

**SULIT**



**KEMENTERIAN PENDIDIKAN TINGGI  
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI**

**BAHAGIAN PEPERIKSAAN DAN PENILAIAN  
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI  
KEMENTERIAN PENDIDIKAN TINGGI**

**JABATAN KEJURUTERAAN AWAM**

**PEPERIKSAAN AKHIR**

**SESI I : 2023/2024**

**DCB20042: BUILDING ELECTRICAL SERVICES**

**TARIKH : 20 DISEMBER 2023**

**MASA : 8.30 AM – 10.30 AM (2 JAM)**

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Kertas ini mengandungi **SEBELAS (11)** halaman bercetak.

Bahagian A: Subjektif (2 soalan)

Bahagian B: Subjektif (4 soalan)

Dokumen sokongan yang disertakan : Appendix

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**JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN**

(CLO yang tertera hanya sebagai rujukan)

**SULIT**

**SECTION A: 50 MARKS****BAHAGIAN A: 50 MARKAH****INSTRUCTION:**

This section consists of **TWO (2)** subjective questions. Answer **ALL** questions.

**ARAHAN:**

Bahagian ini mengandungi **DUA (2)** soalan subjektif. Jawab **SEMUA** soalan.

**QUESTION 1****SOALAN 1**

- CLO2 (a) Estimate MCB fuse rating for a circuit consisting 3 units of 200 Watt ceiling fans and 4 units of 50 Watt fluorescent lights.  
*Anggarkan kadaran fius 'MCB' untuk suatu litar yang mengandungi 3 unit kipas siling 200 Watt dan 4 unit lampu kalimantang 50 Watt.*
- [4 marks]  
[4 markah]
- CLO2 (b) A residential house requires the following wiring with a Single-Phase supply. The power factor is 0.85 and the supply volt is 230V.
- a. 8 units of Fluorescent Lamps 1 X 40 Watt
  - b. 1 unit of Cookware 2 kW
  - c. 3 units of Air Conditioners 2 HP (Horse Power)
- Calculate the followings by considering the Diversity Factor:  
*Sebuah rumah kediaman memerlukan pendawaian berikut dengan bekalan Satu Fasa. Faktor kuasa adalah 0.85 dan voltan bekalan adalah 230V.*
- a. 8 unit Lampu Kalimantang 1 X 40 Watt
  - b. 1 unit Alat Perkakas Pemasak 2 kW
  - c. 3 unit Pendingin Hawa 2 KK (Kuasa Kuda)
- Kirakan yang berikut dengan mengambilkira Faktor Kepelbagaian:*
- i. Maximum Current / Arus Maksima
- [3 marks]  
[3 markah]

- ii. Estimate Current / *Arus Anggaran*

[6 marks]

[6 markah]

CLO2

- (c) A wireman will install cables for a residential house. PVC insulated core cable will be used in the enclosed conduit wiring. By using BS7671:2018 Wiring Regulations, Tables 4D1A, and 4D1B in Appendix 1 and 2, calculate the voltage drop value for the following installation:

*Seorang pendawai akan memasang pemasangan kabel bagi sebuah rumah kediaman. Kable teras penebat PVK akan digunakan dalam sistem pendawaian konduit tertutup. Dengan menggunakan BS7671:2018 Peraturan Pendawaian, Jadual 4D1A dan 4D1B yang terdapat di Lampiran 1 dan 2, kira nilai jatuhan voltan bagi pemasangan berikut:*

- i. Installation of a 10kW powered oven which is supplied with 230V by 10 mm<sup>2</sup> PVC insulated core cable that is inside a 30 meter long conduit pipe.

*Pemasangan sebuah oven berkuasa 10kW yang dibekalkan dengan 230V oleh kabel teras tunggal berpenebat PVC berukuran 10 mm<sup>2</sup> yang berada di dalam paip konduit sepanjang 30 meter.*

[6 marks]

[6 markah]

- ii. Installation of a 2.0 horse power split unit air conditioner which is supplied with 230V by 4 mm<sup>2</sup> PVC insulated core cable that is inside a 150 meter long conduit pipe.

