First Semester Examination
2018/2019 Academic Session

December 2018/January 2019

EEE 332 – COMMUNICATION
(Perhubungan)

Duration : 3 hours
(Masa : 3 jam)

Please check that this examination paper consists of **FOUR TEEN (14)** pages and appendices **TWO (2)** pages of printed appendices material before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **EMPAT BELAS (14)** muka surat dan **DUA (2)** muka surat lampiran yang bercetak sebelum anda memulakan peperiksaan ini.]*
Kertas soalan ini mengandungi dua bahagian, **Bahagian A** dan **Bahagian B**.

Instructions: This question paper consists of **SIX (6)** questions. Answer **FIVE (5)** questions; **THREE (3)** from Section A and **TWO (2)** from Section B. All questions carry the same marks.

*[Arahan: Kertas soalan ini mengandungi **ENAM (6)** soalan Jawab **LIMA (5)** soalan : **TIGA (3)** daripada Bahagian A dan **DUA (2)** daripada Bahagian B. Semua soalan membawa jumlah markah yang sama]*

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]

PART A : Answer ALL question
Bahagian A : Jawab SEMUA soalan

1. (a) Communication system evolves from sending messages through smoke signals and homing pigeons to sending telegraphs and using internet. Name and elaborate the important elements of an electronic communication system. Include some useful block diagrams.

Sistem komunikasi berkembang daripada menghantar mesej melalui isyarat asap dan burung merpati kepada menghantar telegraf dan menggunakan internet. Namakan dan huraikan elemen yang penting di dalam sistem komunikasi elektronik. Masukkan gambarajah yang berguna.

(40 marks/*markah*)

(b) Determine the wavelengths in nanometers for all the following light frequencies. Assume the speed of light is $3\ x\ 10^8$ m/s. Describe the trend that you conclude from the calculations regarding frequency and wavelength.

Tentukan jarak gelombang di dalam nanometer untuk semua frekuensi cahaya yang berikut. Andaikan kelajuan cahaya adalah $3\ x\ 10^8$ m/s. *Terangkan trend yang boleh disimpulkan daripada kira-kira berkenaan frekuensi dan panjang gelombang tersebut.*

(i) $3.45\ x\ 10^{14}\ Hz$
(ii) $3.62\ x\ 10^{14}\ Hz$
(iii) $3.21\ x\ 10^{14}\ Hz$

(20 marks/*markah*)

(c) Identify the wireless system topology and the transmission mode of a radio and television broadcasting.

Kenal pasti topologi sistem tanpa wayar dan jenis penghantaran untuk penyiaran radio dan television.

(20 marks/*markah*)

(d) Discuss which type of transmitter is better between AM and FM transmitter and state the reason why.

Bincangkan yang manakah jenis penghantar yang lebih baik antara penghantar AM dan FM serta jelaskan sebab-sebabnya.

(20 marks/*markah*)

2. (a) (i) Briefly explain the AM modulation concept with the help of figure.
Terangkan secara ringkas konsep pemodulatan AM dengan bantuan gambarajah.

(5 marks/*markah)*

(ii) Discuss on the technique of AM diode detection.
Bincangkan teknik pengesan diod AM.

(5 marks/*markah)*

(iii) Explain how the information signal can be transmitted for a long distance.
Terangkan bagaimana isyarat maklumat boleh dipancar untuk jarak yang jauh.

(10 marks/*markah)*

(b) A Pulau Pinang FM radio transmitting a signal of $v_{FM} = 3\cos[90\pi\times10^6t + \cos(\pi\times10^3t)]$ using an 50 Ω antenna. Calculate:

Stesen radio FM Pulau Pinang memancarkan isyarat $v_{FM} = 3\cos[90\pi\times10^6t + \cos(\pi\times10^3t)]$ *menggunakan antenna 50 Ω. Hitung:*

(i) Carrier signal frequency.
Frekuensi isyarat pembawa.

