UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2016/2017 Academic Session

June 2017

EAP318 – Noise Pollution Control
[*Kawalan Pencemaran Bunyi*]

Duration : 2 hours
[*Masa : 2 jam*]

Please check that this examination paper consists of **NINE (9)** pages of printed materials including appendix before you begin the examination.
[*Sila pastikan kertas peperiksaan ini mengandungi **SEMBILAN (9)** muka surat bercetak termasuk lampiran sebelum anda memulakan peperiksaan ini.*]

Instructions: This paper consists of **FIVE (5)** questions. Answer **FOUR (4)** questions only.
[***Arahan**: Kertas ini mengandungi **LIMA (5)** soalan. Jawab **EMPAT (4)** soalan sahaja.*]

All questions **CAN BE** answered in English or Bahasa Malaysia or combination of both languages.
[*Semua soalan **BOLEH** dijawab dalam Bahasa Inggeris atau Bahasa Malaysia atau kombinasi kedua-dua bahasa.*]

All questions **MUST BE** answered on a new page.
[*Semua soalan **MESTILAH** dijawab pada muka surat baru.*]

Write the answered question numbers on the cover sheet of the answer script.
Tuliskan nombor soalan yang dijawab di luar kulit buku jawapan anda.

In the event of any discrepancies, the English version shall be used.
[*Sekiranya terdapat percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.*]

1. [a] By giving a suitable example, prove that sound wave propagates in circular motion.

Dengan memberikan satu contoh yang sesuai, buktikan bahawa gelombang bunyi tersebar dalam pergerakan bulatan.

[6 marks/*markah*]

[b] With the help of a sketch diagram, describe 'short wave' and 'long wave' in relation to their wavelength and frequency.

Dengan bantuan lakaran kasar, terangkan 'gelombang pendek' dan 'gelombang panjang' yang berkaitan dengan jarak gelombang dan frekuensinya.

[6 marks/*markah*]

[c] Calculate the speed of a sound that travels at a frequency of 9,000 cycles/second and wavelength of 0.3 m.

Kira kelajuan bunyi yang bergerak pada frekuensi 9,000 pusingan/saat dengan jarak gelombang 0. 3 m.

[5 marks/*markah*]

[d] The following ideal noise levels in dB (A) were generated independently in a control room: 67, 85, 73, 80, 77. If all the sources are mixed at the same time, calculate the composite Sound Pressure Level (Lp) that will be heard.

Paras bunyi ideal berikut dalam dB (A) dijana secara berasingan dalam bilik kawalan: 67, 85, 73, 80, 77. Sekiranya kesemua sumber bunyi ini digabungkan pada masa yang sama, kirakan Paras Tekanan Bunyi (Lp) komposit yang bakal didengari.

[8 marks/*markah*]

2. [a] Differentiate between sound intensity and Sound Intensity Level.

Bezakan di antara keamatan bunyi dan Paras Keamatan Bunyi.

[6 marks/*markah*]

[b] Given that a Sound Power Level from a generator is 95 dB. Determine the sound intensity and Sound Intensity Level which will be heard by a person who stands 20 m away from the source.

Diberi bahawa Paras Kuasa Bunyi dari suatu janakuasa adalah 95 dB. Tentukan keamatan bunyi dan Paras Keamatan Bunyi yang akan didengari oleh seseorang yang berdiri 20 m dari sumber bunyi ini.

[9 marks/*markah*]

[c] There are many types of noise analyses. Define 'Phone' and state one of its applications in civil engineering.

Terdapat berbagai jenis analisis bunyi. Definisikan 'Phon' dan nyatakan satu dari aplikasinya dalam kejuruteraan awam.

[5 marks/*markah*]

[d] Using the Equivalent Noise Level Contour given in **Figure 1**, determine the noise level in dB at 100 Hz, if its level at the referenced frequency is 70 dB (70 Phone). Comment your answer.