*Pemasangan sebuah pendingin hawa 2.0 kuasa kuda yang dibekalkan dengan 230V oleh kabel teras tunggal berpenebat PVC berukuran 4 mm<sup>2</sup> yang berada di dalam paip konduit sepanjang 150 meter.*

[6 marks]

[6 markah]

**QUESTION 2****SOALAN 2**

CLO2

- (a) Identify the estimate load for the following items based on **Guideline for Schematic Design, JKR Electrical Engineering Branch Technical Guideline 4<sup>th</sup> Edition:**

- i. 5 units of 18W fluorescent lamps
- ii. 4 units of 13A switch socket outlets
- iii. 10 units of 400mm wall fans
- iv. 2 units of 1.5 HP air-conditioners

*Kenalpasti beban anggaran bagi item berikut berdasarkan **Panduan Rekabentuk Skematik, Panduan Teknik JKR Cawangan Kejuruteraan Elektrik Edisi 4:***

- i. 5 unit 18W lampu kalimantang
- ii. 4 unit 13A suis soket alur keluar
- iii. 10 unit 400mm kipas dinding
- iv. 2 unit 1.5 KK pendingin hawa

[4 marks]

[4 markah]

CLO2

- (b) A new office building has been built in Tanjung Malim. The office receives a single-phase, 230V supply with electrical equipment as stated in Table A2(b). Calculate the total connected load (TCL) and maximum demand (MD) for all of the following electrical appliances for an office as follows by referring to the **Guideline for Schematic Design, JKR Electrical Engineering Branch Technical Guideline 4<sup>th</sup> Edition:**

*Sebuah bangunan pejabat baharu telah dibina di Tanjung Malim. Pejabat tersebut menerima bekalan satu fasa, 230V dengan perkakasan elektrik seperti yang telah dinyatakan di dalam Jadual A2(b). Kirakan jumlah beban tersambung (TCL) dan Kehendak Maksimum (MD) bagi semua kelengkapan elektrik bagi sebuah pejabat seperti berikut dengan merujuk **Panduan Rekabentuk Skematik, Panduan Teknik JKR Cawangan Kejuruteraan Elektrik Edisi 4:***

Table A2(b)/Jadual A2(b)

| Electrical appliances/ <i>Perkakasan elektrik</i>               | Number / <i>Bilangan</i> |
|---|--------------------------|
| 50 W halogen bulb / <i>50 W mentol halogen</i>                  | 10                       |
| 300 mm exhaust fan / <i>300 mm kipas ekzos</i>                  | 2                        |
| 13A 3P Switched Socket Outlet / <i>13A 3P Soket Alur Keluar</i> | 2                        |
| 3 HP Air-conditioner / <i>3 KK pendingin hawa</i>               | 3                        |

[9 marks]

[9 markah]

CLO2 (c) A government quarters will be built with the following electrical fittings and appliances with a nominal voltage supply of 230V.

- a) 10 units of tungsten lights (100W)
- b) 6 units of ceiling fans 1200mm
- c) 6 units of 13A switch socket outlets
- d) 1 unit of cooker 3.0 kW
- e) 1 unit of water heater 1.5 kW

Based on given information, calculate the Total Connected Load (TCL) and the Maximum Demand (MD) for the installation with the Diversity Factor (DF) taken into consideration.

*Sebuah kuarters kerajaan akan dibina dengan dilengkapi perkakasan dan kelengkapan elektrik berikut dengan voltan bekalannya adalah 230V.*

- a) *10 unit lampu tungsten (100W)*
- b) *6 unit of kipas siling 1200mm*
- c) *6 unit 13 A suis soket*
- d) *1 unit of dapur 3.0 kW*
- e) *1 unit pemanas air 1.5 kW*

*Berdasarkan maklumat yang diberi, kira Jumlah Beban Tersambung (TCL) dan Kehendak Maksimum (MD) bagi pemasangan tersebut dengan mengambilkira Faktor Kepelbagaian (DF).*

[12 marks]

[12 markah]

**SECTION B: 50 MARKS*****BAHAGIAN B: 50 MARKAH*****INSTRUCTION:**

This section consists of **FOUR (4)** subjective questions. Answer **TWO (2)** questions.

