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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(TAKE HOME)
SEMESTER II
SESSION 2020/2021

COURSE NAME	:	ELECTRONIC COMMUNICATION SYSTEMS
COURSE CODE	:	BEJ 30103 / BEB 31803
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER ALL QUESTIONS **OPEN BOOK EXAMINATION**

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

Q1 (a) Distinguish between baseband transmission and broadband transmission.

(4 marks)

(b) Television satellite broadcasting is a communication service that relays content distribution using broadcast signals from a communications satellite orbiting the earth directly to the viewer's location. Discuss its transmission mode.

(3 marks)

(c) A communication system is modelled as shown in **Figure Q1(c)** and consists of an amplifier and three cascaded attenuators. The loss stage, A_2 attenuates the incoming power to 90%. The combined of all attenuation in the system is -13.47 dB.

(i) Determine the gain of the amplifier, A_1 in absolute ratio.

(2 marks)

(ii) Examine the loss circuit, A_3 attenuation in dB.

(5 marks)

(iii) Calculate the total gain in dB for this system.

(2 marks)

(iv) If an offset is cascaded from the end of this system and the final output power is limited to half of amplifier A_1 output, propose the type of offset and value in dB.

(4 marks)

Q2 An analog receiver system consists of an antenna and three cascaded RF amplifiers as shown in **Figure Q2**. The system operates in the 17° C of environment temperature. The signal transmission bandwidth is set to 400 MHz.

(a) Determine the input Signal-to-Noise Ratio in dB.

(4 marks)

(b) Calculate the total noise factor.

(5 marks)

(c) Find the output signal power (S_o) in Watt and output noise power (N_o) in dBW.

(6 marks)

(d) The receiver output Signal-to-Noise Ratio can be improved by using a suitable configuration for the cascaded RF amplifiers system. In your opinion, which RF amplifier should be placed at the first stage and why? Prove your answer with mathematical calculation.

(5 marks)

Q3 (a) Given an FM wave as, $v_{FM}(t) = 10sin(200\pi \times 10^6 t + 0.5\cos(8\pi \times 10^3 t))$. From the experimental works of the circuit, the output frequency is proportionally increases with the increase of the input voltage, as tabulated in **Table Q3(a)**.

(i) Determine the frequency deviation K_f.

(2 marks)

(ii) Formulate an expression of the information signal $v_m(t)$.

(2 marks)

(iii) Determine the dissipated power if the signal is delivered through a 75 Ω load.

(2 marks)

(iv) Sketch and label the amplitude spectrum of the FM signal.

(4 marks)

(b) **Figure Q3(b)** shows the Narrowband FM Phase Modulator block diagram combined with a bandpass filter and a Multiplier. Given the carrier signal $v_c(t) = 50\cos(190\pi \times 10^5 t)$, the modulating signal $v_m(t) = 10\cos(20\pi \times 10^3 t)$ and frequency deviation sensitivity, $K_f = 0.7\ {kHz}/{V}$. Determine the following:

(i) Determine the frequency deviation, Δf and the modulation index, β_f.

(2 marks)

(ii) Produce the FM signal equation at point "A".

(6 marks)

(iii) The FM signal at "A" is passed through a bandpass filter to select the upper sideband. Then, the resulted signal is passed through the frequency multiplier with $N = 10$ to convert the signal to wideband FM. At point "B", determine the new carrier frequency, $f_{c(out)}$ and modulation index, $\beta_{f(out)}$.

(2 marks)

Q4 **Figure Q4** shows the combination of analog signals of $m_1(t)$ and $m_2(t)$. Analog to digital converter is used to encode the message signal within Pulse Code Modulation (PCM) technique. The uniform quantization voltage range is limited from -4 V to +4 V. The PCM encodes the message signal into 4-bits folded binary code and is sampled at two times above Nyquist rate.

(a) Determine the time interval between each sample of the message signal.

