
UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2005/2006

November 2005

REG 562 –Teknologi Perkhidmatan Bangunan
(Building Services Technology)

Duration: 3 hours
(Masa: 3 jam)

Sila pastikan bahawa kertas peperiksaan ini mengandungi **ENAM BELAS** muka surat yang tercetak sebelum anda memulakan peperiksaan ini.

*Please check that this examination paper consists of **SIXTEEN** pages of printed material before you begin the examination.*

Pelajar dibenarkan menjawab semua soalan dalam Bahasa Inggeris ATAU Bahasa Malaysia ATAU kombinasi kedua-duanya.

Students are allowed to answer all questions in English OR in Bahasa Malaysia OR in both languages.

Jawab **EMPAT** soalan sahaja. Pilih **DUA (2)** soalan dari **Bahagian A** dan **DUA (2)** soalan dari **Bahagian B**

*Answer **FOUR** questions only. **TWO** questions should be answered from **Part A**, and **TWO** questions from **Part B**.*

BAHAGIAN A

1. (a) Mengapakah seorang pakar atau jurutera perkhidmatan bangunan diperlukan dalam industri pembinaan?

Explain why a building services professional is needed within building industry?

(5 markah/marks)

- (b) Bidang teknologi perkhidmatan bangunan mempunyai pelbagai kegunaan dalam meningkatkan prestasi sesebuah bangunan. Huraikan kepentingan setiap sistem dalam bangunan, fungsi, hubungan antara dua sistem dan kawalan rekabentuk sistem tersebut.

Building Services technology is having a high potential to increase the total building performance. Elaborate the importance of each system within the building, it's functions, and also focused on two system that are inter-related which includes it's design control system.

(20 markah/marks)

2. (a) Mengapakah sistem keselamatan kebakaran atau "fire safety" dikatakan begitu penting sekali didalam industri binaan?

Explain why the fire safety system is very important in building industry?

(5 markah/marks)

- (b) Keselamatan kebakaran seringkali dikaitkan dengan pihak bomba dan penyelamat. Namun demikian, pihak pereka dan professional mahu pun penghuni bangunan perlu memahami 14 komponen-komponen kebakaran dan hayat tumbesaran kebakaran "Fire Growth Graph" bagi tujuan pengurusan keselamatan. Nyatakan dan huraikan kenyataan ini.

Fire safety is often related to the Fire Brigade responsibility. However, the understanding of the 14 components of fire safety in buildings and the Fire Growth Graph should also be known by the professionals and designers in order to manage the entire safety of a building. List down and elaborate the facts above.

(20 markah/marks)

- 3 -

3. (a) Nyatakan perbezaan *Traction Lift* dan *Hydraulic Lift*.

List the differences between Traction Lift and Hydraulic Lift.

(5 markah/marks)

- (b) Huraikan secara ringkas apakah 3 keperluan penting dalam merekabentuk sistem lif dan nyatakan kriteria yang digunakan untuk membuat penganalisaan prestasi lif.

Elaborate the 3 main requirements of lift design and list the criteria used for analysing the lift performance

(10 markah/marks)

- (c) Apakah yang dimaksudkan dengan Masa Perjalanan (T) bagi sesebuah perkhidmatan lif? Kirakan masa perjalanan (T) untuk lif sebuah bangunan pejabat jika spesifikasinya adalah seperti berikut:-

Jumlah kereta lif sekumpulan	=	4
Kapasiti kereta lif	=	21 orang
Kontrak kelajuan lif	=	2.0 m/s
Ketinggian bangunan	=	3.5 m
Bilangan tingkat	=	16 tingkat (termasuk aras tingkat bawah)
Jumlah keluasan pejabat	=	5400 sq.m
Lebar pintu lif	=	1100 mm
Jenis penggerak lif	=	Gearless variable voltage
Jenis pintu lif	=	Bukaan tengah

....4/-

- 4 -

$$S_p = S - S \left[\frac{(S-1)}{S} \right]^n$$

- Di mana:
- S_p = kemungkinan bilangan hentian per trip
 - S = Bilangan aras yang diberi perkhidmatan selain tingkat bawah.
(*Number of floors served above ground floor*)
 - n = bilangan penumpang yang memasuki lif di aras tingkat bawah
(kebiasaannya diambil sebanyak 80% dari beban kotrak)

$$T = \frac{2 (d S_p + D + d)}{V}$$

- laitu;-
- T = Jumlah masa perjalanan
 - d = Jarak memecut
 - S_p = Kemungkinan bilangan hentian per trip
 - D = Jarak keseluruhan di antara aras bawah dengan aras teratas.
 - V = Kelajuan lif (m/s)