***ARAHAN:***

*Bahagian ini mengandungi EMPAT (4) soalan subjektif. Jawab DUA (2) soalan.*

**QUESTION 1*****SOALAN 1***

- CLO1 (a) List **FOUR (4)** types of electric generators.  
*Senaraikan EMPAT (4) jenis penjana elektrik.*
- [4 marks]  
[4 markah]
- CLO1 (b) Explain any **THREE (3)** of the generators listed in **QUESTION B1(a)**.  
*Terangkan TIGA (3) daripada penjana yang disenaraikan pada SOALAN B1(a).*
- [9 marks]  
[9 markah]
- CLO1 (c) The Grid Code and Distribution Code, launched and published by the Energy Commission Malaysia on 21 Dec 2010, is a regulatory instrument used to coordinate various electricity supply activities of the electricity producer, operator, distributor and the consumer. The former is a technical specification which defines the parameters an electricity generating plant and grid system network have to meet to ensure proper functioning of the electrical grid, whereas the Distribution Code is a set of technical regulations established to make certain the operations at the distribution level are being carried out systematically. Explain the following:  
*Kod Grid dan Kod Pengagihan, yang dilancarkan dan diterbitkan oleh Suruhanjaya Tenaga Malaysia pada 21 Dis 2010, adalah instrumen kawal selia yang digunakan untuk menyelaraskan pelbagai aktiviti bekalan elektrik pengeluaran, pengendali, pengedar dan pengguna elektrik. Yang pertama ialah*

*spesifikasi teknikal yang mentakrifkan parameter yang perlu dipenuhi oleh loji penjana elektrik dan rangkaian sistem grid untuk memastikan grid elektrik berfungsi dengan baik, manakala Kod Agihan ialah satu set peraturan teknikal yang ditetapkan untuk memastikan operasi di peringkat pengedaran dijalankan secara sistematik. Terangkan perkara berikut:*

i. Generation / *Penjanaan*

[3 marks]

[3 markah]

ii. Transmission / *Penghantaran*

[3 marks]

[3 markah]

iii. Distribution / *Pengagihan*

[3 marks]

[3 markah]

iv. Single-phase and three-phase supply / *Bekalan satu-fasa dan tiga fasa*

[3 marks]

[3 markah]

**QUESTION 2****SOALAN 2**

CLO1

- (a) Identify
- FOUR (4)**
- examples of final circuit.

*Kenalpasti EMPAT (4) contoh litar akhir.*

[4 marks]

[4 markah]

CLO1

- (b) Explain the components of consumer circuit control sequence as follows:

*Terangkan komponen kawalan berturutan bagi litar pengguna seperti berikut:*

- i. Main fuse /
- Fius utama*

[2 marks]

[2 markah]

- ii. KWh meter /
- Meter kWh*

[2 marks]

[2 markah]

- iii. Residual current device (RCD) /
- Peranti arus baki*

[2marks]

[2 markah]

- iv. Miniature Circuit Breaker (MCB) /
- Pemutus litar kenit*

[3 marks]

[3 markah]

CLO1

- (c) Regulation 11(1) of the Electricity Regulations 1994 states that all wiring or rewiring of an installation or extension to an existing installation, which shall be carried out by an Electrical Contractor or a Private Wiring Unit, has to obtain the approval in writing from a licensee or supply authority. Sketch with labels the wiring diagram of the following installations:

*Peraturan 11(1) Peraturan-Peraturan Elektrik 1994 menyatakan bahawa semua pendawaian atau pendawaian semula pemasangan atau sambungan kepada pemasangan sedia ada, yang hendaklah dijalankan oleh Kontraktor Elektrik atau Unit Pendawaian Persendirian, perlu mendapatkan kelulusan dalam bertulis daripada pemegang lesen atau pihak berkuasa pembekalan.*



*Lakar dan label gambar rajah bagi pemasangan berikut:*

- i. Three lamps controlled by single switch. [6 marks]  
*Tiga lampu dikawal oleh satu suis.* [6 markah]
  
- ii. Ring circuit for 3 units of 13A switch socket outlets. [6 marks]  
*Litar gelang bagi 3-unit soket alur keluar 13A.* [6 markah]

