

**SULIT**



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

**JABATAN KEJURUTERAAN AWAM**

**PEPERIKSAAN AKHIR**

**SESI II : 2021 / 2022**

**DCB20042: BUILDING ELECTRICAL SERVICES**

**TARIKH : 5 JULAI 2022**

**MASA : 11.30 PAGI – 1.30 PETANG (2 JAM)**

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Kertas ini mengandungi **TUJUH (7)** halaman bercetak.

Bahagian A: Struktur (3 soalan)

Bahagian B: Esei (1 soalan)

Dokumen sokongan yang disertakan : Jadual Rujukan Rekabentuk Elektrik

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**JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN**

(CLO yang tertera hanya sebagai rujukan)

**SULIT**

**SECTION A : 75 MARKS*****BAHAGIAN A : 75 MARKAH*****INSTRUCTION:**

This section consists of **THREE (3)** essay structured questions. Answer **ALL** questions.

***ARAHAN :***

*Bahagian ini mengandungi TIGA (3) soalan esei berstruktur. Jawab SEMUA soalan.*

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

CLO1  
C2

- (a) Identify **FIVE (5)** sources of energy used in electrical power generation.

*Kenalpasti LIMA (5) sumber tenaga yang digunakan dalam penjanaan kuasa elektrik.*

[5 marks]

[5 markah]

CLO1  
C3

- (b) The electrical supply distributed to the consumer through distribution line by a single-phase system or three phase system. Explain single phase system.

*Bekalan elektrik diagihkan kepada pengguna melalui talian agihan secara sistem satu fasa dan sistem tiga fasa. Huraikan sistem satu fasa.*

[10 marks]

[10 markah]

CLO1  
C3

- (c) There are two types of circuit connection for socket outlet which is radial and ring.  
Draw a connection of ring circuit for five socket outlets.

*Terdapat dua jenis sambungan litar untuk soket alur keluar iaitu jejari dan gelang. Lukiskan sambungan litar secara gelang bagi lima buah soket keluaran.*

[10 marks]

[10 markah]

## QUESTION 2

### SOALAN 2

CLO1  
C2

- (a) Identify **FIVE (5)** factors in selecting a surface type wiring.

*Kenalpasti **LIMA (5)** faktor dalam pemilihan pendawaian permukaan.*

[5 marks]

[5 markah]

CLO1  
C2

- (b) Trunking wiring system are most often used in larger electrical panels installations.  
Discuss **FIVE (5)** advantages of trunking wiring types.

*Sistem pendawaian sesalur paling kerap digunakan dalam pemasangan panel elektrik yang lebih besar. Bincangkan **LIMA (5)** kelebihan sistem pendawaian sesalur.*

[10 marks]

[10 markah]

CLO1  
C3

(c) Calculate the maximum current and final circuits required by the following situations below if the supply voltage of 240 V and 5-Amp fuse is used.

- i. Installation of 20 units of filament lamp 40 watt and 15 units of 100-watt ceiling fans.

[5 marks]

- ii. Installation of 25 units of filament lamp 80 watt and 10 units of fluorescent lamp 36-watt ceiling fans.

[5 marks]

*Kirakan arus maksima dan jumlah litar akhir yang diperlukan oleh situasi – situasi berikut sekiranya voltan bekalan adalah 240 V dan fius 5 Amp digunakan.*

- i. *Pemasangan bagi 20 unit lampu filament 40 watt dan 15 unit kipas siling 100 watt.*

[5 markah]

- ii. *Pemasangan bagi 25 unit lampu filament 80 watt dan 10 unit kipas siling 36 watt.*

[5 markah]

**QUESTION 3****SOALAN 3**CLO1  
C2

(a) Identify **FIVE (5)** situations in which earthing are not required.

*Kenalpasti **LIMA (5)** keadaan di mana pbumian tidak diperlukan.*

[5 marks]

[5 markah]

CLO1  
C2

(b) Illustrate the TN-S System for grounding wiring connection.

*Ilustrasikan Sistem TN-S bagi sambungan pendawaian pbumian.*

[10 marks]

[10 markah]

CLO1  
C3

(c) Sketch the diagram of ring circuit continuity test of a single-phase wiring installation.

*Lakarkan gambarajah bagi ujian keterusan litar gelang pada pemasangan pendawaian satu fasa.*

[10 marks]

[10 markah]

**SECTION B: 25 MARKS*****BAHAGIAN B: 25 MARKAH*****INSTRUCTION:**

This section consists of **ONE (1)** essay question. Answer the question.

***ARAHAN :***

*Bahagian ini mengandungi SATU (1) soalan esei. Jawab soalan tersebut.*

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

CLO2  
C3

- (a) A 2.5hp air conditioner is supplied with single-phase 240V. Calculate the current rating of over current protection referring to standard and regulation for the air – conditioner.

*Sebuah penyaman udara 2.5kk dibekalkan dengan voltan satu-fasa 240V. Kirakan kadar arus untuk pelindung lebihan arus merujuk kepada peraturan dan piawai bagi penyaman udara ini.*

[5 marks]

[5 markah]

CLO2  
C3

- (b) A quarters receives a single-phase supply, 240V and 0.85 p.f, installs, 6 points 60 Watt tungsten lamp, 1 unit of 1.5hp air conditioner and 1 unit of 3kW water heater. By refer to **Appendix 1** and **Appendix 2**, calculate:

- i. Total Connected Load (TCL)

[5 marks]

- ii. Maximum Demand (MD)

[5 marks]

*Sebuah kuarters menerima bekalan satu fasa, 240V dan 0.85 f.k, membuat pemasangan 6 poin lampu tungsten 60 Watt, 1 unit 1.5kk penyaman udara dan 1 unit pemanas air 3kW. Dengan merujuk **Appendix 1** dan **Appendix 2**, kirakan:*

i. *Jumlah Beban Tersambung (TCL*

*[5 markah]*

ii. *Permintaan Maksimum (MD)*

*[5 markah]*

CLO2  
C3

(c) PVC single-core cable will be used for installation of conduit wiring systems with 2500 Watt. The source distance from the supply is 25 meters with 240V supply. Calculate the appropriate cable size.

