Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015

COURSE NAME	:	COMMUNICATION SYSTEM
COURSE CODE	:	DAR 31703
PROGRAMME	:	3 DAR
EXAMINATION DATE	:	DECEMBER 2014/ JANUARY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **NINE (9)** 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.

(iii) Briefly explain the term half duplex communication transmission. Sketch the block diagram.

(11 marks)

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

(i) Define Analog communication system and digital communication system

(ii) Sketch appropriate diagram for **Q1(b)(i)**

(4 marks)

(c) With reference to **Table Q1(c)**, the Ultrahigh Frequencies (UHF) signal is transmitted from an antenna with Signal to Noise Ratio (SNR) of 20 dB.

i) Calculate the UHF bandwidth.

ii) What is the channel capacity of the signal?

iii) From your point of view, what happens to the channel capacity if the SNR is reduced to 5dB?

(6 marks)

(d) 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)

Q2 (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.

(4 marks)

(b) Using a tree diagram, list the classification of the uncorrelated noise.

(7 marks)

(c) Determine the overall noise factor and noise figure for a three cascaded amplifiers as shown in **Figure Q2(c)**. Then, find the output Signal to Noise Ratio (SNR) in decibel (dB) at the final stage if the input SNR to the whole system is 16 dB.

(12 marks)

(d) Noise is an ever present part of all systems. Any receiver must contend with noise. In analog systems, noise deteriorates the quality of the received signal. Relate the effect of noise on the TV screen and audio transmission?

(2 marks)

Q3 (a) Modulation is a process of imposing information contained in a lower frequency onto a higher frequency signal.

(i) Define amplitude modulation (AM) and frequency modulation (FM).
(ii) Draw the carrier signal, modulating signal, AM signal and FM signal.

(6 marks)

(b) 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 Q3(b)**, calculate:

(i) The carrier frequency, f_c, modulating frequency, f_m and frequency deviation, Δf.
(ii) Number of sets of significant sideband, N and their voltage amplitudes
(iii) Modulation index, β and carrier swing, cs.
(iv) Bandwidth in the FM signal using Carson's Rule and Bessel Table.
(v) Express the FM signal mathematically for the carrier and modulating signal given.
(vi) Draw the frequency spectrum showing their relative amplitudes

(15 marks)

(c) Sketch and explain the usage of a limiter circuit in the discriminator of Frequency Modulation signal.

(4 marks)

Q4 (a) Draw and label correctly the block diagram of the digital data flow in data communication systems.

(6 marks)

(b) An audio frequency signal is band limited to a voice frequency limit, find:

(i) The minimum frequency required to sample the audio signal in order to be transmitted without aliasing.
(ii) The Nyquist interval and the bit rate if the voice signal is being sampled at 8 bits per sample.
(iii) Calculate the time required to send one bit of data.

(7 marks)

(c) There are three most common techniques used in digital modulation which are called the Amplitude Shift-Keying (ASK), Frequency Shift-Keying (FSK) and Binary Phase Shift-Keying (BPSK). If a digital message 10011010 is to modulate a carrier of 10kHz, show the resulting signals of these **three (3)** techniques by sketching the signals.

(6 marks)

(d) With the same message signal as in **Q4(c)**, sketch the encoded signal for Non Return-to-Zero-Mark (NRZ-M), Return-to-Zero unipolar (RZ-unipolar) and Differential Manchester coding scheme.

(6 marks)

Q5 (a) Transmission medium is a method or material substance which can propagate waves or energy. Briefly explain and give an example of each the medium types below:

(i) Guided
(ii) Unguided

(4 marks)

(b) Transmission line consists of two conductors separated from one another by a dielectric which may be either air or some kind of plastic. Describe **two (2)** types of transmission line that commonly used.

(6 marks)

(c) A coaxial cable has inductance of 32nH/m and capacitance of 120pF/m at 50MHz.The diameter of the inner conductor of the cable is 0.6 mm and the relative permittivity (ε_r) of the insulation is 2.23.

(i) Calculate the line impedance of the cable, Z_0.
(ii) Find the outer conductor diameter, d_1.
(iii) Calculate the velocity factor, v_f and propagation velocity, v_p for the cable .

(7 marks)

(d) Transmission line connects between a transmitter to the antenna or the antenna to the receiver. A perfect transmission line does not radiate any energy and does not have any losses.

(i) Briefly describe **three (3)** types of losses in transmission line.
(ii) Suggest a solution to reduce transmission line conductor losses.

(8 marks)

Q6 (a) Typically an antenna consists of an arrangement of metallic conductors (elements), electrically connected (often through a transmission line) to the receiver or transmitter.

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

(7 marks)

(b) The characteristics of radio wave are almost similar to the light waves which are the reflection, the refraction and the diffraction. Explain briefly each of the characteristics mentioned.

(6 marks)

(c) A radio wave moves from air ($\varepsilon_r = 1$) to glass ($\varepsilon_r = 5.8$) with angle of incidence 23^o. Assuming the relative permeability (μ_r) is unity. Calculate:

(i) Refraction angle, θ_2.
(ii) Critical angle, θ_c.

(6 marks)

(d) An electromagnetic wave is created by a local disturbance in the electric and magnetic fields. Wave propagation is any of the ways in which waves travel.