**QUESTION 3****SOALAN 3**

- CLO1 (a) List **FOUR (4)** factors for wiring type selection.  
*Senaraikan **EMPAT (4)** faktor pemilihan jenis pendawaian.*
- [4 marks]  
[4 markah]
- CLO1 (b) Explain **THREE (3)** types of wiring used in buildings.  
*Terangkan **TIGA (3)** jenis pendawaian yang digunakan dalam bangunan.*
- [9 marks]  
[9 markah]
- CLO1 (c) On completion of a wiring installation, a number of tests on the installation have to be conducted to ascertain that the wiring circuits and connected appliances are safe for use. Sub regulations 12(1) and 12(2) of the Electricity Regulations 1994 state that any electrical wiring in an installation shall be under the immediate supervision of a Wireman with Single Phase Restriction or Three Phase Restriction. Upon completion, the Wireman shall certify a Supervision and Completion Certificate. Illustrate the **Continuity Test** conducted after the installation of wiring in terms of its purposes, devices used and readings.  
*Setelah selesai pemasangan pendawaian, beberapa ujian ke atas pemasangan perlu dijalankan untuk memastikan bahawa litar pendawaian dan peralatan yang disambungkan selamat untuk digunakan. Subperaturan 12(1) dan 12(2) Peraturan-Peraturan Elektrik 1994 menyatakan bahawa mana-mana pendawaian elektrik dalam sesuatu pemasangan hendaklah berada di bawah pengawasan segera Pendawai dengan Sekatan Fasa Tunggal atau Sekatan Tiga Fasa. Setelah selesai, Pendawai hendaklah memperakui Sijil Penyeliaan dan Penyiapan. Gambarkan **Ujian Keterusan** yang dijalankan selepas pemasangan pendawaian dari segi tujuan, peralatan yang digunakan dan bacaannya.*
- [12 marks]  
[12 markah]

**QUESTION 4****SOALAN 4**

- CLO1 (a) List **FOUR (4)** components of the earthing system.  
*Senaraikan EMPAT (4) komponen dalam sistem pbumian.*
- [4 marks]  
[4 markah]
- CLO1 (b) Explain **THREE (3)** importance of earthing system in a building.  
*Terangkan TIGA (3) kepentingan sistem pbumian dalam sesebuah bangunan*
- [9 marks]  
[9 markah]
- CLO1 (c) Earthing is a connection system between the metallic parts of an electrical wiring system and the general mass of the earth. This will provide an easy path with a low impedance or resistance to earth to enable the protection system to operate effectively. It will thus ensure safety to human beings/consumers from the dangers of electric shocks if earth leakage currents are present. With the aid of a diagram, explain the procedure for house earthing.  
*Pbumian ialah sistem sambungan antara bahagian logam sistem pendawaian elektrik dan jisim am bumi. Ini akan menyediakan laluan mudah dengan impedans atau rintangan yang rendah kepada bumi untuk membolehkan sistem perlindungan beroperasi dengan berkesan. Ia sekali gus akan memastikan keselamatan kepada manusia/pengguna daripada bahaya renjatan elektrik jika arus bocor bumi berlaku. Dengan bantuan gambar rajah, terangkan prosedur pbumian sebuah rumah.*
- [12 marks]  
[12 markah]

**SOALAN TAMAT**

**TABLE 4D1A**  
**Single-core pvc-insulated cables, non-armoured, with or without sheath**  
**(COPPER CONDUCTORS)**

BS 6004

BS 6231

Ambient temperature : 30 °C

CURRENT-CARRYING CAPACITY (amperes):