(2 marks)

(b) Find the resolution of quantization scheme.

(3 marks)

(c) Calculate the maximum quantization error, Q_e.

(1 marks)

(d) With an aid of a table, relate the 4-bits folded binary code with quantization range.

(6 marks)

(e) Predict the sequence of transmitted PCM code of message signal.

(8 marks)

Q5 (a) Transmission lines are considered to be impedance-matching circuits designed to deliver radio frequency (RF) power from the transmitter to the antenna, and maximum signal from the antenna to the receiver. Draw the general equivalent circuit of the transmission line.

(2 marks)

(b) As an RF engineer, you are required to analyze the transmission's attributes between two radio base stations that are separated at 300 km within line of sight and are operating at 1.2 GHz. Both stations used parabolic antenna with diameter of 2 meter but different efficiency. The following parameters are given for both transmitter and receiver respectively.

Transmitter:

- Transmitted power, $P_T = 15$ W
- 25 meter of transmission line connected to the transmitter antenna
- Input power to antenna, $P_{in} = 9.26$ dBW
- Antenna's efficiency, 80%

Receiver:

- 45 meter of transmission line connected to the receiver antenna with attenuation rate of 8 dB/100 m
- Antenna's efficiency, 90%

With reference to the information provided, solve for the followings:

(i) Calculate transmission line's loss at transmitter in dB.

(3 marks)

(ii) Effective Isotropic Radiated Power (EIRP) of the transmitter in dBW.

(4 marks)

(iii) Power density at receiver's antenna.

(3 marks)

(iv) Free space loss in dB.

(3 marks)

(v) Power received at the antenna in Watt.

(5 marks)

-END OF QUESTIONS -

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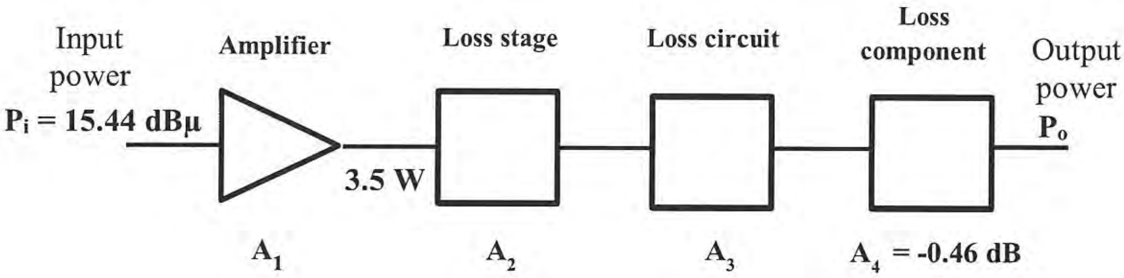

Figure Q1(c)

