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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2012/2013**

COURSE NAME : **MECHANICAL & ELECTRICAL SYSTEMS**

COURSE CODE : **BFC 32603**

PROGRAMME : **3BFF**

EXAMINATION DATE : **DECEMBER 2012/JANUARY 2013**

DURATION : **3 HOURS**

INSTRUCTION : **ANSWER ANY FOUR (4) QUESTIONS ONLY**

THIS QUESTION PAPER CONSISTS OF ELEVEN (11) PAGES

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- Q1** (a) Define the following terms;
- (i) Thermal comfort
 - (ii) Thermal transmittance (U)
- (4 marks)
- (b) There are two main variables that will affect the thermal comfort condition, which named physical and personal variables. Please briefly describe all of the components for each variable.
- (7 marks)
- (c) **FIGURE Q1 (c)** shows a portion of house wall which is facing west in direction. The composition of the wall is the 20 mm glass window, 150 mm of brick wall and 15mm of cement plaster on both sides. The R and k values for each component are as follows:
- | | |
|---------------|---------------------------|
| Glass Windows | = 1.1 m ² C/W |
| Brick wall | = 0.77 W/m ² C |
| Plaster | = 0.18 W/m ² C |
- (i) Calculate the average U-value for this wall configuration.
 - (ii) If during evening hours the difference temperature between indoor and outdoor condition is 2°C, calculate the average heat transfer rate (q_{av}) for the wall.
- (10 marks)
- (d) Heat can be transferred by conduction, convection and radiation within a building envelope. State **two (2)** sources of heat gain in building and strategies to reduce it.
- (4 marks)
- Q2** (a) Define the following terms;
- (i) Ventilation
 - (ii) Natural Ventilation
- (4 marks)
- (b) Give **three (3)** benefits and limitations of stack effect in natural ventilation
- (6 marks)
- (c) The selection of fans type for distribution of air in ventilation systems is highly depends on the purpose of ventilation, location and capacity of air intake and discharge required. List the **three (3)** types of electrically driven fans and briefly explain its functionality, suitability and efficiency in building ventilation system.
- (12 marks)
- (d) Name and sketch the **three (3)** types of centrifugal fan wheels.
- (3 marks)

- Q3** (a) There are two types of fire sprinkler system that could be used for building fire suppression. With the help of sketch, explain both of the systems.
- (9 marks)
- (b) Briefly discuss **four (4)** advantages of hydraulic elevator compared to the electric traction version.
- (4 marks)
- (c) A 15 storey office block with floor height at 3.5 meter each has a nett floor area above ground level of 8500m² and a population density is one person per 10m² of nett floor area. Based on **TABLE Q3(c)(i), Q3(c)(ii), Q3(c)(iii) and Q3(c)(iv)**, calculate the following:
- (i) Flow rate,
 - (ii) Elevator speed,
 - (iii) Minimum number of car and
 - (iv) Elevator capacity.
- Assume the population percentage at 5 min peak demand period is 12 percent. Then, determine the quality of elevator service for the building.
- (8 marks)
- (d) Elevators energy consumption in office buildings is generally considered to be about 5% of building electricity use. Although the amount seems small, it has a potential to create savings in its energy consumption. Discuss **two (2)** opportunities for elevator energy efficiency improvements.
- (4 marks)
- Q4** (a) List down **three (3)** primary energy sources for electrical plant.
- (3 marks)
- (b) Electric power can be distributed in either single phase or three phases systems. Highlight **three (3)** differences between both systems.
- (6 marks)
- (c) There are two main methods for electrical distribution in building which are radial and ring distribution system. Discuss **two (2)** differences between both distribution systems.
- (4 marks)

- (d) Suppose that two 60 watts lamp and two 150 watts lamp are connected in parallel into a 240 volt circuit as in **FIGURE Q4 (d)**. Calculate:
- (i) The current flow through each lamp
 - (ii) The total current in the circuit
 - (iii) The total resistance in the circuit
 - (iv) The total energy consumed in a year, and
 - (v) The cost of electrical energy for the year (based on RM0.50 per kWh).

Assume the lamps are used 8 hours per day and 250 days per year. All calculation steps should be included in your answer.