(10 marks/*markah*)

(ii) Information signal frequency.
Frekuensi isyarat maklumat.

(10 marks/*markah*)

(iii) Transmitted power.
Kuasa yang dipancarkan.

(10 marks/*markah*)

(iv) Modulation index.
Indeks pemodulatan

(5 marks/*markah*)

(v) Frequency deviation.
Sisihan frekuensi.

(5 marks/*markah*)

(vi) Bandwidth based on Bessel function. (Refer to Appendix A)
Lebarjalur berdasarkan fungsi Bessel. (Rujuk kepada Lampiran A)

(10 marks/*markah)*

(c) AM radio transmitter transmitting an AM SSBFC with transmission power of 150 W. If the modulation index of the SSBFC is 70%, calculate:

Stesen pemancar radio AM memancarkan isyarat DSBFC dengan kuasa pemancaran 1500 W. Jika indeks pemodulatan DSBFC adalah 90%, hitung:

(i) Carrier power.
Kuasa pembawa.

(10 marks/*markah)*

(ii) If the mode of transmission has been changed to SSBFC, calculate the transmission power.

Sekiranya mod pemancaran ditukarkan ke SSBFC, hitung kuasa pemancaran.

(10 marks/*markah)*

(iii) If transmission mode has been changed to DSBSC, calculate the transmission power.

Sekiranya pemancaran ditukar ke DSBSC, hitung kuasa pemancaran.

(10 marks/*markah)*

3. (a) Explain the Pulse Amplitude Modulation (PAM) concept. Based on the analog signal and sample pulse given in Figure 1, sketch the output waveform for the Pulse Position Modulation (PPM), Pulse Amplitude Modulation (PAM) and Pulse Code Modulation (PCM).

Jelaskan konsep Pemodulatan Puncak Denyut (PAM). Berdasarkan bentuk gelombang analog dan sampel denyut di Rajah 1, lakarkan keluaran gelombang untuk Pemodulatan Posisi Denyut(PPM), Pemodulatan Puncak Denyut (PAM) dan Pemodulatan Kod Denyut (PCM).

(30 marks/*markah)*

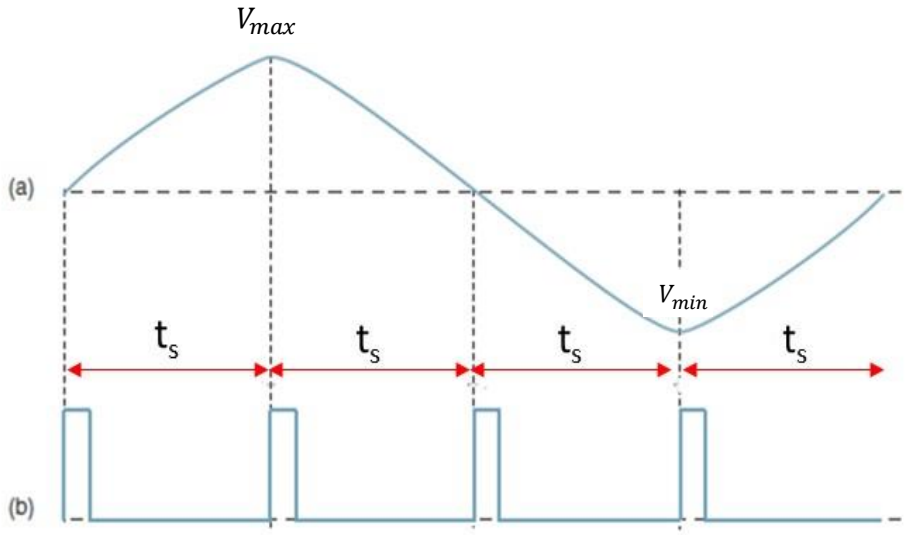


Figure 1 Pulse Modulation: (a) Analog Signal and (b) Sample Pulse

Rajah 1 Pemodulatan Denyut: (a) Gelombang Analog dan (b) Denyut Sampel

(b) List down four advantages of Digital Pulse Modulation compare to Analog Pulse Modulation.