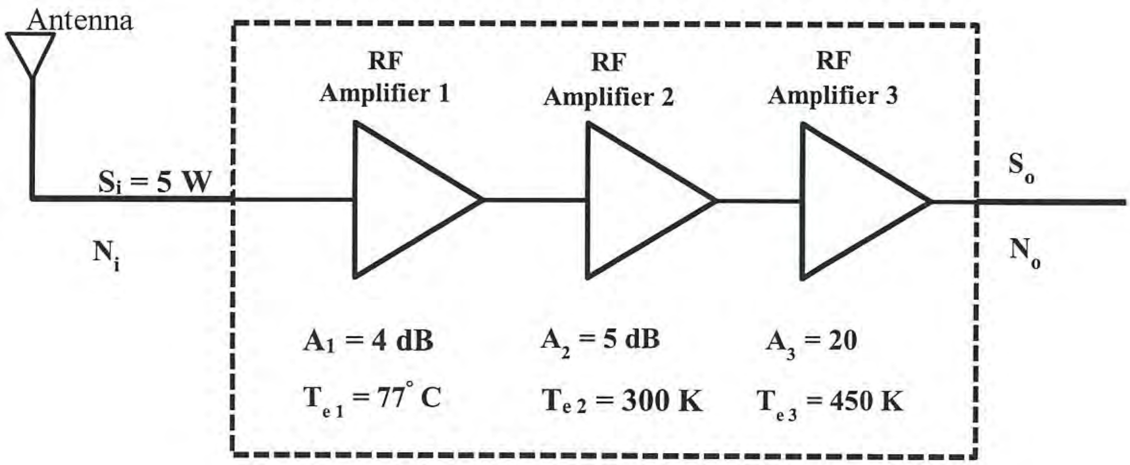

Figure Q2

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Table Q3(a)

Voltage (V)	0.25	0.50	0.75	1.0	1.25
Frequency (kHz)	1.0	2.0	3.0	4.0	5.0

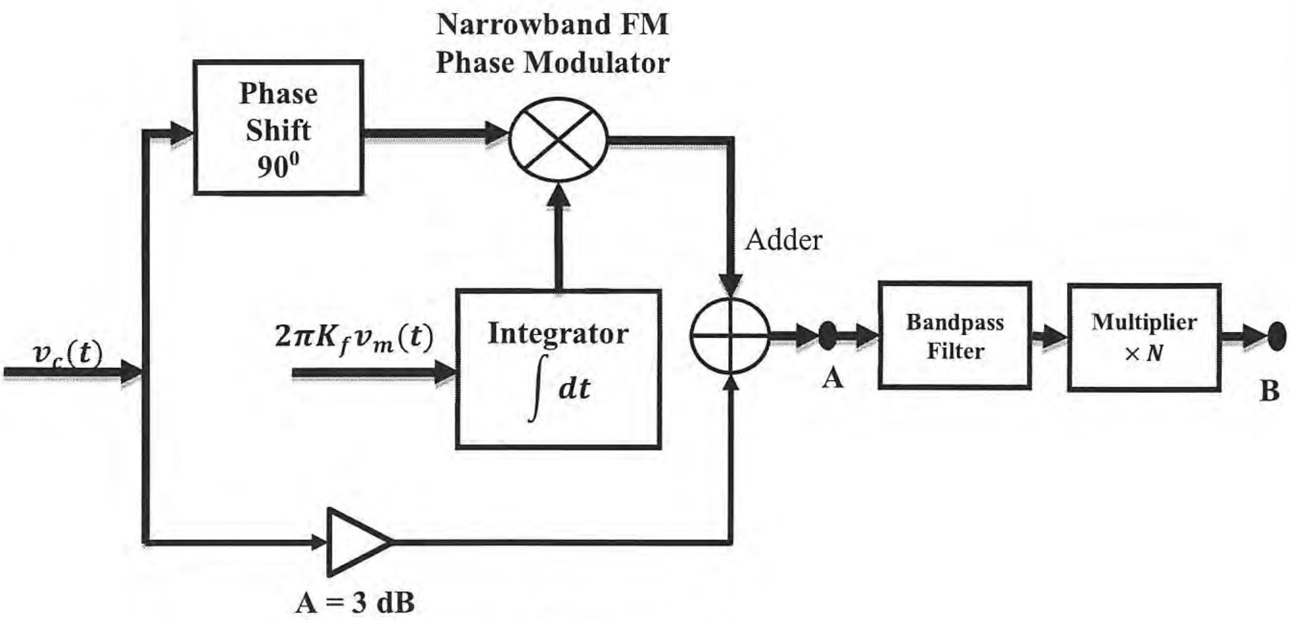

Figure Q3(b)