BS 6346

Conductor operating temperature : 70°C

| Conductor cross-sectional area | Reference Method 4 (Enclosed in conduit in thermally insulating wall etc.) |                                | Reference Method 3 (enclosed in conduit on a wall or in trunking etc.) |                                | Reference Method 1 (clipped direct)                 |   | Reference Method 11 (on a perforated cable tray horizontal or vertical) |   | Reference Method 12 (free air) |                      |         |
|--------------------------------|--|--------------------------------|--|--------------------------------|---|---|---|---|--------------------------------|----------------------|---------|
|                                | 2 cables, single-phase a.c or d.c  | 3 or 4 cables, three-phase a.c | 2 cables, single-phase a.c or d.c                                      | 3 or 4 cables, three-phase a.c | 2 cables, single-phase a.c or d.c flat and touching | 3 or 4 cables, three-phase a.c flat and touching or trefoil | 2 cables, single-phase a.c or d.c flat and touching                     | 3 or 4 cables, three-phase a.c flat and touching or trefoil | Horizontal flat spaced         | Vertical flat spaced | Trefoil |
| 1                              | 2  | 3                              | 4  | 5                              | 6   | 7   | 8   | 9   | 10                             | 11                   | 12      |
| (mm <sup>2</sup> )             | (A)  | (A)                            | (A)  | (A)                            | (A)   | (A)   | (A)   | (A)   | (A)                            | (A)                  | (A)     |
| 1                              | 11   | 10.5                           | 13.5   | 12                             | 15.5  | 14  | -   | -   | -                              | -                    | -       |
| 1.5                            | 14.5   | 13.5                           | 17.5   | 15.5                           | 20  | 18  | -   | -   | -                              | -                    | -       |
| 2.5                            | 19.5   | 18                             | 24   | 21                             | 27  | 25  | -   | -   | -                              | -                    | -       |
| 4                              | 26   | 24                             | 32   | 28                             | 37  | 33  | -   | -   | -                              | -                    | -       |
| 6                              | 34   | 31                             | 41   | 36                             | 47  | 43  | -   | -   | -                              | -                    | -       |
| 10                             | 46   | 42                             | 57   | 50                             | 65  | 59  | -   | -   | -                              | -                    | -       |
| 16                             | 61   | 56                             | 76   | 68                             | 87  | 79  | -   | -   | -                              | -                    | -       |
| 25                             | 80   | 73                             | 101  | 89                             | 114   | 104   | 126   | 112   | 146                            | 130                  | 110     |
| 35                             | 99   | 89                             | 125  | 110                            | 141   | 129   | 156   | 141   | 181                            | 162                  | 137     |
| 50                             | 119  | 108                            | 151  | 134                            | 182   | 167   | 191   | 172   | 219                            | 197                  | 167     |
| 70                             | 151  | 136                            | 192  | 171                            | 234   | 214   | 246   | 223   | 281                            | 254                  | 216     |
| 95                             | 182  | 164                            | 232  | 207                            | 284   | 261   | 300   | 273   | 341                            | 311                  | 264     |