(12 marks)

- Q5** (a) State **three (3)** advantages of cold water supply below:

- (i) Direct system
- (ii) Indirect system

(6 marks)

- (b) Design the main water storage tank capacity if a unit of condominium has the appliances as follows:

- (i) 3 units hands wash basin,
- (ii) 2 units (shower),
- (iii) 1 unit bath,
- (iv) 2 units WC and
- (v) 3 units wash up sink.

Height of this condominium is 30 meter which is 10 storeys and 2 units of house at every level. Consider the 10 hour reserve supply for this storage system. Refer **TABLE Q5 (b)** for the specification for each appliance.

(13 marks)

- (c) Discuss **three (3)** benefits of water efficiency programs.

(6 marks)

TERJEMAHAN BAHASA MALAYSIA

- S1** (a) Berikan maksud istilah yang berikut:
- (i) Keselesaan termal
 - (ii) *Thermal transmittance* (U)
- (4 markah)
- (b) Terdapat dua pemboleh ubah utama yang boleh mempengaruhi keadaan keselesaan termal, iaitu pemboleh ubah fizikal dan personal. Sila terangkan secara ringkas semua komponen bagi setiap pemboleh ubah.
- (7 markah)
- (c) **RAJAH Q1(c)** menunjukkan sebahagian dinding rumah yang menghadap arah barat. Komposisi dinding tersebut terdiri daripada tingkap kaca setebal 20 mm, 150 mm dinding bata dan 15mm plaster simen di kedua-dua belah bahagian. Nilai R dan k bagi setiap komponen adalah seperti berikut:
- Tingkap kaca = $1.1 \text{ m}^2\text{C/W}$
 Dinding bata = $0.77 \text{ W/m}^2\text{C}$
 Plaster = $0.18 \text{ W/m}^2\text{C}$
- (i) Kirakan purata nilai-U untuk konfigurasi dinding seperti ini.
 - (ii) Jika pada waktu malam perbezaan suhu antara keadaan dalaman dan luaran adalah 2°C , hitung kadar pemindahan haba purata (q_{av}) untuk dinding tersebut.
- (10 markah)
- (d) Haba boleh dipindahkan melalui konduksi, perolakan dan sinaran dalam persekitaran bangunan. Nyatakan **dua (2)** sumber haba dalam bangunan dan strategi untuk mengurangkannya
- (4 markah)
- S2** (a) Terangkan perkataan berikut;
- (i) Pengudaraan
 - (ii) Pengudaraan Semulajadi
- (4 markah)
- (b) Berikan **tiga (3)** kelebihan dan kekurangan yang terdapat pada pengudaraan secara kesan tindanan (*Stack Effect Ventilation*) didalam pengudaraan secara semulajadi.
- (6 markah)
- (c) Pemilihan jenis kipas untuk sistem pengudaraan adalah bergantung kepada tujuan pengudaraan, lokasi dan kapasiti pengambilan dan pengaliran keluar udara yang dikehendaki. Senaraikan **tiga (3)** jenis kipas elektrik yang digunakan dalam sistem pengudaraan bangunan dan terangkan dengan ringkas fungsi, kesesuaian dan kecekapannya.
- (12 markah)
- (d) Nama dan lakarkan **tiga (3)** jenis bilah kipas empar (*centrifugal fan wheels*).
- (3 markah)

- S3 (a) Terdapat dua jenis sistem pemercik air (*sprinkler*) yang boleh digunakan untuk sistem pemadam kebakaran. Dengan bantuan lakaran, terangkan kedua-dua sistem tersebut.

(9 markah)

- (b) Secara ringkas bincangkan **empat (4)** kelebihan lif hidraulik berbanding versi tarikan elektrik.

(4Markah)

- (c) Satu blok 15 tingkat dengan ketinggian lantai 3.5 meter mempunyai keluasan lantai bersih di atas paras tanah sebanyak 8500m² dan kepadatan penduduk adalah salah satu orang per 10m². Berdasarkan **JADUAL Q3(c)(i), Q3(c)(ii), Q3(c)(iii) dan Q3(c)(iv)**, hitungkan:

- (i) Kadar alir,
- (ii) Halaju lif,
- (iii) Bilangan minimum kereta dan
- (iv) Kapasiti lif yang diperlukan.

