

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 II : 2022/2023

DCB20042: BUILDING ELECTRICAL SERVICES

TARIKH : 14 JUN 2023

MASA : 2.30 PTG – 4.30 PTG (2 JAM)

Kertas ini mengandungi **SEMBILAN (9)** halaman bercetak.

Bahagian A: Subjektif (2 soalan)

Bahagian B: Subjektif (4 soalan)

Dokumen sokongan yang disertakan : Lampiran 1, 2, 3, 4a, 4b & 5

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) A 32A fuse is labelled with 1.5 fuse factor. Estimate the minimum current at which the fuse element melts.

Satu fius 32A dilabelkan dengan faktor fius 1.5. Anggarkan arus minimum di mana elemen fius akan mencair.

[5 marks]

[5 markah]

- CLO2 (b) Referring to **Appendices 1, 2 & 3** calculate the current of miniature circuit breaker (MCB) for the following cases:

Merujuk Lampiran 1, 2 & 3 kirakan arus bagi pemutus litar kenit (PLK) bagi kes-kes berikut:

- (i) A 3.0 kW water heater for an executive hostel supplied by a single-phase voltage.

Sebuah pemanas air 3.0 kW bagi asrama eksekutif yang dibekalkan oleh voltan satu fasa.

- (ii) 10 units of 60 watts tungsten lamps for an office supplied by a single-phase voltage.

10 unit lampu tungsten 60 watt untuk pejabat yang dibekalkan oleh voltan satu fasa.

[10 marks]

[10 markah]

- CLO2 (c) Referring to **Appendix 4a & 4b**, calculate the acceptable cable size for the following installation.

Merujuk kepada Lampiran 4a & 4b, kirakan saiz kabel yang boleh diterima untuk pemasangan berikut.

Loads/ <i>Beban</i>	=	5.0 kW
Supply voltage/ <i>Voltan bekalan</i>	=	Single phase/ <i>Satu fasa</i>
Wiring type/ <i>Jenis pendawaian</i>	=	Enclosed in trunking/ <i>Bertutup dalam pembuluh</i>
Cable length/ <i>Panjang kabel</i>	=	20 m

[10 marks]

[10 markah]

QUESTION 2

SOALAN 2

- CLO2 (a) Convert the following devices into electrical symbols.
Tukarkan peranti-peranti berikut kepada simbol elektrik.

- i. Ceiling fan/ *Kipas siling*
- ii. Fluorescent lamp/ *Lampu kalimantang*
- iii. Switch socket outlet/ *Soket alur keluaran*
- iv. Emergency lamp/ *Lampu kecemasan*
- v. Distribution board/ *Papan agihan*

[5 marks]

[5 markah]

- CLO2 (b) By using the data on **Table A2(b)**, calculate the current for Total Connected Load (I_{TCL}) and the current for Total Maximum Demand (I_{TMD}) for the classroom. Assume Diversity Factor (DF) for lamp and fan as 0.8, 13A switch socket outlet as 0.1 and the power factor is 0.85. Refer the **Appendix 1** for Connected Load.

Menggunakan data pada **Jadual A2(b)**, kirakan arus Jumlah Beban Sambungan (I_{JS}) dan arus Jumlah Permintaan Maksimum (I_{JPM}) untuk bilik darjah tersebut. Anggarkan Faktor Diversiti (FD) untuk lampu dan kipas sebagai 0.8; soket alur keluaran 13A sebagai 0.1 dan faktor kuasa adalah 0.85. Rujuk **Lampiran 1** untuk nilai Beban Sambungan.