Senaraikan empat kelebihan Pemodulatan Digital berbanding Pemodulatan Analog.

(20 marks/*markah)*

(c) Provide definition of Multiplexing. List down two advantages and disadvantages of Time Division Multiplexing (TDM).

Berikan definisi bagi pemultipleksan. Berikan dua kelebihan dan keburukan Pemultipleksan Pembahagian Masa (TDM).

(20 marks/*markah*)

(d) 8 channels, each with 5 kHz bandwidth are to be multiplexed together using Frequency Division Multiplexing (FDM).

8 saluran, setiap satu dengan 5 kHz lebar jalur akan dimultiplekskan bersama mengunakan Pemultipleksan Pembahagian Frekeunsi (FDM).

(i) Calculate the required bandwidth
Hitung lebar jalur dikehendaki.

(ii) Calculate the required bandwidth if guard band is 500 Hz
Hitung lebar jalur dikehendaki jika jalur kawal ialah 500 Hz.

(iii) Provide explanation about guard band.
Terangkan jalur kawal.

(30 marks/*markah*)

PART B : Answer TWO (2) question
BAHAGIAN B : Jawab DUA (2) soalan

4. (a) Superheterodyne receiver is the most commonly used type of receiver. Illustrate and describe a superheterodyne receiver. Include a sketch of block diagrams.

Penerima superheterodin ialah penerima yang paling banyak digunakan pada masa kini. Ilustrasikan dan terangkan penerima superheterodin. Masukkan ilustrasi gambarajah di dalam penerangan.

(40 marks/*markah*)

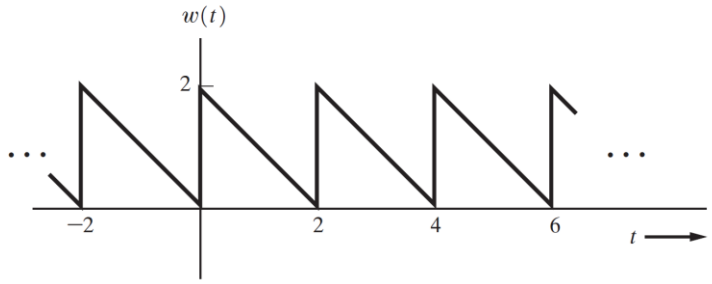
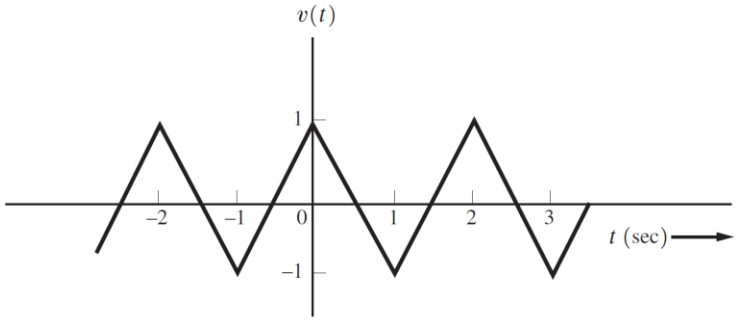
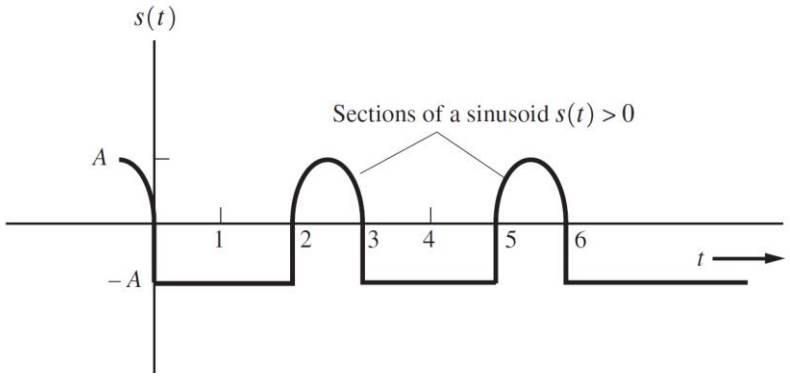
(b) Fourier analysis states that a square wave is made up of a sine wave at the fundamental frequency of the square wave plus an infinite number of odd harmonics.
Analisa Fourier menyatakan bahawa gelombang segiempat sama adalah terdiri daripada gelombang sinus pada frekuensi asasi dan harmonik ganjil yang infiniti.

