TABLE Q1(d): Frequency Allocations

Classification	Frequency. Range (Hz)
ELF	30 – 300
VF	300 – 3 K
VLF	3 K – 30 K
LF	30 K – 300 K
MF	300 K – 3 M
HF	3 M – 30 M
VHF	30 M -300 M
UHF	300 M – 3 G
SHF	3 G – 30 G
EHF	30 G – 300 G

Constant:

Speed of light, C = 3.01 x 10^8 m/s
Boltzmann, K = 1.38x10-23 J/K
Absolute temperature, T = 17°C or 290K

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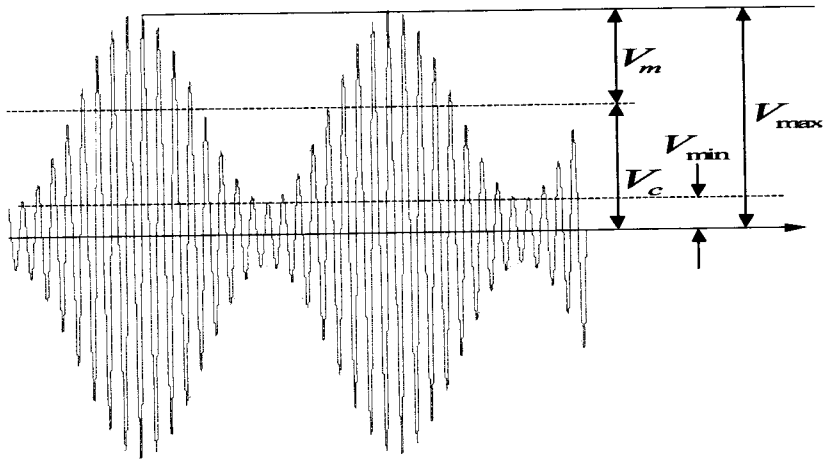

Figure Q2(c): AM Output Wave

TABLE Q4(c): Bessel Function

Modulation index	Carrier J_0	Sidebands									
		J_1	J_2	J_3	J_4	J_5	J_6	J_7	J_8	J_9	J_{10}
0.0	1.00	—	—	—	—	—	—	—	—	—	—
0.25	0.98	0.12	—	—	—	—	—	—	—	—	—
0.5	0.94	0.24	0.03	—	—	—	—	—	—	—	—
1.0	0.77	0.44	0.11	0.02	—	—	—	—	—	—	—
1.5	0.51	0.56	0.23	0.06	0.01	—	—	—	—	—	—
2.0	0.22	0.58	0.35	0.13	0.03	—	—	—	—	—	—
2.5	−0.05	0.50	0.45	0.22	0.07	0.02	—	—	—	—	—
3.0	−0.26	0.34	0.49	0.31	0.13	0.04	0.01	—	—	—	—
4.0	−0.40	−0.07	0.36	0.43	0.28	0.13	0.05	0.02	—	—	—
5.0	−0.18	−0.33	0.05	0.36	0.39	0.26	0.13	0.06	0.02	—	—
6.0	0.15	−0.28	−0.24	0.11	0.36	0.36	0.25	0.13	0.06	0.02	—
7.0	0.30	0.00	−0.30	−0.17	0.16	0.35	0.34	0.23	0.13	0.06	0.02
8.0	0.17	0.23	−0.11	−0.29	0.10	0.19	0.34	0.32	0.22	0.13	0.06