UNIVERSITI MALAYSIA PERLIS

Peperiksaan Semester Kedua

Sidang Akademik 2017/2018

Mac 2018

DKT226 – Basic Communication Engineering

[Asas Kejuruteraan Perhubungan]

Masa : 3 jam

Please make sure that this question paper has **NINE (9)** printed pages including this front page before you start the examination.
*[Sila pastikan kertas soalan ini mengandungi **SEMBILAN (9)** muka surat yang bercetak termasuk muka hadapan sebelum anda memulakan peperiksaan ini.]*

This question paper has **FIVE (5)** questions. Answer **ALL** questions. (100 Marks)
*[Kertas soalan ini mengandungi **LIMA (5)** soalan. Jawab **SEMUA** soalan. (100 Markah)]*

Question 1
[Soalan 1]

(a) Discuss **FOUR (4)** elements of communication system.
*[Bincangkan **EMPAT (4)** unsur-unsur bagi sistem perhubungan]*

(8 Marks/ *Markah*)

(b) A student uses equipment in a communication laboratory to measure the output power for AM radio receiver. The AM receiver radio comprises of an amplifier, a filter and a mixer with absolute power gain of $A_1 = 200$, $A_2 = 0.5$ and $A_3 = 95$, respectively. Given the input power P_{in} is 32 dBm, determine:
[Seorang pelajar telah menggunakan peralatan di dalam makmal perhubungan untuk mengukur kuasa keluaran bagi radio penerima AM. Radio penerima AM terdiri daripada satu penguat, satu penapis dan satu pencampur dengan gandaan kuasa mutlak masing-masing adalah $A_1 = 200$, $A_2 = 0.5$ dan $A_3 = 95$. Diberi kuasa masukan P_{in} ialah 32 dBm, tentukan:]

(i) The input power, P_{in} in mW.
[Kuasa masukan, P_{in} dalam mW.]

(1 Mark/ *Markah*)

(ii) The overall gain, A_t (dB) for AM receiver radio.
[Gandaan keseluruhan, A_t (dB) bagi radio penerima AM.]

(2 Marks/ *Markah*)

(iii) The output power, P_{out} in Watts and dBm.
[Kuasa keseluruhan, P_{out} dalam Watt dan dBm.]

(2 Marks/ *Markah*)

(c) Thermal noise is a kind of noise that is associated with the rapid and random movement of electrons within a conductor due to thermal agitation. For an amplifier operating at a temperature of 18^0C with a bandwidth of 20 kHz, determine: (Given the Boltzman constant, $k = 1.38 \times 10^{-23}$ J/K)
[Hingar haba adalah satu jenis hingar yang mana berkaitan dengan pergerakan laju dan rawak elektron-elektron dalam satu konduktor disebabkan oleh pengadukan haba. Untuk satu penguat yang beroperasi pada suhu 18^0C dengan lebarjalur 20 kHz, tentukan: (Diberi Pemalar Boltzman, $k = 1.38 \times 10^{-23}$ J/K)]

(i) The thermal noise power in Watts and dBm.
[Kuasa hingar haba dalam Watt dan dBm].

(2 Marks/ *Markah*)

(ii) The RMS noise voltage for a 100-Ω internal resistance and a 100-Ω load resistance.
[Voltan hingar RMS untuk rintangan dalam 100-Ω dan rintangan beban 100-Ω].

(1 Mark/ *Markah*)

....3/-

(d) Modulation is performed in a transmission by a circuit called a modulator. Justify **FOUR (4)** reasons why modulation is needed in a communication system.
*[Pemodulatan dilakukan dalam satu penghantaran oleh satu litar yang dipanggil pemodulat. Wajarkan **EMPAT (4)** sebab kenapa pemodulatan diperlukan dalam sesuatu sistem perhubungan.]*
(4 Marks/ *Markah*)

advantages :

1. channel assignment.
2. reduction of noise and interference.
3. increase transmission speed.
4. for ease radiation and reduction of antenna size.

a) 3 mode:

① Ground wave.
- used for a low-frequency large transmission (less than 1 MHz).