Table A2(b)/ Jadual A2(b)

CIRCUIT/ LITAR	LOADS/ BEBAN	NUMBER/ BILANGAN
Circuit 1/ Litar 1	1 X 36W Fluorescent Lamp/ Lampu Kalimantan 400mm Wall Fan/ Kipas Dinding	6 4
Circuit 2/ Litar 2	60W Tungsten Lamp/ Lampu Tungsten 1200mm Ceiling Fan/ Kipas Siling	6 2
Circuit 3/ Litar 3	13A Switch Socket Outlet/ Soket Alur Keluaran	2
Circuit 4/ Litar 4	13A Switch Socket Outlet/ Soket Alur Keluaran	2

[10 marks]

[10 markah]

- CLO2 (c) Based on the given data in **Table A2(b)**, produce a wiring schematic diagram consisting of the main switch, residual circuit devices (RCD), miniature circuit breakers (MCB) and final circuits. Refer to **Appendix 5** to allocate RCD current sensitivity and minimum cable size.

Berdasarkan pada data diberi pada **Jadual A2(b)**, hasilkan sebuah rajah skematik pendawaian yang terdiri daripada suis utama, peranti litar baki (PLB), pemutus litar kenit (PLK) dan litar akhir. Rujuk **Lampiran 5** untuk menentukan kepekaan PLB dan saiz kabel minimum.

[10 marks]

[10 markah]

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

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

ARAHAN:

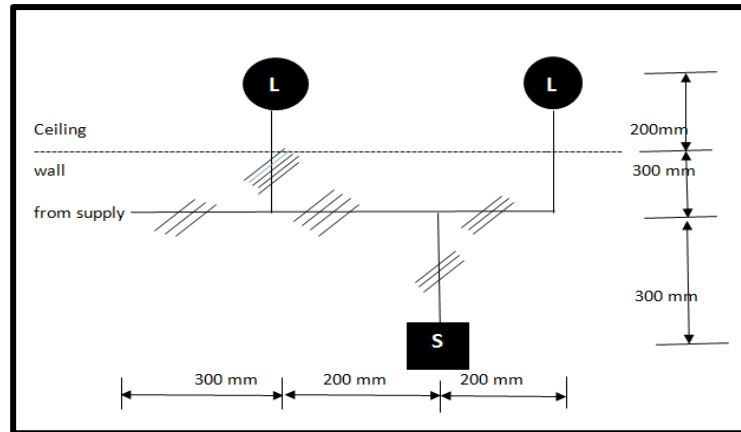
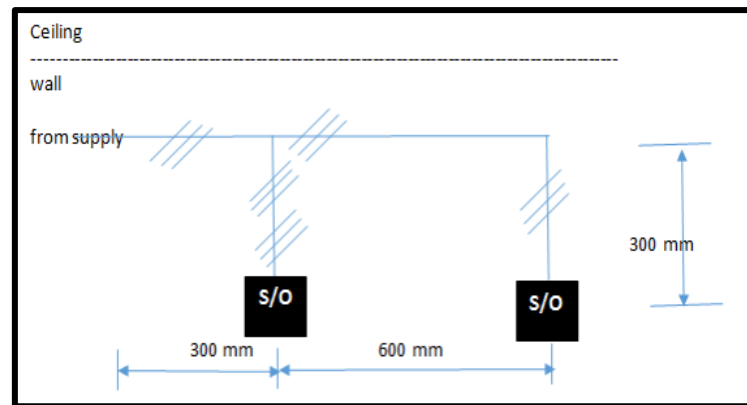
Bahagian ini mengandungi EMPAT (4) soalan subjektif. Jawab DUA (2) soalan sahaja.

QUESTION 1**SOALAN 1**

- CLO1 (a) Identify **FIVE (5)** methods of a distribution system.
Kenalpasti LIMA (5) kaedah sistem pengagihan.
- [5 marks]
[5 markah]
- CLO1 (b) By using a diagram explain how hydro energy is converted to electrical energy by using a diagram.
Terangkan dengan gambar rajah, bagaimana tenaga hidro ditukar kepada tenaga elektrik.
- [10 marks]
[10 markah]
- CLO1 (c) Sketch with appropriate labels, an example of a Single-Phase Consumer Unit Schematic Diagram.
Lakarkan berserta label yang sesuai, satu contoh Diagram Skematik Unit Pengguna bagi bekalan Satu Fasa.
- [10 marks]
[10 markah]

