UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	COMMUNICATION ENGINEERING
COURSE CODE	:	DAE 32603
PROGRAMME CODE	:	DAE
EXAMINATION DATE	:	JULY 2024
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTIONS	:	1. ANSWER ALL QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ Closed book 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) Illustrate the block diagram for the communication engineering system.

(2 marks)

(b) Calculate the bandwidth for VHF (Very High Frequencies) in the frequency range from 30MHz to 300MHz.

(2 marks)

(c) Give the advantages and disadvantages of digital and analogue communication systems.

(4 marks)

(d) A load impedance of 125+j80 Ω terminates a 50 Ω transmission line that is 0.4λ long. Calculate:

(i) The reflection coefficient at the load.

(2 marks)

(ii) Signal-to-wave ratio, SWR on the line.

(2 marks)

(iii) The return loss.

(2 marks)

(iv) The percentage of power reflected by the transmission line.

(2 marks)

(v) Power transmitted by the transmission line.

(2 marks)

(e) An isotropic antenna is a point source that radiates electromagnetic energy at a constant rate in all directions.

(i) Calculate the power density 15 km away from an isotropic radiator radiating 10W of power.

(3 marks)

(ii) If the radiator is substituted with an antenna, the electric field strength increases by a factor of **two (2)**. Determine the antenna's gain in dBi.

(4 marks)

Q2 (a) List **six (6)** parameters used to evaluate the ability of a receiver to successfully demodulate radio signals.

(6 marks)

(b) A FM signal, $v_{FM}(t) = 25\cos(400\pi \times 10^6 t + 2.5\sin 4\pi \times 10^3 t)$ is transmitted to an antenna with an internal resistance of 50 Ω. By referring to **Table Q2.1**, determine :

Table Q2.1 Bessel Table

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

(i) Total power, P_T.

(2 marks)

(ii) Modulation index, β.

(1 mark)

(iii) Peak frequency deviation, f_d.

(3 marks)

(iv) Amplitude spectrum voltages.

(6 marks)

(v) Bandwidth using Bessel function table, BW_{Bessel}.

(2 marks)

(vi) Bandwidth using Carson's rule, BW_{Carson}.

(2 marks)

(vii) Sketch the FM signal in the frequency domain.

(3 marks)

Q3 (a) In general terms, noise can be defined as interference or interruption.

(i) Explain the definition of electrical noise.

(1 mark)

(ii) State **two (2)** examples of each type of uncorrelated noise.

(4 marks)

(iii) Find the thermal noise power in a signal with a bandwidth of 1500 MHz and temperature of 27°C. Given Boltzmann's constant is 1.38×10^{-23} J/K.

(4 marks)

(iv) Calculate the noise voltage, V_N for a 100 Ω internal resistance.

(2 marks)

(v) Differentiate between harmonic distortion and intermodulation distortion.

(4 marks)

(b) **Figure Q3.1** shows a three cascaded amplifier with dedicated gain and noise figure. Solve

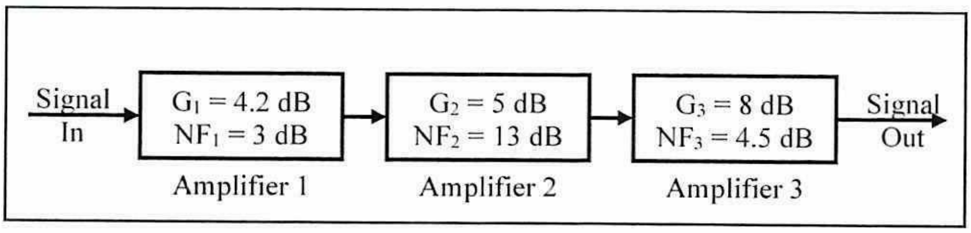

Figure Q3.1 The noise figure and power gain of the amplifier

(i) The overall noise factor and noise figure.

(8 marks)

(ii) The output Signal to Noise Ratio (SNR) in decibel (dB) at the final stage if the input SNR to the whole system is 40 dB.

(2 marks)

Q4 (a) Describe **five (5)** advantages of digital communication compared to analogue communication.

(5 marks)

(b) Amplitude shift keying (ASK) is the simplest digital modulation technique that contains digital information signal (v_m) and carrier signal (v_c) as shown in **Figure Q4.1**. If the carrier signal is $v_c(t) = 10 \sin 5000\, t$, find the possible output for the V_{ASK} signal.

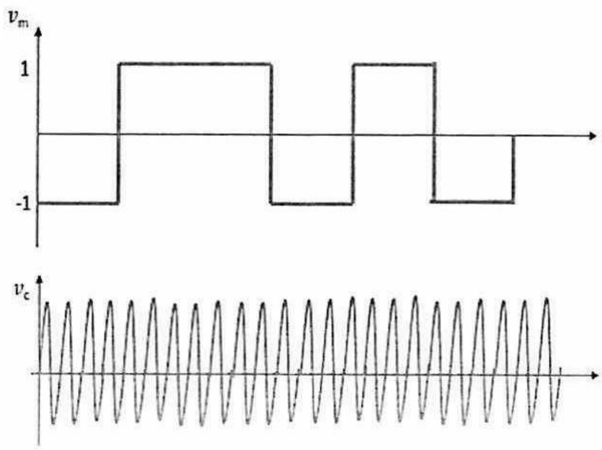

Figure Q4.1 Information signal and carrier signal

(4 marks)

(c) The analogue signal in **Figure Q4.2** is sampled with a frequency which is 20% higher than the Nyquist sampling rate. The bit rate of this Pulse Code Modulation (PCM) transmission is fixed at 720 kbps and the modulating frequency is 100 kHz.

