UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
Sidang Akademik 2007/2008

April 2008

EEK 365 – SISTEM PENGAGIHAN ELEKTRIK KUASA

Masa: 3 jam

Sila pastikan bahawa kertas peperiksaan ini mengandungi SEPULUH muka surat dan DUA muka surat LAMPIRAN yang bercetak sebelum anda memulakan peperiksaan ini.

Kertas soalan ini mengandungi ENAM soalan.

Jawab LIMA soalan.

Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru.

Agihan markah bagi setiap soalan diberikan di sudut sebelah kanan soalan berkenaan.

Jawab semua soalan dalam bahasa Malaysia atau bahasa Inggeris atau kombinasi kedua-duanya.

...2/-

1. Terdapat dua penyuap dari pencawang utama (Rajah 1) yang mempunyai pengubah 11/0.433 kV yang bercabang pada talian di A, B, C, D, E, F, G, H dan I. Tiga pembahagi telah dipasang di dalam sistem tersebut dan akan beroperasi seperti di dalam gambarajah.

There are two feeders from the main substation (Figure 1) has 11/0.433 kV transformer spur line at A, B, C, D, E, F, G, H and I. Three sectionalizer installed in the system and operate as shown in diagram.

(a) Merujuk kepada Lampiran, tentukan saiz konduktor pada penyuap dan kejatuhan voltan pada penghujung K pada keadaan kebiasaan di mana voltan pengaturan di dalam lingkungan 5%.

With the info given in the Appendix, determine the feeder conductor size and voltage drop at the end K in normal condition where the voltage regulation is within 5%.

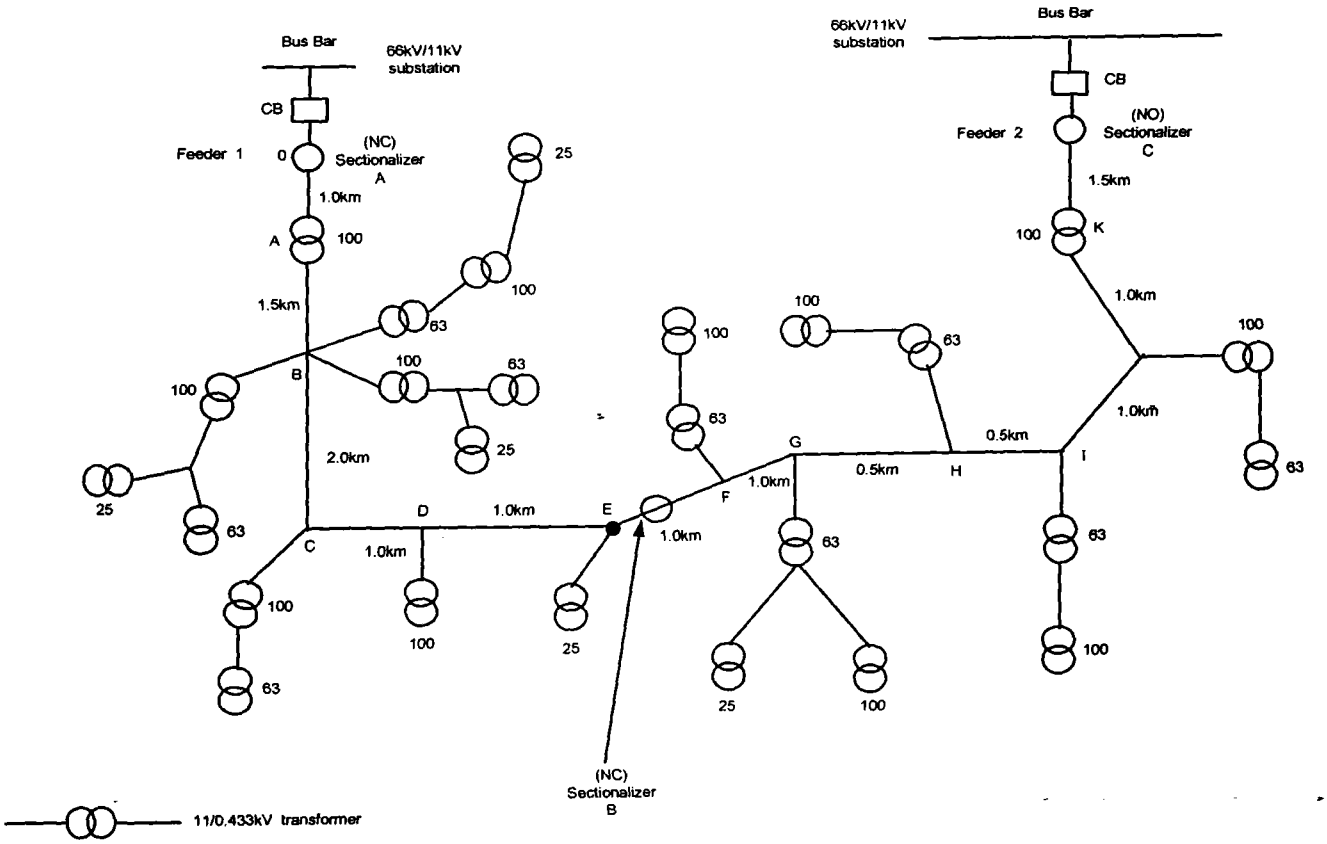
(50%)

