

**CONFIDENTIAL**



**UTHM**  
Universiti Tun Hussein Onn Malaysia

**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER I  
SESSION 2014/2015**

COURSE NAME	:	COMMUNICATION ENGINEERING
COURSE CODE	:	DAE 32603
PROGRAMME	:	3 DAE
EXAMINATION DATE	:	DECEMBER 2014/ JANUARY 2015
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER <b>FOUR (4)</b> QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF NINE (9) PAGES

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- Q1** (a) An electromagnetic wave travels from the source to the destination in a complete system of communication.
- (i) Explain each element of the communication system. (4 marks)
- (ii) Sketch the block diagram of a transmitter. (2 marks)
- (b) There are **two (2)** types of medium in electronic communication system.
- (i) State both types. (2 marks)
- (ii) Gives an example of each type as in **Q1(b)(i)**. (2 marks)
- (c) With reference to **Table Q1(c)**, the Super High Frequency (SHF) signal is transmitted from an antenna with Signal to Noise Ratio (SNR) of 20 dB.
- (i) State **two (2)** applications of SHF. (2 marks)
- (ii) Calculate the SHF bandwidth. (2 marks)
- (iii) Calculate the channel capacity of the signal. (2 marks)
- (iv) From your point of view, shows what happens to the channel capacity if the SNR is increased to 30dB? (3 marks)
- (d) Signals travel in different ways. Explain with the aid of diagrams **three (3)** types of transmission modes. (6 marks)

- Q2** (a) Given an input to a conventional AM modulator is a 700 kHz carrier with amplitude of  $40 V_p$ . The second input is a 25 kHz modulating signal that is of sufficient amplitude to cause a change in the output wave of  $\pm 12.5 V_p$ . Determine;
- (i) Modulation coefficient,  $m$ . (2 marks)
  - (ii) Index modulation percentage,  $M$  (1 marks)
  - (iii) Upper and lower side frequency amplitude,  $V_{USB}$  and  $V_{LSB}$ . (1 marks)
  - (iv) Frequency limit for upper and lower sideband ( $f_{USB}$  and  $f_{LSB}$ ), (2 marks)
  - (v) Bandwidth,  $BW$ . (1 marks)
  - (vi) The total power of the AM wave,  $P_T$ , if load resistance  $R_L = 75 \Omega$ . (4 marks)
  - (vii) Sketch the output spectrum for this AM DSBFC (Double Sideband Full Carrier). (3 marks)
- (b) A Tuned Radio Frequency (TRF) receiver is to be designed with a single tuned circuit using a  $10\mu H$  inductor.
- (i) Calculate the capacitance range of the variable capacitor required to tune from 550 kHz to 1550 kHz. (5 marks)
  - (ii) The ideal 10 kHz bandwidth,  $BW$  is to occur at 1100 kHz. Determine the required selectivity,  $Q$ . (2 marks)
  - (iii) Calculate the bandwidth,  $BW$  of this receiver at 550 kHz and 1550 kHz. (4 marks)

- Q3** (a) Frequency modulation (FM) is considered to be superior to amplitude modulation (AM).
- (i) Give **three (3)** advantages of frequency modulation (FM). (3 marks)
- (ii) Give **two (2)** disadvantages of frequency modulation (FM). (2 marks)
- (b) An FM signal,  $v_{FM}(t) = 22 \sin(4\pi \times 10^8 t - 1.5 \cos 7\pi \times 10^3 t)$ , is applied to a  $63\Omega$  antenna. By referring to **Table Q3(b)**, determine the following :
- (i) Total power,  $P_T$ . (1 mark)
- (ii) Peak frequency deviation,  $\Delta f$ . (3 marks)
- (iii) Deviation sensitivity ( $k_f$ ), if 300 mV is require to achieved part **Q3(b)(ii)**. (2 marks)
- (iv) Amplitude spectrum voltages. (5 marks)
- (v) Bandwidth using Bessel table. (1 mark)
- (vi) Approximate bandwidth by Carson's rule. (1 mark)
- (vii) Sketch the FM signal spectra. (3 marks)
- (c) List **four (4)** types of FM demodulator circuits that you know. (4 marks)