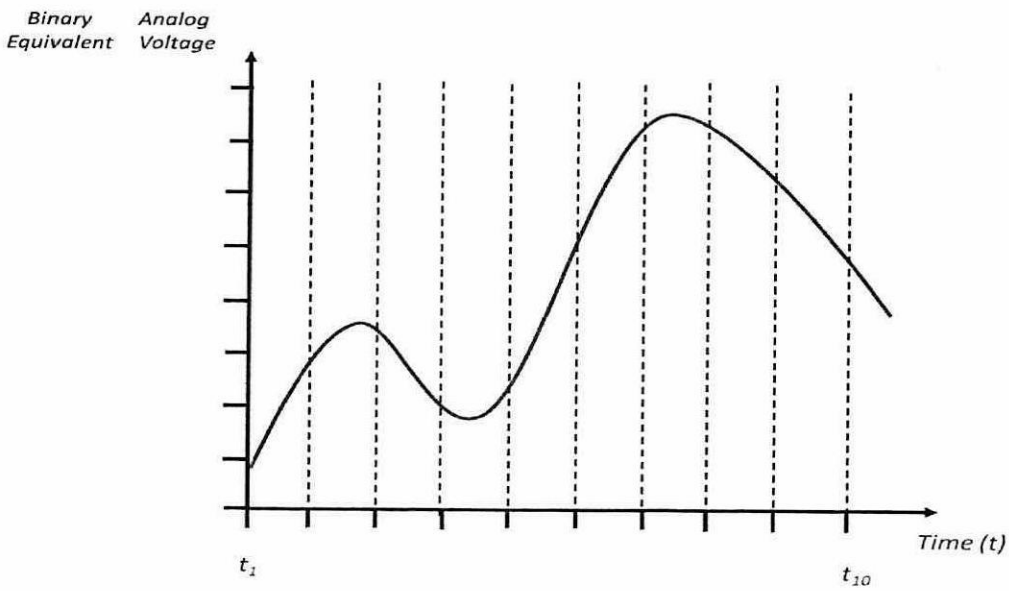

Figure Q4.2 Analogue Signal

(i) Determine the quantisation level.

(6 marks)

(ii) Based on the quantization level in **Q4(c)(i)**, find the corresponding voltage and binary equivalent for each time interval from t_1 to t_{10}. State your answer in **Table Q4.1**.

Table Q4.1 Answers table

Time	Analogue Voltage (V)	Binary Equivalent
t_1		
t_2		
t_3		
t_4		
t_5		
t_6		
t_7		
t_8		
t_9		
t_{10}		

(10 marks)

- END OF QUESTIONS -

LIST OF FORMULA

$V_{env} = V_c(1 + m \sin 2\pi f_m t)$	$m = \frac{V_m}{V_c}$ or $m = \frac{V_{\max} - V_{\min}}{V_{\max} + V_{\min}}$
$v_{AM} = V_c \sin 2\pi f_c t + \frac{V_m}{2} \cos 2\pi(f_c - f_m)t - \frac{V_m}{2} \cos 2\pi(f_c + f_m)t$	
$v_{FM} = Vc.\cos(\omega_c t + \beta \sin \omega_m t)$	$\beta = \frac{f_d}{f_m}$
$\beta = \frac{k_f V_m}{\omega_m}$	$BW = \frac{f_r}{Q}$
$BW = 2N f_m$	$BW = 2f_m(1 + \beta)$
$f_r = \frac{1}{2\pi\sqrt{LC}}$	$X_L = 2\pi\ f_r L$
$Q = \frac{X_L}{R}$	$S_L = \frac{V_{max} - V_{min}}{2^n}$
$f_s = 2f_m$	$v_{ASK} = [1 + v_m(t)] \cdot [V_c \sin(\omega_c t)]$
$v_{FSK} = V_c \sin(2\pi\ [f_c + v_m(t)\ \Delta f]t)$	$BR = SR\ x\ n$
$V_N = \sqrt{4RKTB}$	$SNR_{dB} = 10 log \frac{Ps}{Pn}$
$P_N = KTB$	$\Gamma = \frac{V_{max} - V_{min}}{V_{max} + V_{min}}$
$F_T = F_1 + \frac{F_2 - 1}{A_1} + \frac{F_3 - 1}{A_1 A_2} + \frac{F_N - 1}{A_1 A_2 \ldots A_{N-1}}$	$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0}$
$SWR = \frac{1 + \lvert\Gamma\rvert}{1 - \lvert\Gamma\rvert}$	$RL = -20\ log\lvert\Gamma\rvert$
$P_{reflect} = \lvert\Gamma\rvert^2 \times 100\%$	$P_{transmit} = 100\% - P_{reflect}$
$Z_0 = \frac{276}{\sqrt{\varepsilon_r}} \log \frac{d}{r}$	$Z_0 = \frac{138}{\sqrt{\varepsilon_r}} \log \frac{d_1}{d_2}$
$E = \frac{\sqrt{30 \times P_{rad} \times G}}{r}$	$P_d = \frac{P_{rad} \times G}{4\pi r^2}$
$P_d = E \times H = \frac{E^2}{120\pi}$	$P_d = \frac{P_t}{4\pi r^2}$

TERBUKA