(b) Perancangan untuk sistem pengagihan seperti di dalam gambarajah telah berubah di mana pembahagi A dan C akan biasa tertutup dan pembahagi B beroperasi dalam keadaan biasa terbuka, justeru mengasingkan penyuap 1 dan penyuap 2 pada titik E. Pada pengaturan voltan yang sama tentukan saiz konduktor penyuap 1 dan kejatuhan voltan pada hujung titik E.

Planning for the distribution system in Figure changed where sectionalizer A and C will be normally closed and sectionalizer B operates as normally opened which separated Feeder 1 and Feeder 2 at point E. Under the same voltage regulation determine conductor size of feeder 1 and voltage drop at end point of E.

(50%)

...3/-



Rajah 1
Figure 1

2. Terdapat 6 sistem pengagihan yang asas digunakan oleh penyedia bekalan kuasa. Terangkan 5 daripada sistem tersebut dengan merujuk kepada tatarajah, keboleharapan dan kesesuaian terhadap jenis beban dengan bantuan gambarajah.

There are six basic distribution system used by utilities. Explain only five of them with regard to system of configuration, reliability and suitable types of load with assist of figure.

(100%)

...4/-

3. Suatu diagram pendawaian daripada sistem pengagihan elektrik kuasa seperti yang ditunjukkan dalam Rajah 3. Beban-beban yang tersambung pada sub-distribution panels (SDP) diberikan dalam senarai Jadual IIIA. Seluruh cables diletakan didalam trunkings besi. Dengan menggunakan data yang tersedia dalam Jadual IIIB, C dan D dan voltage drop maksimum ialah 2.5%, kira :

A wiring diagram of a power distribution system such shown in Figure 3. Loads that connected on sub-distribution panels (SDP) are given in Table IIIA. All the cables are to be in steel trunkings. Using the data provided in Table IIIB, C and D and a maximum voltage drop of 2.5%, calculate :

(a) Size seluruh circuit breakers (MCB), di mana MCBs yang tersedia adalah 5 A, 6 A, 10 A, 16 A, 20 A, 25 A, 35 A, 45 A, 50 A, 60 A, 75 A and 100 A

The size of all circuit breakers (MCB), where MCBs available are at 5 A, 6 A, 10 A, 16 A, 20 A, 25 A, 35 A, 45 A, 50 A, 60 A, 75 A and 100 A

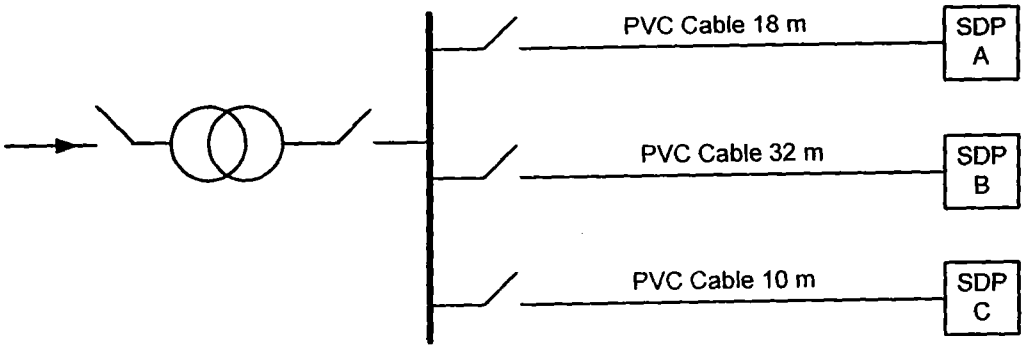
(b) Size seluruh kabel PVC yang diperlukan jika tida ada kabel lain yang terdapat di dalam trunking tersebut dan suhu ambient ialah 35°C.

The size of all PVC cables required if no other sets of cables in the trunking and the ambient temperature is 35°C.

(c) Rating transformer (kVA).
The rating of transformer (kVA).