QUESTION 2**SOALAN 2**

- CLO1 (a) Identify **FIVE (5)** basic components in the consumer unit.
Kenal pasti LIMA (5) komponen asas dalam unit pengguna.
- [5 marks]
[5 markah]
- CLO1 (b) By using all the listed components in **Question B2(a)**, sketch the following distribution circuit:
Dengan menggunakan semua komponen yang disenaraikan pada Soalan B2(a), lakar litar agihan berikut:
- (i) Distribution for multi storey building
Pengagihan untuk bangunan bertingkat
- (ii) Distribution circuit power and lighting
Pengagihan litar kuasa dan lampu
- [10 marks]
[10 markah]
- CLO1 (c) **Figure B2(c)(i)** and **Figure B2(c)(ii)** show the block diagram of wiring installation. Sketch the details of the circuit diagram for both.
Rajah B2(c)(i) dan Rajah B2(c)(ii) menunjukkan diagram blok bagi pemasangan pendawaian. Lakarkan litar diagram terperinci bagi keduanya.
- [10 marks]
[10 markah]

Figure B2(c)(i)/ *Rajah B2(c)(i)*Figure B2(c)(ii)/ *Rajah B2(c)(ii)*

QUESTION 3

SOALAN 3

- CLO1 (a) Identify **FIVE (5)** wiring systems that are commonly used in buildings.
Kenalpasti LIMA (5) sistem pendawaian yang biasa digunakan dalam bangunan.
- [5 marks]
[5 markah]
- CLO1 (b) Explain **FIVE (5)** IEEE regulations for switch.
Jelaskan LIMA (5) peraturan IEEE untuk suis.
- [10 marks]
[10 markah]

- CLO1 (c) Group 1 has completed a wiring practical for a single lamp with one switch circuit. As one of the team members, you need to conduct a test to ensure each conductor in the circuit has its continuity. With the aid of a diagram, explain the method of conducting the test.

Kumpulan 1 telah siap melaksanakan praktikal pendawaian untuk litar satu lampu dengan satu suis. Sebagai salah seorang ahli pasukan, anda perlu melakukan ujian bagi memastikan setiap pengalir di dalam litar mempunyai keterusan. Dengan bantuan gambarajah, jelaskan kaedah bagi melaksanakan ujian tersebut.

[10 marks]

[10 markah]

QUESTION 4

SOALAN 4

- CLO1 (a) Identify **FIVE (5)** importances of electrical installation to be earthed.
*Kenalpasti **LIMA (5)** kepentingan pemasangan elektrik perlu dibumikan.*

[5 marks]

[5 markah]

- CLO1 (b) The Electricity Supply Regulations 1994 in **Figure B4(b)** shows that there are few methods that can be used for earthing. Produce an information chart to simplify the meaning of earthing methods.

*Peraturan Bekalan Elektrik 1994 dalam **Rajah B4(b)** menunjukkan terdapat beberapa kaedah yang boleh digunakan untuk pbumian. Hasilkan carta maklumat untuk memudahkan maksud kaedah pbumian.*

▶ Regulation 35. Method of earthing.

In any installation a complete system of earthing conductors made of an acceptable material and having an adequate cross-sectional area with one or more earth plates, pipes or rods shall be provided. Such system of earthing conductors shall be connected to the earth and effectively maintained.

Figure B4(b)/ Rajah B4(b)

[10 marks]

[10 markah]

CLO1

- (c) Explain how the following factors can affect the level of earthing resistance.
Terangkan bagaimana faktor-faktor berikut boleh mempengaruhi tahap rintangan pbumian.
- i. Soil condition/ *Keadaan tanah*
 - ii. Moisture in soil/ *Kelembapan dalam tanah*
 - iii. Physical composition/ *Komposisi fizikal*
 - iv. Climate condition/ *Keadaan cuaca*
 - v. Dissolved salt/ *Keterlarutan garam*

[10 marks]

[10 markah]

SOALAN TAMAT

APPENDIX 1 / LAMPIRAN 1

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
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

Appendix 2: Diversity Factor (DF)

Updated: 21st 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.