*Kabel PVK teras-tunggal akan digunakan bagi pemasangan sistem pendawaian conduit dengan kuasa 2500 Watt. Jarak antara punca daripada bekalan ialah 25 meter dengan bekalan 240V. Kirakan saiz kabel yang sesuai.*

*[10 marks]*

*[10 markah]*

**SOALAN TAMAT**

**TABLE 1: CURRENT – CARRYING CAPACITY**

CURRENT-CARRYING CAPACITY (amperes):

Ambient temperature : 30°C  
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
									2 cables single phase a.c. or d.c. or 3 cables three phase a.c.	2 cables single phase a.c. or d.c. or 3 cables three phase a.c.	3 cables trefoil. three phase a.c.
	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	20	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
120	210	188	269	239	330	303	349	318	396	362	308
150	240	216	300	262	381	349	404	369	456	419	356
185	273	245	341	296	436	400	463	424	521	480	409
240	320	286	400	346	515	472	549	504	615	569	485
300	367	328	458	394	594	545	635	584	709	659	561
400	-	-	546	467	694	634	732	679	852	795	656
500	-	-	626	533	792	723	835	778	982	920	749
630	-	-	720	611	904	826	953	892	1138	1070	855
800	-	-	-	-	1030	943	1086	1020	1265	1188	971
1000	-	-	-	-	1154	1058	1216	1149	1420	1337	1079

**NOTES:**

1. Where the conductor is to be protected by a semi-enclosed fuse to BS3036, see item 6.2 of the preface to this appendix within the 16th edition regs.

2 The current-carrying capacities in columns 2 to 5 are also applicable to flexible cables to BS6004 table 1(c) and to 90°C heat resisting pvc cables to BS6231 tables 8 and 9 where the cables are used in fixed installations.



## TABLE 2: VOLTAGE DROP

VOLTAGE DROP (per ampere per metre)

### TABLE 4D1B

Conductor operating temperature: 70°C

Conductor cross-sectional area  1	2 cables d.c.  2	2 cables, single phase a.c.									3 or 4 cables, three-phase a.c.											
		Reference Methods 3&4 (enclosed in conduit etc, in or on a wall). 3			Reference Methods 1 & 11 (clipped direct or on trays, touching) 4			Reference Method 12 (spaced*) 5			Reference Methods 3&4 (enclosed in conduit etc, in or on a wall). 6			Reference Methods 1, 11 & 12 (in trefoil) 7			Reference Methods 1 & 11 (flat and touching) 8			Reference Method 12 (flat spaced *) 9		
		(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
120	0.36	0.39	0.27	0.47	0.37	0.175	0.41	0.37	0.26	0.45	0.33	0.23	0.41	0.32	0.150	0.36	0.32	0.23	0.40	0.32	0.30	0.44
150	0.29	0.31	0.27	0.41	0.30	0.175	0.34	0.29	0.26	0.39	0.27	0.23	0.36	0.26	0.150	0.30	0.26	0.23	0.34	0.26	0.30	0.40
185	0.23	0.25	0.27	0.37	0.24	0.170	0.29	0.24	0.26	0.35	0.22	0.23	0.32	0.21	0.145	0.26	0.21	0.22	0.31	0.21	0.30	0.36
240	0.180	0.195	0.26	0.33	0.185	0.165	0.25	0.185	0.25	0.31	0.17	0.23	0.29	0.160	0.145	0.22	0.160	0.22	0.27	0.160	0.29	0.34
300	0.145	0.160	0.26	0.31	0.150	0.165	0.22	0.150	0.25	0.29	0.14	0.23	0.27	0.130	0.140	0.190	0.130	0.22	0.25	0.130	0.29	0.32
400	0.105	0.130	0.26	0.29	0.120	0.160	0.20	0.115	0.25	0.27	0.12	0.22	0.25	0.105	0.140	0.175	0.105	0.21	0.24	0.100	0.29	0.31
500	0.086	0.110	0.26	0.28	0.098	0.155	0.185	0.093	0.24	0.26	0.10	0.22	0.25	0.086	0.135	0.160	0.086	0.21	0.23	0.081	0.29	0.30
630	0.068	0.094	0.25	0.27	0.081	0.155	0.175	0.076	0.24	0.25	0.08	0.22	0.24	0.072	0.135	0.150	0.072	0.21	0.22	0.066	0.28	0.29
800	0.053	-	-	-	0.068	0.150	0.165	0.061	0.24	0.25	-	-	-	0.060	0.130	0.145	0.060	0.21	0.22	0.053	0.28	0.29
1000	0.042	-	-	-	0.059	0.150	0.160	0.050	0.24	0.24	-	-	-	0.052	0.130	0.140	0.052	0.20	0.21	0.044	0.28	0.28

NOTE: \* Spacings larger than those specified in Method 12 (see table 4A 16th edition regs) will result in larger volt drop.

Tables 4D1A & 4D1B are extracted from IEE Regs, 16th Edition which must be used in order to correctly apply these tables. A copy may be obtained from: Institution of Electrical Engineers, PO Box 96, Stevenage, Hertfordshire, ENGLAND, SG1 2SD.

## APPENDIX 1: TCL GUIDE

### 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

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

## APPENDIX 2: DIVERSITY FACTOR

### 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.