(d) Rating busbar
The rating of busbar

...5/-



Rajah 3
Figure 3

Table IIIA SDP Loads Rating

Sub-Distribution Panel	Type of loads	Quatity (pcs)
SDP A	Indoor lighting lamps 100 W, 240 V, pf = 1	30
	Electric Pumps, induction motor 500 W, 240 V, pf = 0.7	3
	Out door lighting lamps 40 W, 240 V, pf =0.6	9
	Milling machine (3-phase Induction Motor), 200 W, 415 V, 50 Hz, pf = 0.7	10
SDP B	Lift (3-phase induction motor), 15 Hp, 415 V, 50 Hz, pf = 0.8	1
	Three-phase Outlet (power point), 415 V, 3000 W	3
	Fans (3-phase induction motor), 10 Hp, 415 V, 50 Hz, pf = 0.7	2
SDB C	Computer, 240 V, 200 W, pf = 0.6	30
	Outlet (power point), 1000 W, 240 V	15
	Photocopy machine, 240 V, 500 W, pf =0.8	3

...6/-

Table IIIB Correction Factor For Ambient Temperature of PVC Cables

Ambient Temperature °C	25	30	35	40	45
Correction Factor	1.03	1.0	0.94	0.87	0.79

Table IIIC Current carrying capacity and voltage drops for PVC Cable

Conductor cross-sectional area (mm^2)	**Current carrying capacity for conduits (A)**	**Voltage drops (mV/A/m)**
4	32	11.0
6	41	7.3
10	57	6.1
16	75	4.4
25	135	3.5

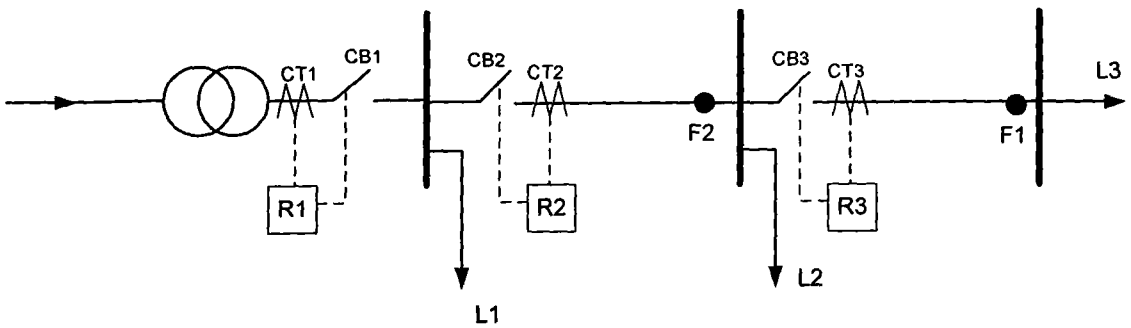
Table IIID Correction Factor For Groups of More Than one circuit of single-core cables installed in conduits or trunking

Ambient Temperature °C	25	30	35	40	45
Correction Factor	1.03	1.0	0.94	0.87	0.79

(100%)

4. Sistem pengagihan elektrik kuasa sederhana seperti yang ditunjukkan pada Rajah 4.

A simple radial power distribution system such as shown in Figure 4.



Rajah 4
Figure 4

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Tentukan setting plug settings (PS) dan seting time multiplier TM untuk seluruh geganti tiga fasa yang diberikan berikut ini :

Determine the plug settings (PS) and time multiplier ™ setting of all three relays given the following data:

(a) Geganti R3 adalah geganti IDMTL dengan time-current characteristic ialah :

$t = \frac{13.5}{M-1}$ di mana time multiplier setting geganti ini ialah 0.3.

Relay R3 is a IDMTL relay with time-current characteristic is :

$t = \frac{13.5}{M-1}$ *where the time multiplier setting of this relay is 0.3.*

(b) Geganti R1 dan geganti R2 adalah geganti IDMTL dengan time-current characteristic ialah :

Relay R1 and relay R2 are IDMTL relays with time-current characteristic is :

$$t = \frac{0.14}{M^{0.02}-1}$$

(c) Beban L1 : arus beban penuh = 350 A
Load L1 : full-load current = 350 A

Beban L2 : arus beban penuh = 200 A
Load L2 : full-load current = 200 A

Beban L3 : arus beban penuh = 100 A
Load L3 : full-load current = 100 A

...8/-

(d) Arus gangguan tiga fasa pada titik F1 = 1000 A
Three-phase fault current at point F1 = 1000 A

Arus gangguan tiga fasa pada titik F2 = 2000 A
Three-phase fault current at point F2 = 2000 A

(e) Ratio of relay R1 current transformer CT1 is 500/5 A
Ratio of relay R1 current transformer CT1 is 500/5 A

Ratio of relay R2 current transformer CT2 is 300/5 A
Ratio of relay R2 current transformer CT2 is 300/5 A

Ratio of relay R3 current transformer CT3 is 100/5 A
Ratio of relay R3 current transformer CT3 is 100/5 A

(f) Time discrimination antar geganti ialah 0.4 saat
Time discrimination between relays of 0.4 seconds

(100%)

5. Satu transformer pengagihan elektrik kuasa Dy, 25 MVA, 11 kV/ 415V, 50 Hz akan diamankan dengan menggunakan sistem pengamani differential. Restraint coil geganti adalah pada 5 A.