② Sky wave.
- used for the propagation of EM wave with a frequency range of 3–30 MHz.

③ Space wave.
- used for a line of sight communication (LOS).
- very high frequency.

b) overall power gain, A_{PT}.

(i)

$A_{PT} = 15\,dB + (-8\,dB) + 60\,dB$.

$= 67\,dB$.

(ii) Noise factor:

$NF_1 = \text{antilog}\left(\frac{15\,dB}{10}\right)$

$= 31.62$

$NF_2 = \text{antilog}\left(\frac{-8\,dB}{10}\right)$

$= 0.158$

$NF_3 = \text{antilog}\left(\frac{60\,dB}{10}\right)$

$= 20$.

Overall noise figure,

$= F_1 + \left(\frac{F_2 - 1}{A_2}\right) + \left(\frac{F_3 - 1}{A_1 A_2}\right)$

$= 10 + \left(\frac{31.62 - 1}{-8}\right) + \left(\frac{20 - 1}{(-8)(15)}\right)$

$= 10 + (-3.83) + (-0.158)$

$= 6.012$.

$10 \log 6.012 = 7.79$ dB.

(c) A telecommunication technician is given a task to assess the output power levels of a conventional AM transmitter with respect to different kind of modulation modes with the same intelligibility received. Given that the antenna transmits a 13.2 kW of total power at 75% modulation, determine:

[Seorang juruteknik telekomunikasi telah diberi tugas untuk menilai tahap-tahap keluaran kuasa suatu alat pemancar dengan pemodulatan yang berbeza dengan penerimaan kebolehfahaman yang sama. Diberi antenna memancar jumlah kuasa sebanyak 13.2 kW pada pemodulatan 75%, tentukan:]

(i) The total power, P_t delivers through the antenna.
[Jumlah kuasa, P_t yang dihantar melalui antena tersebut.]

(2 Marks/ *Markah*)

(ii) The total power using Double-Side Band Suppressed Carrier (DSBSC).
[Jumlah kuasa menggunakan Jalur Sisi Kembar Pembawa Tertindas (DSBSC).]

(2 Marks/ *Markah*)

(iii) The percentage of power saving of Single-Side Band Full Carrier (SSBFC) compares to Doube-Side Band Full Carrier (DSBFC).
[Peratus penjimatan kuasa Jalur Sisi Tunggal Pembawa Penuh (SSBFC) berbanding dengan Jalur Sisi Kembar Pembawa Penuh (DSBFC).]

(2 Marks/ *Markah*)

Question 3
[Soalan 3]

(a) A radio broadcasting station using AM with its carrier frequency of 500 kHz is amplitude-modulated by a single-tone modulating frequency of 5 kHz to produce an AM modulated wave. The maximum and minimum peak voltages of the envelope are 20 V_p and 4 V_p respectively. Determine:
[Satu stesen penyiaran radio menggunakan AM dengan frekuensi pembawa 500 kHz termodulat amplitude oleh satu-nada frekuensi pemodulat 5 kHz untuk menghasilkan gelombang termodulat AM. Voltan puncak maksimum dan minimum sampul tersebut masing-masing ialah 20 V_p dan 4 V_p. Tentukan:]

(i) The peak amplitudes of the audio, carrier and sideband voltages.
[Amplitud puncak voltan bagi audio, pembawa dan jalur sisi.]
(3 Marks/ *Markah*)

(ii) The modulation index, m and percentage modulation.
[Indeks pemodulatan, m dan peratus pemodulatan.]
(2 Marks/ *Markah*)

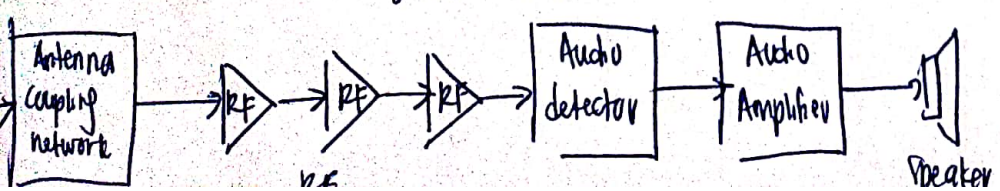
(iii) The frequency limits for the upper and lower sidebands.
[Had frekuensi jalur bahagian atas dan bawah.]
(2 Marks/ *Markah*)