APPENDIX 3 / LAMPIRAN 3

Fuse rate for MCCB, MCB & RCCB

Keterangan MCCB

- Kadar Voltan : 230V/400V
- Kadar Arus : 16A, 20A, 30A, 40A, 50A, 60A, 80A, 100A, sehingga 2000A
- *Double Pole/TPN/4 Pole*

Keterangan MCB

- Kadar Voltan : 230V/400V
- Kadar Arus : 2A, 4A, 6A, 10A, 16A, 20A, 25A, 32A, 40A, 50A, 63A
- *Single Pole/Double Pole/3 Pole/4 Pole*

Keterangan (RCCB)

- Kadar Voltan : 230V/400V
- Kadar Arus : 16A, 25A, 40A, 63A, 80A
- Kepekaan : 10mA, 30mA, 100mA, 300mA, 500mA
- *Double Pole/4 Pole*

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

BS 6004

BS 6231

BS 6346

Ambient temperature : 30 °C

Conductor operating temperature : 70 °C

CURRENT-CARRYING CAPACITY (amperes):

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	3	2	3 or 4	2	3 or 4	2	3 or 4	Horizontal flat spaced	Vertical flat spaced	Trefoil	
1	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)
1.5	11	10.5	13.5	12	15.5	14	-	-	-	-	-	-
	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	110
35	99	89	125	110	141	129	156	141	181	162	137	137
50	119	108	151	134	182	167	191	172	219	197	167	167
70	151	136	192	171	234	214	246	223	281	254	216	216
95	182	164	232	207	284	261	300	273	341	311	264	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 a wall)	Reference Method 11 (clipped direct or on trays, touching)	Reference Method 1 & 12 (spaced*)	Reference Method 3 & 4 (Enclosed in conduit etc. in or on a wall)	Reference Method 11 & 12 (in trefoil)	Reference Method 1 & 11 (flat and touching)	Reference Method 12 (spaced*)	
1	2	4	4	5	6	7	8	9		
(mm ²)	(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		
25	1.75	1.80	1.75	1.75	1.50	1.50	1.50	1.50		
35	1.25	1.30	1.25	1.25	1.10	1.10	1.10	1.10		
50	0.93	0.95	0.93	0.93	0.81	0.80	0.80	0.80		
70	0.63	0.65	0.63	0.63	0.56	0.55	0.55	0.55		
95	0.46	0.49	0.47	0.47	0.42	0.41	0.41	0.40		

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

APPENDIX 5 / LAMPIRAN 5

Requirements For the Use of Residual Current Circuit Breakers (Sensitivity) Based on Regulation 36, Electricity Regulations 1994

No.	Installation Type	Residual Current Device Sensitivity (Maximum)	Requirement
1.	Overall Wiring (Single Phase or Three Phase)	100mA (0.1A)	Mandatory
2.	Final Circuit for Power (13A socket outlets)	30mA (0.03A)	Mandatory
3.	Wet places (toilets and wet kitchens) /Water heater circuits	10mA (0.01A)	Mandatory

Use of Minimum Cross Sectional Area Rating of Wiring Conductors

The following are the minimum cross sectional areas of conductors based on their applications:-

Conductor Cross Sectional Area in mm ²	Material	Application
1.5 mm ²	Copper	Lighting/fan circuit
2.5 mm ²	Copper	13A socket outlet circuit
4.0 mm ² – 6.0 mm ²	Copper	General Power Circuit (example: water heater, cooker unit, motor/pump)
16.0 mm ² / 25.0 mm ²	Copper	Main Circuit