Jarak memecut bergantung kepada penggerak (drive) lif tertentu dan rekabentuk kelajuan yang diberikan:-

Kelajuan Lif (speed)	Jenis	Jarak memecut (d)
0.5 m/s	Geared Rheostatic	0.3 m
1.0 m/s	Geared Rheostatic	1.5 m
1.5 m/s	Geared Rheostatic	2.6 m
1.5 m/s	Variable Voltage GR	1.3 m
2.0 m/s	Gearless Variable Voltage	2.2 m
2.5 m/s	Gearless Variable Voltage	3.1 m
3.0 m/s	Gearless Variable Voltage	4.0 m

Anggap bangunan itu dipunyai oleh satu penyewa dan keluasan lantai setiap tingkat adalah sama serta setiap orang memerlukan keluasan "*occupancy density*" = 9.5 sq.m.

(10 markah)

What is meaning of Transportation Time (T) for a lift?

Calculate the (T) for the lift system of a office building with the relevant specification:-

Total lift car in a lobby	=	4
Lift car capacity	=	21 persons
Lift contract speed	=	2.0 m/s
Building height per floor	=	3.5 m
Nos. of storey	=	16 floor (including ground floor)
Total office floor area	=	5400 sq.m
Lift door	=	1100 mm
Lift drive type	=	Gearless variable voltage
Lift opening	=	Centre.

$$Sp = S - S \left[\frac{(S-1)}{S} \right]^n$$

Where: Sp = probability of stop per trip
 S = Number of floors served above ground floor
 n = Number of passenger entering the lift at ground floor
 (80% from the design contract)

$$T = \frac{2 (d Sp + D + d)}{V}$$

That is:- T = Total travelling time
 d = Acceleration distance
 Sp = Probability of stop per trip
 D = Total distance between ground floor to the highest floor level
 V = Lift speed (m/s)

The acceleration distance depending on the lift drive types and also the design speed given:-

Lift contract speed	Life drive types	Acceleration distance (d)
0.5 m/s	Geared Rheostatic	0.3 m
1.0 m/s	Geared Rheostatic	1.5 m
1.5 m/s	Geared Rheostatic	2.6 m
1.5 m/s	Variable Voltage GR	1.3 m
2.0 m/s	Gearless Variable Voltage	2.2 m
2.5 m/s	Gearless Variable Voltage	3.1 m
3.0 m/s	Gearless Variable Voltage	4.0 m

Assuming that the building is a single tenant with a standard floor area level and each person required occupancy density = 9.5 sq.m.

(10 markah/marks)

...6/-

4. (a) Berikan sumber-sumber cahaya yang berkaitan dengan sains pencahayaan dan apakah objektif rekabentuk pencahayaan? Terangkan secara terperinci setiap objektif tersebut dengan penerangan yang jelas. Nyatakan juga keperluan kawalan sistem pencahayaan.

List the source of lights which are related to the science of lighting and also the objectives of lighting design. Explain in detail each of the objectives with clear examples. Also write the usage of lighting control system that is needed and available.

(15 markah/marks)

- (b) Jika satu sumber cahaya mempunyai "intensity" yang seragam iaitu 60 cd dari semua arah. Apakah jumlah (total) "luminous flux" yang dipancarkan? Sekiranya fluks itu disumbang oleh lampu tungsten halogen (30 lm/W), berapakah kuasa elektrik yang akan diserap oleh lampu itu?

Memandangkan ia adalah sumber satu titik (*one point source*) dan difokuskan kepada solid angle $\omega = 0.5$ sr, jika 80% fluks itu kekal dalam proses ini, apakah purata "intensity" di dalam "solid angle" itu?

$$\boxed{I = \frac{F}{\omega}}$$

di mana

I = intensity

F = flux atau fluks

ω = solid angle = $\frac{A}{r^2}$ atau $\frac{2\pi r^2}{r^2} = 2\pi$

If the single source of light with the constant intensity of 60 cd is coming from all direction, what is the total "luminous flux" that will be emitted? And if the flux given by the tungsten halogen lamp (30 lm/W), how many electricity watt will the lamp absorb?

It is coming from a single point source and being focused into solid angle angle $\omega = 0.5$ sr, if 80% flux is being maintained in this process, what is the overall "intensity" within that "solid angle"?

$$\boxed{I = \frac{F}{\omega}}$$

Where

I = intensity

F = flux atau fluks

ω = solid angle = $\frac{A}{r^2}$ or $\frac{2\pi r^2}{r^2} = 2\pi$

(10 markah / marks)

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- (c) Kirakan pemasangan bilangan "luminaire" yang sesuai bagi sebuah bilik untuk mencapai purata pencahayaan "illuminance" dengan spesifikasi yang diberikan.