*Menggunakan Kontur Paras Bunyi Setara dalam **Rajah 1**, tentukan paras bunyinya dalam dB pada 100 Hz, jika parasnya pada frekuensi rujukan standard adalah 70 dB (70 Phon). Komen jawapan anda.*

[5 marks/*markah*]

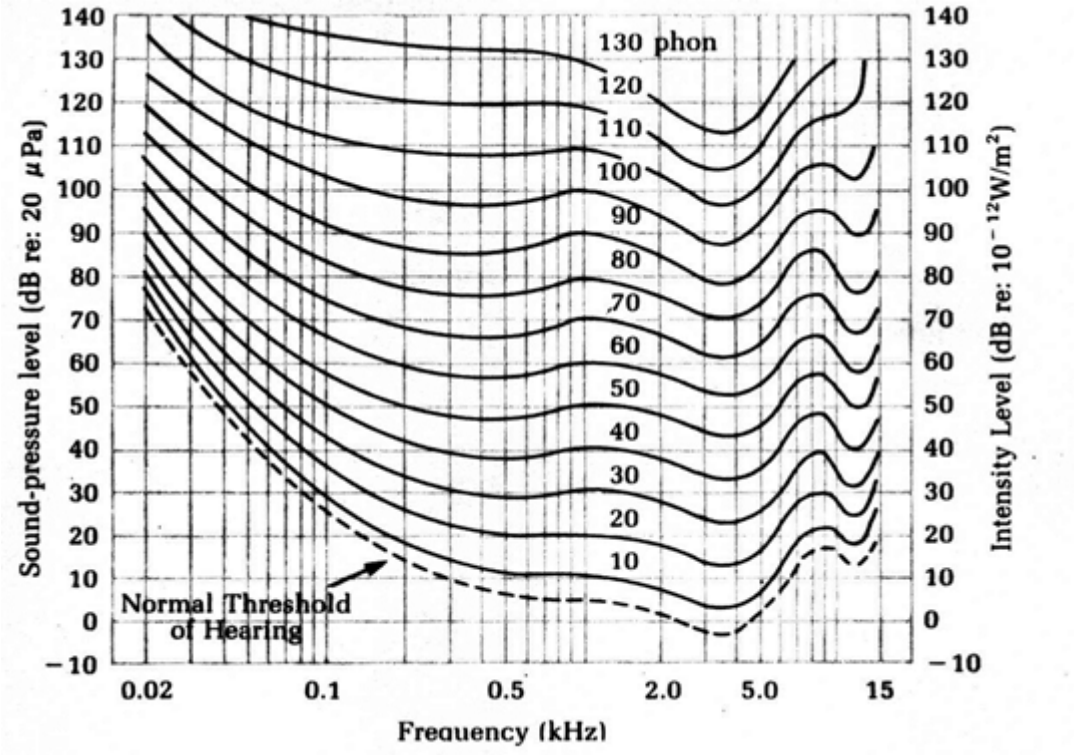

Figure 1: Fletcher & Munson Equivalent Noise Level Contour
Rajah 1: Kontor Paras Bunyi Setara Fletcher & Munson

3. [a] Explain **THREE (3)** impacts of noise to community.

*Terangkan **TIGA (3)** impak pencemaran bunyi kepada komuniti.*

[10 marks/*markah*]

[b] Define Daily Safe Noise Dose (D)

Definisikan dos harian selamat pencemaran bunyi (D)

[5 marks/*markah*]

[c] An operator of a factory spends his first 5 hours in the production line with noise level of 87 dB(A). After having his lunch and rest time for one hour in a room of 85 dB(A), the operator continues his work in the compression room of 94 dB(A) for four hours. Calculate the daily safe noise dose of the operator and conclude the result with suggestion. Use **Table 1** as reference.

*Seorang pekerja kilang menghabiskan 5 jam pertama dalam bahagian pengeluaran dengan tahap bunyi 87 dB(A). Selepas makan tengah hari dan berehat selama satu jam di dalam bilik 85 dB(A), pekerja itu meneruskan kerjanya di bilik pemampatan dengan tahap bunyi 94 dB(A) selama empat jam. Kira dos harian bunyi selamat yang diterima oleh pekerja tersebut dan berikan kesimpulan beserta cadangan penambahbaikan. Gunakan **Jadual 1** sebagai rujukan.*

[10 marks/*markah*]

Table 1: Noise Level and Exposure Limit according to First Schedule, Regulation 5 (1), Factories and Machinery (Noise Exposure) Regulations 1989, under The Malaysian Factories and Machinery Act 196.

Jadual 1: Tahap Bunyi dan Had Pendedahan mengikut Jadual Pertama, Peraturan 5 (1), Peraturan Kilang dan Jentera (Pendedahan Bunyi Bising) 1989, di bawah Akta Kilang dan Jentera 196 Malaysia.