Refer to other type of waveforms shown in Table 1 and analyze what type of waves made up the harmonics of each waveform.
Merujuk kepada jenis-jenis gelombang yang lain yang ditunjukkan di dalam Jadual 1 dan analisis jenis harmonik yang membentuk gelombang tersebut.

(30 marks/*markah*)

Table 1

Jadual 1

(i)	
(ii)	
(iii)	

(c) A fiber optic transmission is one of the wired types of channel that can be employed in a communication system. It offers high capacity and high-speed transmission but is not as cost effective as a wire copper transmission. Given a 20-km optical fiber link with the following parameters:
Penghantaran optik fiber ialah salah satu saluran yang menggunakan wayar dalam sistem komunikasi. Ia menawarkan penghantaran berkapasiti dan berkelajuan tinggi tetapi tidak semurah penghantaran wayar kuprum. Diberi kabel fiber optik sepanjang 20 km, dengan parameter berikut:

LED output power of 30 mW.
Kuasa keluaran LED sebanyak 30 mW
Four 5-km sections of optical cable each with a loss of 0.5 dB/km.
Empat seksyen dengan 5 km panjang kabel fiber optik dengan kehilangan sebanyak 0.5 dB/km
Three cable-to-cable connectors with a loss of 2 dB each.
Tiga penyambung kabel-ke-kabel dengan kehilangan sebanyak 2 dB setiap satu
Light source-to-fiber interface loss of 1.9 dB.
Kehilangan sumber cahaya-ke-fiber antara muka sebanyak 1.9 dB
Fiber-to-light detector loss of 2.1 dB.
Kehilangan pengesan fiber-ke-cahaya ialah sebanyak 2.1 dB
Assume there is no losses due to cable bends and no cable splices.
Andaikan tiada kehilangan disebabkan kabel bengkok dan tiada kabel sambat

(i) Calculate the cable loss and cable connector loss.
Anggarkan kehilangan di dalam kabel dan penyambung kabel.
(10 marks/*markah)*

(ii) Estimate the power the optical power received in mW.
Anggarkan kuasa keluaran optikal yang diterima di dalam mW.
(20 marks/*markah)*

5. (a) Explain three advantages of digital modulation in comparison with an analogue modulation.
Terangkan tiga kebaikan pemodulatan digital berbanding pemodulatan analog.
(20 marks/*markah)*

(b) Explain what the information capacity is according to Shannon rule.
Jelaskan apakah maksud kapasiti maklumat mengikut hukum Shannon.
(20 marks/*markah)*

(c) A telephone line is able to transmit an analog signal with a maximum power of 20 dBm and the noise on the line is at a level of -30 dBm. If the line will be used for digital signal transmission, how much information capacity can be transmitted according to Shannon rule. Bandwidth of the line is 3 kHz.
Suatu talian telefon boleh menghantar isyarat analog dengan kuasa maksima 20 dBm dan hingar pada talian tersebut berada pada paras – 30 dBm.
Sekiranya talian tersebut akan digunakan untuk penghantaran isyarat digital, berapakah kapasiti maklumat yang boleh dihantar mengikut hukum Shannon. Lebar jalur talian adalah 3 kHz.
(25 marks/*markah)*

(d) Explain how the ASK signal can be generated mathematically. Explain the usefulness of the ASK signal and the drawback.
Terangkan bagaimana isyarat ASK boleh dijana secara matematik. Nyatakan kegunaan isyarat ASK dan keburukannya.
(25 marks/*markah)*