Dimensi ruang bilik:	Panjang	= 20m
	Lebar	= 10m
	Ketinggian lantai ke siling	= 3m
	Ketinggi meja kerja	= 0.8m

Pembalikan efektif ruang lantai	= R[F]	= 0.20
Pembalikan efektif dari dinding	= R[W]	= 0.50
Pembalikan efektif ruang syiling	= R[C]	= 0.70

Diberi juga jenis pemasangan lampu iaitu lampu 2 tiub 1.5m panjang yang dipasang terus ke siling. Ia memerlukan pencahayaan "illuminance" sebanyak 500 lux di atas ruang meja kerja. Anggapkan nilai F = 5400 dan Faktor hilang cahaya = 80%.

$$E(s) = \frac{F \times n \times N \times LLF \times UF(s)}{\text{Keluasan ruang (s)}}$$

OR

Calculate using the lumen method to obtain the number of luminaires necessary for the following room in order to achieve a given average illuminance.

Room dimensions :	Length	= 20m
	Width	= 10m
	Height (floor to ceiling)	= 3m
	Height of working plane	= 0.8m

Effective reflectance of floor cavity	= R[F]	= 0.20
Effective reflectance of walls	= R[W]	= 0.50
Effective reflectance of ceiling cavity	= R[C]	= 0.70

Also given luminaire types as twin popular pack 1.5m long luminaire mounted directly to the ceiling. And illuminance required on the working plane is 500 lux.

Assuming F = 5400 and light loss factor = 80%.

$$E(s) = \frac{F \times n \times N \times LLF \times UF(s)}{\text{Area of surface (s)}}$$

(10 markah/marks)

BAHAGIAN B

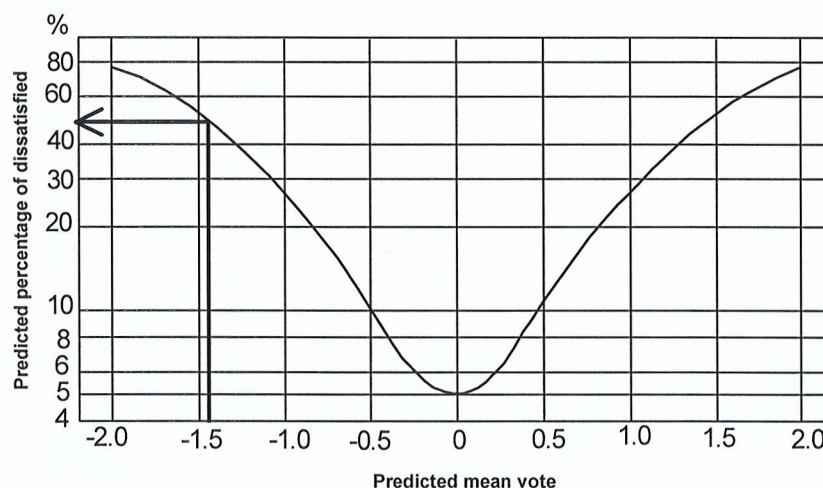
5. (a) Berikan definisi terma-terma ini yang biasa digunakan dalam kajian keselesaan terma.
- i. PMV
 - ii. PPD
 - iii. Pilihan tahap keselesaan
 - iv. Ketidakpuasan
 - v. Kebolehterimaan terma

Define these common terms in thermal comfort study:

- i. PMV
- ii PPD
- iii. Comfort vote
- iv Dissatisfied
- v. Thermal acceptability

- (b) Berdasarkan definisi yang diberikan dalam 4(a) di atas huraikan keadaan yang ditunjukkan dalam gambarajah ini.

Based on the definitions in 4(a) discuss the situation that is shown in the figure.



(25 markah/marks)

6. (a) Bincangkan lima (5) kriteria yang dipertimbangkan dalam pemilihan sistem pendingin hawa.

Discuss five (5) criteria that are always considered in air-conditioning system selection.

- (b) Satu sistem pendingin hawa digunakan untuk menyejukkan udara bekal pada suhu 27 °Cbk dan 20 °Cbb kepada 20 °Cbk dan 14 °Cbb, bagi satu ruang berisipadu 1500 m³ yang memerlukan 5 pertukaran udara sejam.

An air-conditioning system is used to cool supply air at 27 °Cdb and 20 °Cdb to 20 °Cdb and 14 °Cdb, in an area of 1500 m³ volume, requiring 5 air changes per hour.

- i. Berdasarkan kepada carta psikrometrik, plotkan proses-proses yang terlibat.

Based on the psychrometric chart, plot the process involved

- ii. Tentukan keupayaan pendingin

Determine the chiller rating

(25 markah/marks)