(i) Give the advantages and the disadvantages of ground wave propagation.
(ii) Sketch the diagrams of the normal propagation modes, ground wave, sky wave and space wave.

(6 marks)

- END OF QUESTION -

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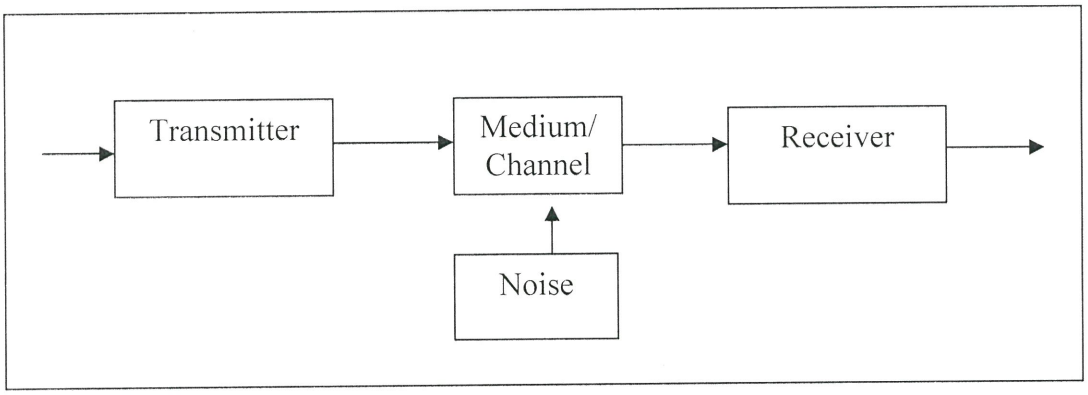

FIGURE Q1(a)(ii)

TABLE Q1(c): Frequency Allocations

Designation	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

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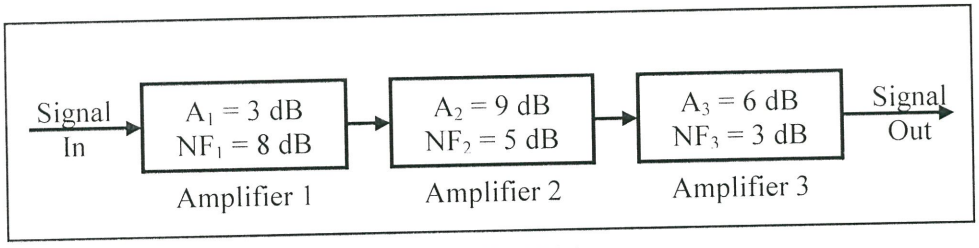

FIGURE Q2(c)

TABLE Q3(b): Bessel Function

Modulation index	Carrier	Sidebands									
	J_0	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

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Formulea:

$$C = BW \times \log_2\left(1+\frac{S}{N}\right)$$

$$F_T = F_1 + \frac{F_2 - 1}{A_1} + \frac{F_3 - 1}{A_1 A_2}$$

$NF_T = 10 \log 6.26$

$NF_T = SNR_{in} - SNR_{out}$

$$Z_0 = \sqrt{\frac{L}{C}}$$

$$Z_0 = \frac{276}{\sqrt{k}} \log \frac{d}{r}$$

$$Z_0 = \frac{138}{\sqrt{k}} \log \frac{d_1}{d_2}$$

$$v_f = \frac{1}{\sqrt{\varepsilon}}$$

$$v_p = v_f c$$

$c = 3 \text{ X } 10^8$

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	FM	PM
Modulated wave	$m(t) = V_c \cos\left[\omega_c t + \frac{K_1 V_m}{f_m}\sin(\omega_m t)\right]$	$m(t) = V_C \cos[\omega_c t + KV_m$
$\cos(\omega_m t)]$		
or	$m(t) = V_C \cos[\omega_c t + m \sin(\omega_m t)]$	$m(t) = V_C \cos[\omega_c t + m \cos(\omega_m t)]$
or	$m(t) = V_c \cos\left[\omega_c t + \frac{\Delta f}{f_m}\sin(\omega_m t)\right]$	$m(t) = V_C \cos[\omega_c t + \Delta\theta$
$\cos(\omega_m t)]$		
Deviation sensitivity	K_1 (Hz/V)	K (rad/V)
Deviation	$\Delta f = K_1 V_m$ (Hz)	$\Delta\theta = KV_m$ (rad)
Modulation index	$m = \frac{K_1 V_m}{f_m}$ (unitless)	$m = KV_m$ (rad)
or	$m = \frac{\Delta f}{f_m}$ (unitless)	$m = \Delta\theta$ (rad)
Modulating signal	$v_m(t) = V_m \sin(\omega_m t)$	$v_m(t) = V_m \cos(\omega_m t)$
Modulating frequency	$\omega_m = 2\pi f_m$ rad/s	$\omega_m = 2\pi f_m$ rad/s
or	$\omega_m/2\pi = f_m$ (Hz)	$\omega_m/2\pi = f_m$ (Hz)
Carrier signal	$V_C \cos(\omega_c t)$	$V_C \cos(\omega_c t)$