Andaikan peratusan penduduk pada 5 min permintaan waktu puncak adalah 12 peratus. Kemudian, tentukan kualiti perkhidmatan lif bagi bangunan itu.

(8 markah)

- (d) Penggunaan tenaga untuk lif di bangunan pejabat umumnya dianggap kira-kira 5% daripada keseluruhan penggunaan elektrik bangunan. Walaupun jumlah itu seolah-olah kecil, ia mempunyai potensi untuk mewujudkan penjimatan dalam penggunaan tenaga. Bincangkan **dua (2)** kaedah untuk penambahbaikan kecekapan tenaga lif.

(4 markah)

- S4 (a) Senaraikan **tiga (3)** sumber utama tenaga untuk loji elektrik.

(3 markah)

- (b) Kuasa elektrik boleh diedarkan sama ada dalam sistem fasa tunggal atau tiga fasa. Terangkan **tiga (3)** perbezaan diantara kedua-dua sistem tersebut.

(6 markah)

- (c) Terdapat dua kaedah utama untuk pengagihan elektrik di dalam bangunan iaitu sistem jejarian dan cincin. Bincangkan **dua (2)** perbezaan diantara sistem pengagihan cincin dan sistem pengagihan jejarian ini.

(4 markah)

- (d) Katakan terdapat dua lampu berkuasa 60 watt dan dua lampu berkuasa 150 watt disambungkan secara selari dalam litar bersumberkan 240V seperti dalam **RAJAH Q4 (d)**. Kirakan:
- (i) arus mengalir pada setiap lampu
 - (ii) jumlah arus dalam litar
 - (iii) jumlah rintangan dalam litar
 - (iv) jumlah tenaga yang digunakan dalam setahun, dan
 - (v) kos tenaga elektrik bagi tahun tersebut (berdasarkan RM0.50 setiap kWh).

Anggap lampu digunakan selama 8 jam sehari dalam 250 hari setahun. Semua langkah pengiraan hendaklah dimasukkan dalam jawapan anda.

(12 markah)

- S5** (a) Nyatakan **tiga (3)** kelebihan bekalan air sejuk di bawah:

- (i) Sistem langsung
- (ii) Sistem tidak langsung

(6 markah)

- (b) Kira isipadu sistem tangki penyimpanan air utama sebuah kondominium jika sebuah unit mempunyai peralatan seperti berikut:

- (i) 3 unit lembangan membasuh tangan (*hands wash basin*),
- (ii) 2 unit pancur mandi, (*shower*)
- (iii) 1 unit kolam mandi, (*bath*)
- (iv) 2 unit tandas (*WC*) dan
- (v) 3 unit basuh sehingga tenggelam (*wash up sink*).

Ketinggian kondominium ini adalah 30 meter merangkumi 10 tingkat dan 2 unit rumah di setiap peringkat. Pertimbangkan rizab bekalan 10 jam untuk sistem penyimpanan ini. Rujuk **JADUAL Q5 (b)** untuk spesifikasi setiap perkakas.

(13 markah)

- (c) Bincangkan **tiga (3)** faedah program kecekapan air.

(6 markah)

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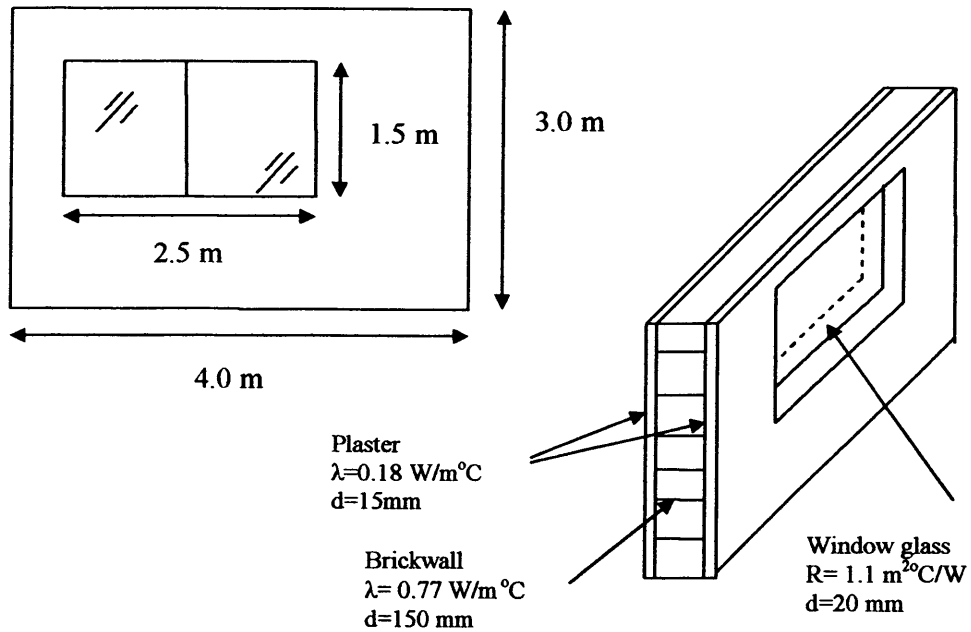