**TABLE  
4D1B**

**VOLTAGE DROP (per ampere per metre):**

**Conductor operating temperature: 70°C**

| Conductor cross-sectional area | 2 cables d.c | 2 cables, single-phase a.c  |      |      |  |       |      |                               |      |      | 3 or 4 cables, three-phase a.c                                    |      |      |  |       |      |   |      |      |                               |      |      |
|--------------------------------|--------------|---|------|------|--|-------|------|-------------------------------|------|------|---|------|------|--|-------|------|---|------|------|-------------------------------|------|------|
|                                |              | Reference Method 3 & 4 (Enclosed in conduit etc. in or on a wall) |      |      | Reference Method 1 & 11 (clipped direct or on trays, touching) |       |      | Reference Method 12 (spaced*) |      |      | Reference Method 3 & 4 (Enclosed in conduit etc. in or on a wall) |      |      | Reference Method 1, 11 & 12 (in trefoil) |       |      | Reference Method 1 & 11 (flat and touching) |      |      | Reference Method 12 (spaced*) |      |      |
| 1                              | 2            | 3   |      |      | 4  |       |      | 5                             |      |      | 6   |      |      | 7  |       |      | 8   |      |      | 9                             |      |      |
| (mm <sup>2</sup> )             | (mV/A/m)     | (mV/A/m)  |      |      | (mV/A/m)   |       |      | (mV/A/m)                      |      |      | (mV/A/m)  |      |      | (mV/A/m)                                 |       |      | (mV/A/m)                                    |      |      | (mV/A/m)                      |      |      |
| 1                              | 44           | 44  |      |      | 44   |       |      | 44                            |      |      | 38  |      |      | 38                                       |       |      | 38  |      |      | 38                            |      |      |
| 1.5                            | 29           | 29  |      |      | 29   |       |      | 29                            |      |      | 25  |      |      | 25                                       |       |      | 25  |      |      | 25                            |      |      |
| 2.5                            | 18           | 18  |      |      | 18   |       |      | 18                            |      |      | 15  |      |      | 15                                       |       |      | 15  |      |      | 15                            |      |      |
| 4                              | 11           | 11  |      |      | 11   |       |      | 11                            |      |      | 9.5   |      |      | 9.5                                      |       |      | 9.5   |      |      | 9.5                           |      |      |
| 6                              | 7.3          | 7.3   |      |      | 7.3  |       |      | 7.3                           |      |      | 6.4   |      |      | 6.4                                      |       |      | 6.4   |      |      | 6.4                           |      |      |
| 10                             | 4.4          | 4.4   |      |      | 4.4  |       |      | 4.4                           |      |      | 3.8   |      |      | 3.8                                      |       |      | 3.8   |      |      | 3.8                           |      |      |
| 16                             | 2.8          | 2.8   |      |      | 2.8  |       |      | 2.8                           |      |      | 2.4   |      |      | 2.4                                      |       |      | 2.4   |      |      | 2.4                           |      |      |
|                                |              | r   | x    | z    | r  | x     | z    | r                             | x    | z    | r   | x    | z    | r  | x     | z    | r   | x    | z    | r                             | x    | z    |
| 25                             | 1.75         | 1.80  | 0.33 | 1.80 | 1.75   | 0.20  | 1.75 | 1.75                          | 0.29 | 1.80 | 1.50  | 0.29 | 1.55 | 1.50                                     | 0.175 | 1.50 | 1.50  | 0.25 | 1.55 | 1.50                          | 0.32 | 1.55 |
| 35                             | 1.25         | 1.30  | 0.31 | 1.30 | 1.25   | 0.195 | 1.25 | 1.25                          | 0.28 | 1.30 | 1.10  | 0.27 | 1.10 | 1.10                                     | 0.170 | 1.10 | 1.10  | 0.24 | 1.10 | 1.10                          | 0.32 | 1.15 |
| 50                             | 0.93         | 0.95  | 0.30 | 1.00 | 0.93   | 0.190 | 0.95 | 0.93                          | 0.28 | 0.97 | 0.81  | 0.26 | 0.85 | 0.80                                     | 0.165 | 0.82 | 0.80  | 0.24 | 0.84 | 0.80                          | 0.32 | 0.86 |
| 70                             | 0.63         | 0.65  | 0.29 | 0.72 | 0.63   | 0.185 | 0.66 | 0.63                          | 0.27 | 0.69 | 0.56  | 0.25 | 0.61 | 0.55                                     | 0.160 | 0.57 | 0.55  | 0.24 | 0.60 | 0.55                          | 0.31 | 0.63 |
| 95                             | 0.46         | 0.49  | 0.28 | 0.56 | 0.47   | 0.180 | 0.50 | 0.47                          | 0.27 | 0.54 | 0.42  | 0.24 | 0.48 | 0.41                                     | 0.155 | 0.43 | 0.41  | 0.23 | 0.47 | 0.40                          | 0.31 | 0.51 |


Note : \* Spacings larger than those specified in Method 12 (see Table 4A1) will result in larger voltage drop

**Table 4.1** Table of typical allowances for diversity (IEE On-site guide, Table 1B)

| Purpose of final circuit fed from conductors or switchgear to which diversity applies                         | Individual household installations, including individual dwellings of a block  | Type of premises   |  |
|---|--|--|--|
|   |  | Small shops, stores, offices and business premises   | Small hotels, boarding houses, guest houses, etc.  |
| 1 Lighting  | 66% of total demand  | 90% of total current demand  | 75% of total current demand  |
| 2 Heating and power (but see 3–8 below)   | 100% of total current demand up to 10 A<br>+50% of any current demand in excess of 10 A                              | 100% f.l. of largest appliance<br>+75% of remaining appliances   | 100% f.l. of largest appliance<br>+80% f.l. of second largest appliance<br>+60% of remaining appliances  |
| 3 Cooking appliances  | 10 A<br>+30% f.l. of connected cooking appliances in excess of 10 A<br>+5 A if socket-outlet incorporated in unit    | 100% f.l. of largest appliance<br>+80% f.l. of second largest appliance<br>+60% f.l. of remaining appliances         | 100% of largest appliance<br>+80% f.l. of second largest appliance<br>+60% f.l. of remaining appliances  |
| 4 Motors (other than lift motors which are subject to special consideration)                                  |  | 100% f.l. of largest motor<br>+80% f.l. of second largest motor<br>+60% f.l. of remaining motors                     | 100% f.l. of largest motor<br>+50% f.l. of remaining motors  |
| 5 Water heaters (instantaneous type)*   | 100% f.l. of largest appliance<br>+100% of second largest appliance<br>+25% f.l. of remaining appliance              | 100% f.l. of largest appliance<br>+100% of second largest appliance<br>+25% f.l. of remaining appliances             | +100% f.l. of largest appliance<br>+100% of second largest appliance<br>+25% f.l. of remaining appliances  |
| 6 Water heaters (thermostatically controlled)   | NO DIVERSITY ALLOWABLE†  |  |  |
| 7 Floor warming installations   | NO DIVERSITY ALLOWABLE†  |  |  |
| 8 Thermal storage space heating installations   | NO DIVERSITY ALLOWABLE†  |  |  |
| 9 Standard arrangements of final circuits in accordance with IEE Appendix 5                                   | 100% of current demand of largest circuit<br>+40% of current demand of every other circuit                           | 100% of current demand of largest circuit<br>+50% of current demand of every other circuit                           |  |
| 10 Socket outlets other than those included in 9 above and stationary equipment other than those listed above | 100% of current demand of largest point of utilisation<br>+40% of current demand of every other point of utilisation | 100% of current demand of largest point of utilisation<br>+75% of current demand of every other point of utilisation | 100% of current demand of largest point of utilisation +75% of current demand of every point in main rooms (dining rooms, etc.) +40% of current demand of every other point of utilisation |