A 25 MVA, 11 kV/ 415V, 50 Hz Dy power distribution transformer is to be protected by a bias differential protection system. The restraint coil of the relay is rated at 5 A.

(a) Lukis litar untuk sistem pengaman tersebut.
Draw the circuit of that protection system.

(b) Kira ratio transformer arus CT yang digunakan pada kedua belah sisi transformer.
Calculate the ratios of the current transformer CT that used on both sides of the transformer.

(c) Kira arus leakage dalam geganti untuk proteksi transformer tersebut ketika transformer beroperasi pada beban penuh.

Calculate the leakage current in relay for the transformer protection when the transformer is operating at full load.

(100%)

6. Jawablah soalan-soalan berikut ini :
Answer these questions :

(a) Apa tujuan daripada pembumian di titik bintang pada penjana tiga fasa melalui suatu induktor?

What are the purposes of earthing the star point of a three-phase generators through an inductor ?

(b) Apa fungsi sistem pembumian ?.
What is function of an earthing system ?

(c) Bagaimana pengamanan overhead cables dan peralatan pole-mounted dari sambaran petir?

How do you protect overhead cables and pole-mounted equipment from direct lightning strikes ?

(d) Apa penyebab terjadinya elektrik satatik? Dan bagaimana memindahkannnya secara aman?

What are the causes of static electricity? and How can the static electricity be removed safely ?

(e) Arus gangguan daripada suatu litar telah pun dikira iaitu 30 kA. Jika breaker trip dalam masa 1.5 seconds, tentukan size CPC (circuit protective conductor) yang menggunakan kabel PVC dengan copper conductors k=143.

The fault current of a circuit was calculated to be 30 kA. If the breaker trip in 1.5 seconds, determine the size of CPC (circuit protective conductor) using PVC cables with copper conductors k=143.

(100%)

oooOooo

Voltage regulation—11 kV overhead lines

Conductor (ACSR) mm^2	km-MVA for line regulation at 0.85 pf (temperature rise 30°C), 70°C conductor					
	5%	6%	7%	8%	9%	10%
20	3.63	4.41	5.21	5.95	6.78	7.63
30	5.17	6.27	7.38	8.52	9.67	10.84
50	7.60	9.24	10.85	12.56	14.30	15.99
80	10.23	12.40	14.60	16.85	19.22	21.56
100	12.43	15.08	17.73	20.50	23.32	26.20

Aluminium Conductors, Galvanized Steel-reinforced (ACSR) IS: 398 (Part 2): 1996

Nominal aluminium area	Stranding and wire diameter		Sectional area of aluminium	Total sectional area	Approximate diameter	Approximate mass	Calculated resistance at 20°C maximum	Approximate calculated breaking load	Approx. current carrying capacity at 45°C ambient
	Aluminium	Steel							
(1) mm^2	(2) mm	(3) mm	(4) mm^2	(5) mm^2	(6) mm	(7) kg/km	(8) ohm/km	(9) kN	(10) (A)
10	6/1.50	1/1.50	10.60	12.37	4.50	43	2.780	3.97	–
18	6/1.96	1/1.96	18.10	21.12	5.88	73	1.618	6.74	–
20	6/2.11	1/2.11	20.98	24.48	6.33	85	1.394	7.61	107
30	6/2.59	1/2.59	31.61	36.88	7.77	128	0.9289	11.12	139
50	6/3.35	1/3.35	52.88	61.70	10.05	214	0:5524	18.25	193
80	6/4.09	1/4.09	78.83	91.97	12.27	319	0.3712	26.91	250
100	6/4.72	7/1.57	105.0	118.5	14.15	394	0.2792	32.41	300
150	30/2.59	7/2.59	158.1	194.9	18.13	726	0.1871	67.34	398
200	30/3.00	7/3.00	212.1	261.5	21.00	974	0.1390	89.67	482
400	42/3.50	7/1.96	404.1	452.2	26.88	1281	0.07311	88.79	–
420	54/3.18	7/3.18	428.9	484.5	28.62	1621	0.06868	130.32	736
520	54/4.13	7/3.53	528.5	597.0	31.77	1998	0.05595	159.60	835
560	42/4.13	7/2.30	562.7	591.7	31.68	1781	0.05231	120.16	–