Noise Level/ *Paras bunyi* *dB(A) – slow** *dB(A) – perlahan**	Exposure Limit (Hour-Minute)/ *Had Pendedahan (Jam-minit)*
85	16-0
86	13-56
87	12-8
88	10-34
89	9-11
90	8-0
91	6-58
92	6-4
93	5-17
94	4-36
95	4-0
96	3-29
97	3-2
98	2-50
99	2-15
100	2-0
101	1-44
102	1-31
103	1-19
104	1-9
105	1-0
106	0-52
107	0-46
108	0-40
109	0-34
110	0-30
111	0-26
112	0-23
113	0-20
114	0-17
115	0-15

*Noise level meter is set at 'slow' rate

**Meter paras bunyi dilaraskan pada kadar 'perlahan'*

4. [a] A daily traffic noise monitoring has resulted in the following data **(Table 2):**

Pemantauan hingar lalu lintas harian telah memberikan data berikut ***(Jadual 2) :***

Table 2/ *Jadual 2*

Duration (minutes)/ *Masa (minit)*	Sound Level dB(A)/ *Paras bunyi dB(A)*
10	73
20	70
30	68
40	78
50	81
60	79
70	70
80	66
90	67
100	70

Calculate:

Kira:

[i] L_{dn}(1hr). Comment your answer.

L_{dn}(1hr). Komen jawapan anda.

[5 marks/*markah*]

[ii] The values of L_{10}, L_{50}, and L_{90}. Comment your answer.

Nilai bagi L_{10}, L_{50} dan L_{90}. Komen jawapan anda.

[14 marks/*markah*]

[b] Give **THREE (3)** factors that influence noise propagation indoor.

Berikan ***TIGA (3)*** *faktor yang mempengaruhi penyebaran bunyi dalam bangunan.*

[6 marks/*markah*]

5. [a] A number of residential areas in Klang Valley is located next to the highway. The noise generated from the traffic has caused disturbances to the residents. Explain **SIX (6)** possible measures that could be implemented to mitigate the noise.

*Beberapa kawasan perumahan di Lembah Klang terletak bersebelahan dengan lebuh raya. Bunyi trafik yang terhasil telah menyebabkan gangguan kepada penduduk. Terangkan **ENAM (6)** kaedah yang boleh dilaksanakan dalam mengurangkan bunyi ini.*

[12 marks/*markah*]

[b] A wall in a room is made of concrete with an area of 100 m^2. Measurement indicated that the wall is capable to reduce 50 dB noise level. A new wooden door is planned to be installed at the wall for renovation purpose. Calculate the required area of the new door (the door capacity is 20 dB) that will enable the noise reduction of 30 dB for the entire wall.

Satu dinding konkrit di dalam sebuah bilik mempunyai keluasan 100 m^2. Pengukuran menunjukkan bahawa dinding konkrit tersebut mampu untuk mengurangkan 50 dB tahap bunyi bising. Satu pintu kayu baharu perlu dipasang pada dinding tersebut untuk tujuan pengubahsuaian. Hitung luas pintu baharu (kapasiti pintu ialah 20 dB) yang diperlukan supaya pengurangan 30 dB dapat diperolehi oleh keseluruhan dinding.

[13 marks/*markah*]

APPENDIX/*LAMPIRAN*

Useful formulae:

1) $C = 20.05\ T^{0.5}$

2) $I = w/s$

3) $L_I = 10 \log_{10} I/10^{-12}$

4) $Lp = 20 \log_{10} (P/Po)$, $Po = 20\ \mu Pa$

5) $Lw = 10 \log_{10} (w/10^{-12})$

6) $Leq = 10 \log_{10} \sum ti\ 10^{\ Li/10}$

7) $L_{wp} = 10 \log_{10} 1/N \sum 10^{\ (Lj/10)}$

8) $L_{pp} = 20 \log_{10} 1/N \sum 10^{\ (Lj/20)}$

9) $T_L = 10\log10 \left\{ \frac{s}{\tau 1 s1 + \ldots. + \tau 2 s2} \right\}$

10) $T_L = 10 \log_{10} 1/\tau$

11) NNI = Average Peak Noise Level + $15 \log_{10} N$ - 80
Average Peak Noise Level = $10 \log10\ 1/N \sum 10^{\ \text{Peak noise level } /10}$ dB (A)

12) Traffic Leq = 42.3 + 10.2 log (Vc + 6 Vt) – 13.9 log D + 0.13 S

13) Traffic Ldn = 31.0 + 10.2 log [AADT+ T% AADT/20)] -13.9 log D + 0.13 S

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