\* For the purpose of this table an instantaneous water heater is deemed to be a water heater of any loading which heats water only while the tap is turned on and therefore uses electricity intermittently.

† It is important to ensure that the distribution boards are of sufficient rating to take the total load connected to them without the application of any diversity.

|   |  |   |
|---|--|---|
|  | <b>PANDUAN TEKNIK</b><br><b>CAWANGAN KEJURUTERAAN ELEKTRIK</b><br><b>EDISI 4</b> | <b>CKE.GP.01.43(00).2011</b>                                  |
|   |  | <b>JKR 20300-025-09</b><br>Date : 1 <sup>st</sup> August 2011 |
| <b>CHAPTER</b><br><b>5.0</b>  | <b>GUIDELINES FOR SCHEMATIC DESIGN</b>   | Page : C5/ 12 of 14   |

**Appendix 1: TCL Guide (updated: 15.5.2006)**

| NO | DESCRIPTION                   | ESTIMATED LOAD    |
|----|-------------------------------|-------------------|
| 1  | 18W Fluorescent               | 24W               |
| 2  | 36W Fluorescent               | 42W               |
| 3  | 60W Tungsten                  | 60W               |
| 4  | 100W Tungsten                 | 100W              |
| 5  | 1 × 8W (F) EL                 | 10W               |
| 6  | 2 × 8W (F) LAMPU 'K' SIGN     | 20W               |
| 7  | 9W PLC                        | 15W               |
| 8  | 11W PLC                       | 17W               |
| 9  | 13W PLC                       | 19W               |
| 10 | 18W PLC                       | 24W               |
| 11 | 9W PLCE                       | 10W               |
| 12 | 11W PLCE                      | 12W               |
| 13 | 13W PLCE                      | 14W               |
| 14 | 18W PLCE                      | 20W               |
| 15 | 50W Halogen Bulb              | 50W               |
| 16 | 70W Metal Halide/SON          | 80W               |
| 17 | 150W Metal Halide/SON         | 170W              |
| 18 | 250W Metal Halide/SON         | 280W              |
| 19 | 400W Metal Halide/SON         | 440W              |
| 20 | Obstruction Light             | 100W              |
| 21 | Electric Bell                 | Ignore            |
| 22 | 2 × 8W (F) Insect Killer      | 20W               |
| 23 | 1500mm Ceiling Fan            | 80W               |
| 24 | 1200mm Ceiling Fan            | 60W               |
| 25 | 400mm Wall Fan                | 60W               |
| 26 | 500mm Wall Fan                | 80W               |
| 27 | 400mm Automatic Fan           | 80W               |
| 28 | 200mm Exhaust Fan             | 15W               |
| 29 | 250mm Exhaust Fan             | 25W               |
| 30 | 300mm Exhaust Fan             | 40W               |
| 31 | 13A 3P Switched Socket Outlet | 250W              |
| 32 | 15A Switched Socket Outlet    | 500W              |
| 33 | 15A SPN Isolator              | Motor H.P. rating |
| 34 | 20A SPN Isolator              | Motor H.P. rating |
| 35 | 30A SPN Isolator              | Motor H.P. rating |
| 36 | 15A TPN Isolator              | Motor H.P. rating |
| 37 | 20A TPN Isolator              | Motor H.P. rating |