(iv) The bandwidth of the modulated signal.
[Lebarjalur isyarat termodulat.]
(1 Mark/ *Markah*)

(v) According to the above values, construct the output AM envelope with complete labels.
[Berdasarkan nilai-nilai di atas, binakan keluaran sampul AM dengan label yang lengkap.]
(4 Marks/ *Markah*)

(vi) Sketch and label the frequency spectrum of the modulated signal.
[Lakar dan label spektrum frekuensi isyarat termodulat.]
(3 Marks/ *Markah*)

(b) There are two basic types of radio receivers in amplitude modulation (AM), namely coherent and non-coherent radio receiver. Tuned Radio Frequency (TRF) receiver and superheterodyne receiver are the examples of non-coherent receiver. With the aid of a suitable diagram, discuss the basic operation of Tuned Radio Frequency (TRF) receiver.
[Terdapat dua jenis penerima radio asas di dalam penggunaan pemodulatan amplitud iaitu jelas dan tidak-jelas. Contoh bagi penerima tidak-jelas ialah frekuensi radio tertala (TRF) dan superheterodin. Dengan bantuan rajah yang sesuai, bincangkan operasi asas penerima frekuensi radio tertala (TRF).]
(5 Marks/ *Markah*)



Question 4
[Soalan 4]

(a) There are **TWO (2)** methods in generating Frequency Modulation (FM) signal. Differentiate the two methods and give **TWO (2)** example circuits for each method.
*(Terdapat **DUA (2)** kaedah untuk menghasilkan isyarat Frekuensi Pemodulatan (FM). Bezakan dua kaedah tersebut dan berikan **DUA (2)** contoh litar bagi setiap kaedah.]*

(8 Marks/ *Markah*)

(b) Given an FM modulated waveform $V_{FM}(t) = 4\cos[(8.6 \times 10^5)\pi t + 2\sin(27 \times 10^3)\pi t]$ is transmitted through an antenna with a load resistance $R_L = 15\ \Omega$. By referring to the Bessel Function Table in Appendix 1, answer the following questions:
[Diberi satu gelombang pemodulatan FM, $V_{FM}(t) = 4\cos[(8.6 \times 10^5)\pi t + 2\sin(27 \times 10^3)\pi t]$ yang dipancarkan melalui satu antena yang mempunyai rintangan beban $R_L = 15\ \Omega$. Dengan merujuk kepada Jadual Fungsi Bessel di dalam Lampiran 1, jawab soalan-soalan berikut:]

(i) Determine the carrier frequency, f_c, modulating frequency, f_m and modulation index, m_f.
[Tentukan frekuensi pembawa, f_c, frekuensi pemodulat, f_m dan indeks pemodulatan, m_f.]

(3 Marks/ *Markah*)

(ii) Determine the relative amplitudes of the carrier and side frequencies.
[Tentukan amplitud nisbi bagi pembawa dan sisi frekuensi.]

(5 Marks/ *Markah*)

(iii) Determine the total power in modulated carrier, P_t.
[Tentukan jumlah kuasa dalam pembawa termodulat, P_t.]

(1 Mark/ *Markah*)

(iv) Produce the power spectrum of the modulated output wave with their respective power amplitudes.
[Hasilkan spektrum kuasa gelombang keluaran modulatan untuk setiap kuasa amplitud yang berkenaan.]