FIGURE Q1 (c) : Wall composition

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TABLE Q3(c)(i) : Lift speed

| Speed (m/s) | Lift travel in metres | | | |
|-------------|-----------------------|--------------|---------|-----------|
| | Municipal flats | Luxury flats | Offices | Bed lifts |
| 0.25–0.375 | – | – | – | 5 |
| 0.50 | 30 | 15 | 10 | 10 |
| 0.75 | 45 | 20 | 15 | – |
| 1.00 | 55 | 25 | 20 | 20 |
| 1.50 | – | – | 30 | 45 |
| 2.50 | – | – | 45 | 100 |
| 3.50 | – | – | 60 | – |
| 5.00 | – | – | 125 | – |

TABLE Q3(c)(ii) : Handling capacity and interval

| Passenger lift performance (base on 3.3m height floor to floor heights) and lifts serving all of 15 floor | | | | Interval (s) | Handling capacity (persons) |
|---|---------------|------------------|------------------|------------------|-----------------------------------|
| Number of cars | Speeds m/s | 12 passengers | 16 passengers | 20 passengers | 24 passengers |
| 4 | 2.5 | 29 | 32 | 37 | 41 |
| | | 103 | 112 | 127 | 137 |
| 4 | 3.5 | | 31 | 36 | 40 |
| | | | 116 | 132 | 142 |
| 5 | 3.5 | | 25 | 29 | 32 |
| | | | 146 | 165 | 178 |
| 6 | 3.5 | | | 24 | 27 |
| | | | | 198 | 213 |

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TABLE Q3(c)(iii) : Quality service of interval (s)

| Interval (s) | Quality of service |
|---------------------|---------------------------|
| 25–35 | Excellent |
| 35–45 | Acceptable for offices |
| 60 | Acceptable for hotels |
| 90 | Acceptable for flats |

TABLE Q3(c)(iv) : Number of lift

Minimum number of lifts for offices

| Installation | Quality of service |
|---------------------------------|---------------------------|
| One lift for every three floors | Excellent |
| One lift for every four floors | Average |
| One lift for every five floors | Below average |

Note: A lower standard than the above would be acceptable for hotels and blocks of flats. Where large numbers of people have to be moved, cars smaller than twelve-person capacity are not satisfactory.

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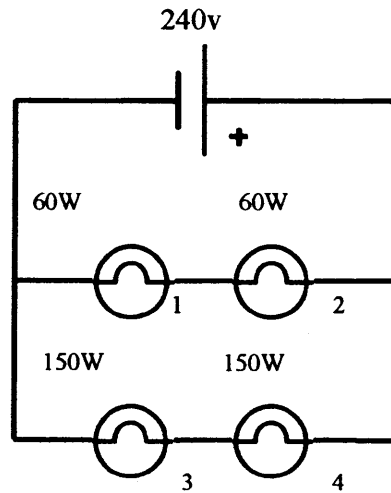


FIGURE Q4 (d) : Electrical circuit

TABLE Q5(b) : Volumes of water required for single use of appliances

| Appliance | Volume required in liters |
|--------------------|---------------------------|
| Wash Basin: | |
| Hand wash | 5 |
| Hand and face wash | 10 |
| Hair wash | 20 |
| Shower | 40 |
| Bath | 110 |
| W.C. | 10 |
| Washing machine | 150 |
| Sink: | |
| Wash up | 15 |
| Cleaning | 10 |