Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	ELECTRONIC COMMUNICATION SYSTEMS
COURSE CODE	:	BEJ 30103
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	DECEMBER 2019/ JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) Transmission impairments is defined as any undesired effect on the signals while traveling from a transmitter to a receiver. Explain **THREE (3)** transmission impairments in communication systems.

(6 marks)

(b) Describe briefly **THREE (3)** types of transmission mode in electronic communication and give **ONE (1)** example for each type.

(6 marks)

(c) Differentiate between baseband transmission and broadband transmission in electronic communication.

(3 marks)

(d) Determine the input signal power in dBW for an amplifier with an input noise power of 0.01 W, output signal power of 14 W, output noise power of 0.35 W, and noise figure of 5.4 dB.

(5 marks)

Q2 (a) Discuss the influence of temperature on thermal noise

(2 marks)

(b) An amplifier has a bandwidth of 30 MHz when it operates in temperature of 290 K. If the input noise is generated by a 50 Ω resistor,

(i) calculate the system's noise power and thermal noise voltage.

(2 marks)

(ii) Draw clearly the equivalent noise sources for thevenin representation.

(2 marks)

(iii) An input signal with a power of 0 dBm is fed into the amplifier. Calculate the signal to noise ratio (SNR) at the amplifier's equivalent noise temperature is 57 □.

(7 marks)

(c) A three stage cascaded amplifier for radio receiver system is shown in **Figure Q2(c)**. Suggest a new configuration to minimize the effect of noise.

(5 marks)

(d) State the reason why the proposed configuration in question **Q2(c)** is selected.

(2 marks)

Q3 (a) The simplest form of envelope detector is diode detector. Based on **Figure Q3(a)** explain the operation of the circuit and sketch the waveform for each node (a,b,c).

(10 marks)

(b) A frequency modulation (FM) signal is, $2000\sin(2\pi\times10^{8}t+2\sin\pi\times10^{4}t)$ V. The FM signal is applied to a 50Ω antenna. Determine

(i) the carrier frequency,

(1 mark)

(ii) the transmitted power,

(2 marks)

(iii) index modulation,

(1 mark)

(iv) bandwidth (BW),

(2 marks)

(v) power in the largest and smallest sidebands.

(2 marks)

Q4 (a) Explain the important of analog to digital conversion (ADC) in any modern communication systems.

(4 marks)

(b) With the aid of a diagram, describe the steps of analog to digital conversion.

(6 marks)

(c) A modulating signal m(t) of 3 kHz bandwidth is sampled at rate of 33.33 % higher than the Nyquist rate. The maximum allowable error in the sample amplitude is 0.5% of the peak amplitude m_p. Assume binary encoding is used, determine the minimum bandwidth of the channel to transmit the encoded binary signal.

(10 marks)

Q5 (a) Diffrentiate between balanced and unbalanced transmission line.

(6 marks)

(b) A microwave link is to be set up between two cities which are 100 km away. The link will operates at 3 GHz using two parabolic horn feed antenna at both the transmitter and receiver. The parabolas are 1 m in diameter and 80% efficient in radiating the input signal. If the input signal is 20 W, find the

(i) gain of the antennas,

(4 marks)

(ii) Equivalent isotropic radiated power (EIRP),

(2 marks)

(iii) power density at the receiver,

(2 marks)

(iv) free space loss,

(2 marks)

(v) output power from the receive antenna. State your assumption(s) if any.

(4 marks)

-END OF QUESTIONS –

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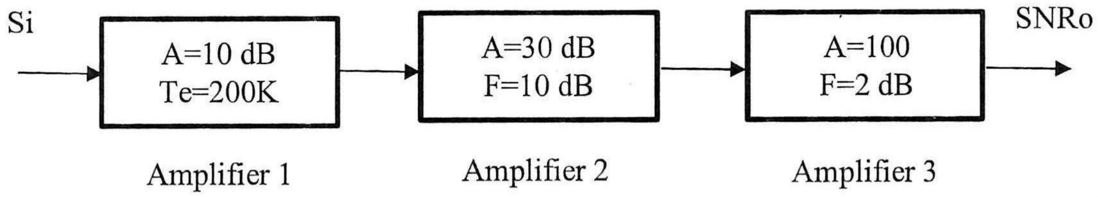

Figure Q2(c)