(e) By using an appropriate diagram, explain what is the ASK, FSK and PSK signal.
Dengan menggunakan rajah yang bersesuaian, terangkan apakah isyarat ASK, FSK dan PSK.
(10 marks/*markah)*

6. (a) Explain function of sampling circuit in Pulse Code Modulation (PCM) transmitter. Explain one method of Pulse Code Modulation (PCM) sampling process. Sketch the natural and flat output waveform based on the given input waveform and pulse sample at Figure 2.

Terangkan fungsi litar pensampelan Pemodulatan Kod Denyut (PCM). Terangkan satu kaedah Pemodulatan Kod Denyut (PCM) pensampelan proses. Lakarkan 'natural' dan 'flat' keluaran gelombang berdasarkan input gelombang dan sampel denyut yang diberikan di Rajah 2.

(40 marks/*markah*)

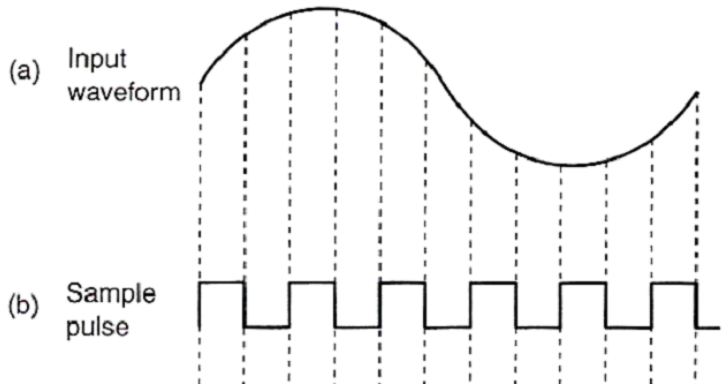


Figure 2

Rajah 2

(b) Explain the concept of Frequency Division Multiplexing (FDM).

Terangkan konsep Pemultipleksan Pembahagian-Masa (FDM).

(20 marks/*markah*)

(c) A set of parameters for a particular Pulse Code Modulation (PCM) system is given as the following;

Satu set parameter bagi sistem Pemodulatan Kod Denyut (PCM) tertentu diberikan seperti berikut;

Minimum dynamic range = 24 dB

Julat dinamik minima = 24 dB

Maximum analog input frequency = 10 kHz
Frekuensi masukan analog maksima = 10 kHz

Maximum decoded voltage at receiver = ± 3.00 V
Voltan ternyahkod maksima pada penerima = ± 3.00 V

Determine the following:
Tentukan yang berikut:

(i) Minimum sample rate.
Kadar sampel minima.

(5 marks/*markah*)

(ii) Minimum number of bits used in the PCM code.
Bilangan bit minima yang digunakan dalam kod PCM.

(20 marks/*markah*)

(iii) Resolution.
Resolusi.

(7.5 marks/*markah*)

(iv) Quantization error.
Ralat pengkuantuman.

(7.5 marks/*markah*)

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APPENDIX

LAMPIRAN

Course Outcomes (CO) – Programme Outcomes (PO) Mapping

Pemetaan Hasil Pembelajaran Kursus – Hasil Program

Questions ***Soalan***	**CO**	**PO**
1	1	1
2	2	2
3	3	1
4	1	2
5	2	2
6	3	1

APPENDIX A

LAMPIRAN A

Table 7-3 Bessel Functions of the First Kind, $J_n(m)$

Modulation Index	Carrier	Side Frequency Pairs													
m	J_0	J_1	J_2	J_3	J_4	J_5	J_6	J_7	J_8	J_9	J_{10}	J_{11}	J_{12}	J_{13}	J_{14}
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	—	—	—	—	—	—	—	—	—	—
2.4	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	—	—	—	—	—	—
5.45	0	−0.34	−0.12	0.26	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	0.05	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