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|  | <b>PANDUAN TEKNIK<br/>CAWANGAN KEJURUTERAAN ELEKTRIK<br/>EDISI 4</b> | <b>CKE.GP.01.43(00).2011</b>       |
|   |  | <b>JKR 20300-025-09</b>            |
|   |  | Date : 1 <sup>st</sup> August 2011 |
| <b>CHAPTER<br/>5.0</b>  | <b>GUIDELINES FOR SCHEMATIC DESIGN</b>                               | Page : C5/ 13 of 14                |

| NO | DESCRIPTION         | ESTIMATED LOAD    |
|----|---------------------|-------------------|
| 38 | 30A TPN Isolator    | Motor H.P. rating |
| 39 | 45A TPN Isolator    | Motor H.P. rating |
| 40 | 60A TPN Isolator    | Motor H.P. rating |
| 41 | 1 HP Air-Cond       | 746W              |
| 42 | 1.5 HP Air-Cond     | 1119W             |
| 43 | 2 HP Air-Cond       | 1492W             |
| 44 | 2.5 HP Air-Cond     | 1865W             |
| 45 | 3 HP Air-Cond       | 2238W             |
| 46 | Water Heater        | 3Kw               |
| 47 | Cooker              | 7.5Kw             |
| 48 | Booster Pump        | Motor H.P. rating |
| 49 | Fire Fighting Pump  | Motor H.P. rating |
| 50 | Fire Fighting Panel | 250W              |
| 51 | CO2 Point           | 500W              |
| 52 | SATS System         | 500W              |
| 53 | HI KLEEN System     | Motor H.P. rating |



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|  | <p>PANDUAN TEKNIK<br/>CAWANGAN KEJURUTERAAN ELEKTRIK<br/>EDISI 4</p> | <p>CKE.GP.01.43(00).2011</p>             |
|   |  | <p>JKR 20300-025-09</p>                  |
|   |  | <p>Date : 1<sup>st</sup> August 2011</p> |
| <p>CHAPTER<br/>5.0</p>  | <p>GUIDELINES FOR SCHEMATIC DESIGN</p>                               | <p>Page : C5/ 14 of 14</p>               |

Appendix 2: Diversity Factor (DF)

Updated: 21<sup>st</sup> March 2008

| Building         | School | Health    |               | Mosque | Hall | Hostel |           | Dining Hall/ Canteen | Office | Lab      |         | Quarters |
|------------------|--------|-----------|---------------|--------|------|--------|-----------|----------------------|--------|----------|---------|----------|
|                  |        | Essential | Non-Essential |        |      | School | Executive |                      |        | Computer | Science |          |
| Lamp/ Fan        | 0.8    | 0.8       | 0.9           | 0.9    | 0.8  | 0.8    | 0.8       | 0.8                  | 0.8    | 0.8      | 0.8     | 0.8      |
| 13A S/S/O        | 0.1    | 0.4       | 0.4           | 0.4    | 0.4  | 0.1    | 0.4       | 0.4                  | 0.4    | 0.6      | 0.6     | 0.5      |
| 15A S/S/O        | 1      | 1         | 1             | 1      | 1    | 1      | 1         | 1                    | 1      | 1        | 1       | 1        |
| AC Motor Pump    | 1      | 1         | 1             | 1      | 1    | -      | 1         | 1                    | 1      | 1        | 1       | 1        |
| Outdoor Lighting | 1      | 1         | 1             | 1      | -    | -      | -         | -                    | 1      | 1        | 1       | 1        |
| Water Heater     | -      | -         | -             | -      | -    | -      | 1         | 1                    | -      | -        | -       | 1        |
| Cooker Unit      | 1      | 1         | 1             | -      | -    | -      | -         | -                    | -      | -        | -       | -        |
| Isolator         | 1      | 1         | 1             | 1      | 1    | 1      | 1         | 1                    | 1      | -        | -       | -        |

Note: \* DF may be relook based on the day and night profile usage.