- Q4** (a) Transmission line is a medium connection between transmitter to receiver in communication system. List **four (4)** types of transmissions line. (4 marks)
- (b) In general term, noise can be defined as interference or interruption.
- (i) Explain the definition of Electrical Noise (2 marks)
- (ii) Differentiate between the correlated and uncorrelated noise. (4 marks)
- (iii) Uncorrelated noise divided into two general categories, external and internal. State **two (2)** primary source of external noise and **two (2)** primary source of internal noise. (4 marks)
- (c) Determine the overall noise factor and noise figure for a three cascaded amplifiers as shown in **Figure Q4 (c)**. Then, find the input Signal to Noise Ratio (SNR) in decibel (dB) at the initial stage if the output SNR to the whole system is 53 dB. (11 marks)

- Q5** (a) 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)
- (b) A ground wave is a radio wave that travels along earth's surface. Give :
- (i) **Two (2)** advantages of ground wave propagation. (2 marks)
- (ii) **Three (3)** disadvantages of ground wave propagation. (3 marks)
- (c) An antenna is to be installed to receive a LOS wave transmitted from a 150m in height antenna located at a distance of 90 km from this installation. Determine the necessary height of the receiving antenna in km. (4 marks)
- (d) A submarine under the sea level sends a signal to a mainland station with an angle of  $63.5^\circ$  against the water surface. If the sea water has  $\epsilon_{r1} = 12$ ,  $\mu_{r1} = 0.45$  and the air has  $\epsilon_{r2} = 1$ ,  $\mu_{r2} = 6.5$ . Determine.
- (i) Sea water refraction index. (2 marks)
- (ii) Air refraction index. (2 marks)
- (iii) Angle of refraction. (2 marks)
- (iv) The critical angle. (2 marks)
- (v) The critical angle if the ratio between  $n_1 : n_2$  is 1 :20. (2 marks)

- Q6** (a) Antenna array is formed when two or more antenna elements are combined to form a single antenna. Antenna element is an individual radiator such as half or quarter wave dipole. Driven and parasitic are the **two (2)** types of element in antenna array.
- (i) Explain the function and the length of driven and parasitic element. (6 marks)
  - (ii) Sketch the diagram of antenna array. (3 marks)
- (b) Antenna polarization is the direction in space of electric vector of the electromagnetic wave from the antenna. List **three (3)** types of antenna polarizations. (3 marks)
- (c) In transmission line connection, a parallel wire cable has inductance of 32 nH/m and capacitance of 70 pF/m at 900MHz. The radius conductor of the cable is 0.584 mm and the relative permittivity ( $\epsilon_r$ ) of the insulation is 2.23. Solve:
- (i) Line impedance of the cable. (2 marks)
  - (ii) Distance between conductors. (3 marks)
  - (iii) Velocity factor. (2 marks)
  - (iv) Propagation velocity of the cable. (2 marks)
  - (v) Wavelength in free space. (2 marks)
  - (vi) Wavelength while travelling through the coaxial cable. (2 marks)

- END OF QUESTION -

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**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

**Table Q3(b): 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



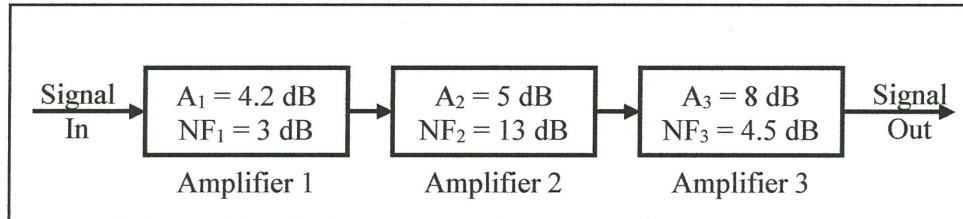
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**FIGURE Q4 (c)****List of formula:**

1. General equation for Frequency Modulation

$$v_{FM} = V_c \cos[\omega_c t + \beta \sin(\omega_m t)]$$

2. Formula for line impedance of coaxial and parallel wire cable.

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

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