(3 Marks/ *Markah*)

i) $v_{FM}(t) = 4\cos[(8.6\times10^5)\pi t + 2\sin(27\times10^3)\pi t]$ (f_c, f_m)

$2\pi f_c = 8.6\times10^5\ \pi$

$f_c = \frac{8.6\times10^5}{2}$

$f_c = 4.3\times10^5\ Hz$

$2\pi f_m = 27\times10^3\ \pi$

$f_m = \frac{27\times10^3}{2}$

$= 13.5\ kHz$

$m_f = \frac{\Delta f}{f_m}$

$m_f = 2$

$\therefore n = 4$

ii) $P_t = \frac{V_0}{2R} + \frac{2(V_1)^2}{2R} + \frac{2(V_2)^2}{2R} \ldots$

$= \frac{(0.88)^2}{2(15)} + \frac{2(2.2)^2}{2(15)} + \frac{2(0.6)^2}{2(15)} + \frac{2(0.44)^2}{2(15)} + \frac{2(0.12)^2}{2(15)}$

$\approx 2.2 \quad 1.8 \quad 1.3 \quad 0.1 \quad 0.02$

$= 3W$

i) $J_0 = (0.22)(4) = 0.88V$
$J_1 = (0.55)(4) = 2.2V$
$J_2 = (0.15)(4) = 0.6V$
$J_3 = (0.11)(4) = 0.44V$
$J_4 = (0.03)(4) = 0.12V$

iv)

Question 5
[Soalan 5]

(a) Frequency-shift keying (FSK) is another relatively simple, low-performance type of digital modulation. For a binary FSK signal with a mark frequency of 49 kHz, a space frequency of 51 kHz, and an input bit rate of 2 kbps, determine:
[Penguncian anjakan frekuensi (FSK) merupakan sejenis pemodulatan digital berprestasi rendah dan mudah. Bagi isyarat perduaan FSK dengan frekuensi tanda 49 kHz, ruang frekuensi 51 kHz dan kadar bit adalah 2 kbps, tentukan:]

(i) Peak frequency deviation, Δf.
[Sisihan frekuensi puncak, Δf.]

(2 Marks/ *Markah*)

(ii) Minimum bandwidth.
[Lebarjalur minimum.]

(2 Marks/ *Markah*)

(iii) Baud value.
[Nilai baud.]

(1 Marks/ *Markah*)

(b) There are **TWO (2)** basic techniques used to perform the sampling function in digital modulation namely natural and flat-top sampling.
*[Terdapat **DUA (2)** teknik asas yang digunakan untuk melakukan fungsi pensampelan dalam pemodulatan digital yang iaitu pensampelan semulajadi dan atas-rata.]*

(i) Differentiate the **TWO (2)** techniques as mentioned above.
*[Bezakan **DUA (2)** teknik seperti yang disebutkan di atas.]*

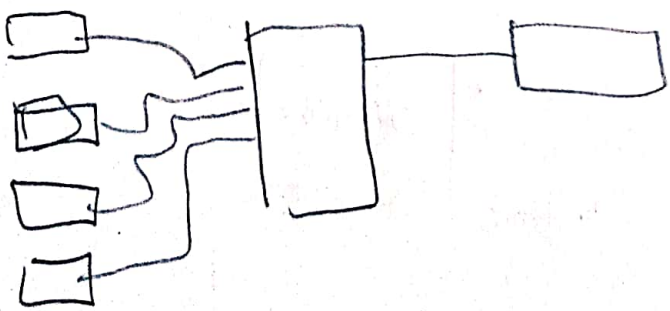
(4 Marks/ *Markah*)

(ii) Sketch and label the output waveform of signals to show the two techniques.
[Lakar dan labelkan bentuk-bentuk isyarat yang menggambarkan dua teknik tersebut.]

(4 Marks/ *Markah*)

(c) With the aid of a block diagram, discuss the transmitting end of a Frequency Division Multiplexing (FDM) system in multiplexing the signals.
[Dengan bantuan gambar rajah blok, bincangkan hujung pengantar bagi sesuatu Permultipleksan Pembahagi Frekuensi (FDM) dalam permultipleksan isyarat.]

(7 Marks/ *Markah*)



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Appendix 1
[Lampiran 1]

Table 1: Bessel Function Table:
[Jadual 1: Jadual Fungsi Bessel:]

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