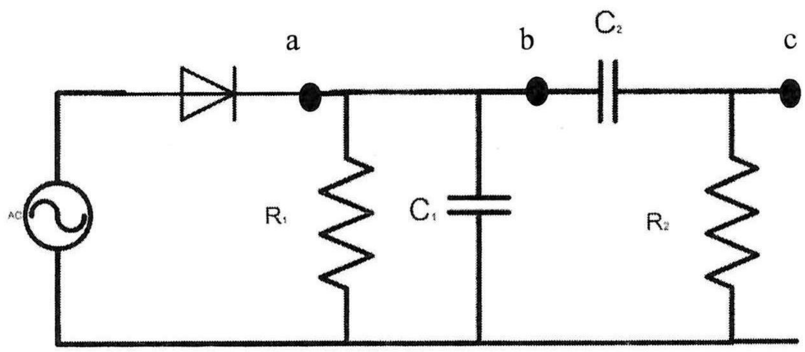

Figure Q3(a)

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Table 1: 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

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NOISE

$P_N = kTB$	$V_N = \sqrt{4RkTB}$	$\%TDH = \frac{v_{higher}}{v_{fundamental}} x100\%$	$cp = mf_1 \pm nf_2$
$SNR = \frac{P_S}{P_N}$	$F = \frac{SNR_i}{SNR_o}$	$SNR_o = \frac{A_p S_i}{A_p N_i}$	$T_e = T(F-1)$
$F_T = F_1 + \frac{F_2-1}{A_1} + \frac{F_3-1}{A_1A_2} + \ldots + \frac{F_n-1}{A_1A_2\ldots A_{n-1}}$		$T_e = T_1 + \frac{T_2}{A_1} + \frac{T_3}{A_1A_2} + \ldots + \frac{T_n}{A_1A_2\ldots A_{n-1}}$	
$F_{system} = 1 + \frac{(F_T-1)T_o}{T_i}$			

AMPLITUDE MODULATION

$$V_{AM} = V_C \sin 2\pi f_c t + \frac{V_m}{2}\cos 2\pi(f_c - f_m)t - \frac{V_m}{2}\cos 2\pi(f_c + f_m)t$$

$m = \frac{V_m}{V_C}$	$P_T = P_C\left(1 + \frac{m^2}{2}\right)$

FREQUENCY MODULATION

$m(t) = V_c \cos[\omega_c t + \frac{K_1V_m}{f_m}\sin(\omega_m t)$	$\Delta f = K_1V_m$	$m = \frac{K_1V_m}{f_m}$
$P_c = \frac{V_c^2}{2R}$		

DIGITAL MODULATION

$Q_{e(\max)} = \frac{resolution}{2}$	$DR = \frac{V_{\max}}{\text{Resolution}} = 2^n -$	$Sampling\ rate = 2 \times f_{highest}$	
$Bit\ rate = SR \times number\ of\ bits$		$BW_{pcm} \geq \frac{1}{2}BR$	$BW_{pcm} = BR$
$E_b = P_R T_b$	$N_0 = kT_N$	$C = 2BW \log_2 M$	$baud = \frac{C}{k}$

	ASK	FSK	PSK
Coherent	$P = \frac{1}{2} erfc\sqrt{\frac{E_b}{2N_0}}$		$P = \frac{1}{2} erfc\sqrt{\frac{E_b}{N_0}}$
Non-coherent	$P = \frac{1}{2} e^{-\frac{E_b}{2N_0}}$		$P = \frac{1}{2} e^{-\frac{E_b}{N_0}}$

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TRANSMISSION LINE and ANTENNA			
$\delta = \frac{1}{\sqrt{\pi f \mu_c \sigma_c}}$	$Z_0 = \sqrt{\frac{R + j\omega L}{G + j\omega C}}$	$\gamma = \alpha + j\beta$	$\beta = \frac{2\pi}{\lambda}$
$v_f = \frac{v_p}{c}$	$v_f = \frac{1}{\sqrt{\varepsilon_r}}$	$v_p = \frac{1}{\sqrt{LC}}$	$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0}$
$EIRP = P_{in} \times G_T$	$P_d = \frac{P_{in} G_T}{4\pi d^2}$	$FSL = 20\log\left(\frac{4\pi d}{\lambda}\right)$	$P_{out} = \frac{P_{in} G_T G_R}{\left(\frac{4\pi d}{\lambda}\right)^2}$