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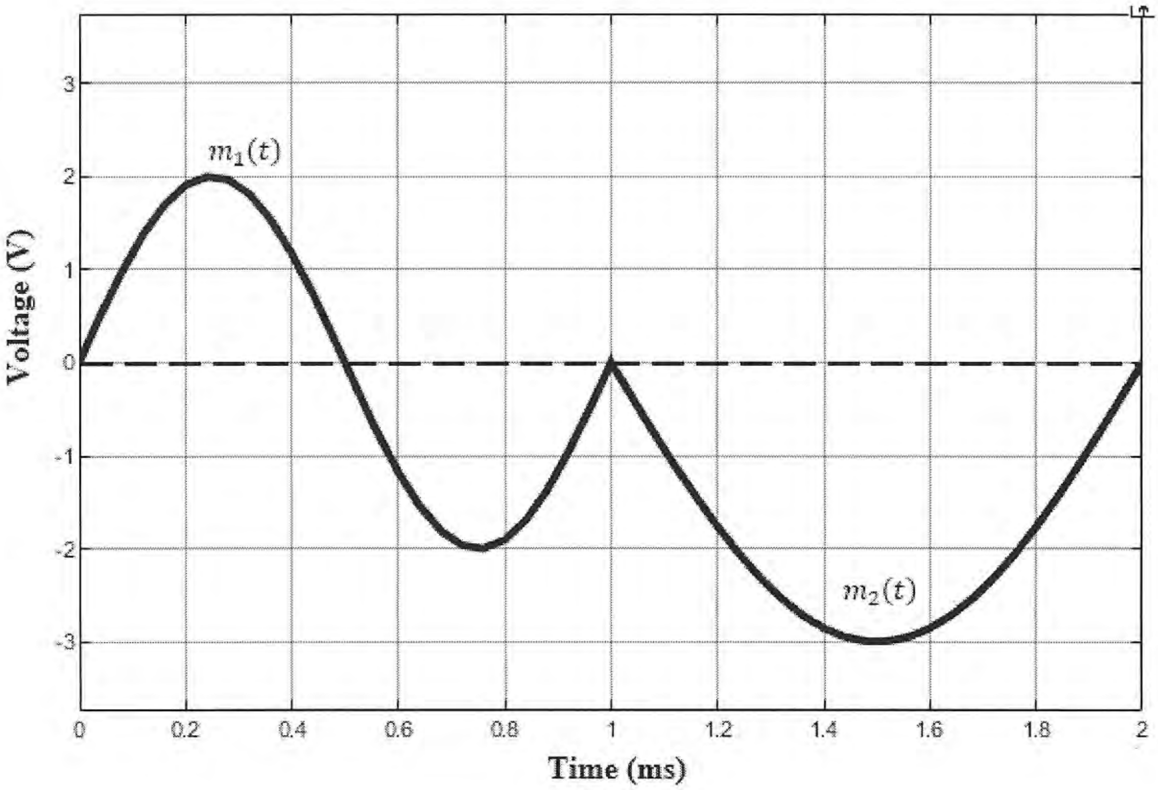

Figure Q4

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Bessel Function Table

Modulation index	Sideband																
	Carrier	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0.00	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												
2.41	0	0.52	0.43	0.20	0.06	0.02											
2.5	−0.05	0.50	0.45	0.22	0.07	0.02	0.01										
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	0.05	0.02								
5.53	0	−0.34	−0.13	0.25	0.40	0.32	0.19	0.09	0.03	0.01							
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	0.03					
8.65	0	0.27	0.06	−0.24	−0.23	0.03	0.26	0.34	0.28	0.18	0.10	0.05	0.02				
9.0	−0.09	0.25	0.14	−0.18	−0.27	−0.06	0.20	0.33	0.31	0.21	0.12	0.06	0.03	0.01			
10.0	−0.25	0.04	0.25	0.06	−0.22	−0.23	−0.01	0.22	0.32	0.29	0.21	0.12	0.06	0.03	0.01		
12.0	0.05	−0.22	−0.08	0.20	0.18	−0.07	−0.24	−0.17	0.05	0.23	0.30	0.27	0.20	0.12	0.07	0.03	0.01