UNIVERSITI TUN HUSSEIN ONN MALAYSIA

PEPERIKSAAN AKHIR
SEMESTER II
SESI 2008/2009

NAMA MATA PELAJARAN	: SISTEM KUASA ELEKTRIK
KOD MATA PELAJARAN	: DEK 3213
KURSUS	: 3 DEE/DET/DEX
TARIKH PEPERIKSAAN	: APRIL/MEI 2009
JANGKAMASA	: 2 1/2 JAM
ARAHAN	: JAWAB EMPAT (4) SOALAN SAHAJA DARIPADA ENAM (6) SOALAN

KERTAS SOALAN INI MENGANDUNGI LAPAN (8) MUKA SURAT

Q1 (a) **Briefly describe the load and Fault terms.**

(4 marks)

(b) **Give the definition of one-line diagram and state the advantages of the one-line diagram.**

(7 marks)

(c) **Briefly describe (use diagram to assist your explanation),**

(i) The Radial System
(ii) The Ring Main System

(14 marks)

Q2 (a) A 3-phase transformer 10 KVA, 440 V has a reactance of 4 Ω. Determine the per-unit reactance if the base value

(i) 15 KVA and 415 V
(ii) 5 KVA and 600 V

(4 marks)

(b) An interconnected system with its rated value is shown as in Figure Q2(b). Obtain the per-unit reactance and the base value for this system is chosen to be 11 kV and 50 MVA at the generator (G_2). Draw the equivalent impedance diagram (per-unit).

Ratings:

$$G_1 - 40\,MVA, 13.8kV, X = 20\%.$$
$$G_2 - 50\,MVA, 11kV, X = 35\%$$
$$T_1 - 40\,MVA, 13.8/69kV, X = 8\%$$
$$T_2 - 50\,MVA, 69/11kV, X = 9\%$$
$$T_3 - 30\,MVA, 64/34.5kV, X = 7\%$$
$$X_{TA} = j8\Omega$$
$$X_{TB} = j10\Omega$$
$$X_{TC} = j6\Omega$$

(21 marks)

Q3 A three-phase 50 Hz double circuit line is composed of ACSR Pelican conductors arranged as shown in Figure Q3. Calculate;

(a) inductive reactance in Ω/km per phase.
(b) capacitive reactance in Ω.km per phase to neutral.
($k = 8.85 \times 10^{-12}$F/m)

(25 marks)

Q4 (a) Most of the faults that occur on power systems are unsymmetrical faults. One of them is line to earth fault. Prove the equation below if fault occurs at line 'a' by using equation of symmetrical voltage and current.

$$I_{a1} = \frac{E_a}{Z_1 + Z_2 + Z_0}$$

(14 marks)

(b) Calculate the three-phase fault current and the corresponding fault level in MVA by using a base of 100 MVA if fault occurs at point F in Figure Q4(b).

(11 marks)

Q5 (a) The protection schemes must have high sensitivity in its operation when a fault occurs under minimum fault conditions. Several consequences of fault have been identified and they can be summarized as follows: When a fault occurs under minimum fault conditions there are several consequences of fault that have been identified. Explain three of the consequences.

(9 marks)

(b) In the system protection components there have their design criteria that have been considered such as Reliability, Selectivity, Speed, Economy and Simplicity. Explain all of the design criteria's.

(10 marks)

(c) By referring to the Figure Q5(c). There are three major components which are commonly constituted in a power system protection scheme: circuit breaker, transducers and relays. Explain operation of the system when the fault occurs in the system.

(6 marks)

Q6 (a) One circuit of a single-phase transmission line is composed of three solid 0.4 cm radius wires in side *X*. The return circuit is composed of two solid 0.6 cm radius wires in side *Y*. The arrangement of conductors is shown as Figure Q6(a). Calculate the inductance in H/m for;

(i) side *X*
(ii) side *Y*
(iii) The complete line

(15 marks)

(b) A three-phase fault occurs at point F in the system of Figure Q6(b). Calculate the fault MVA for the system. The reactances are all in percentage. Choose 50 MVA as a base value.

(10 marks)

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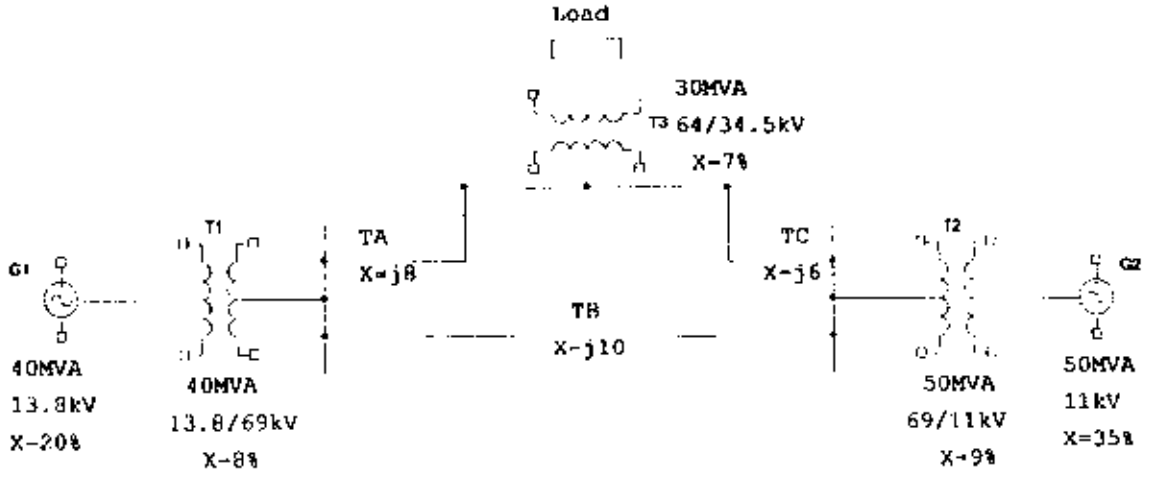

Figure Q2(b)

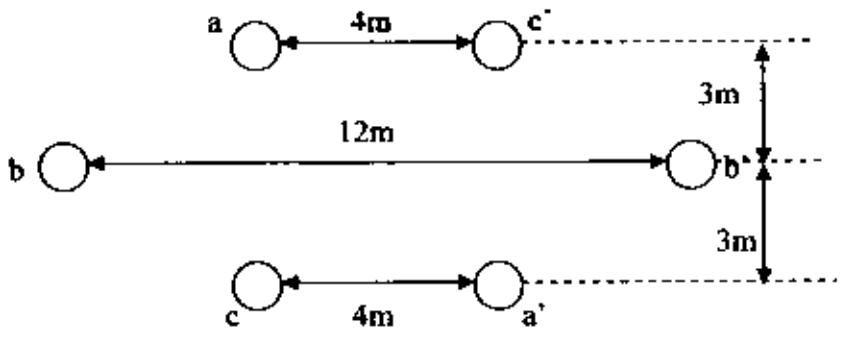

Figure Q3

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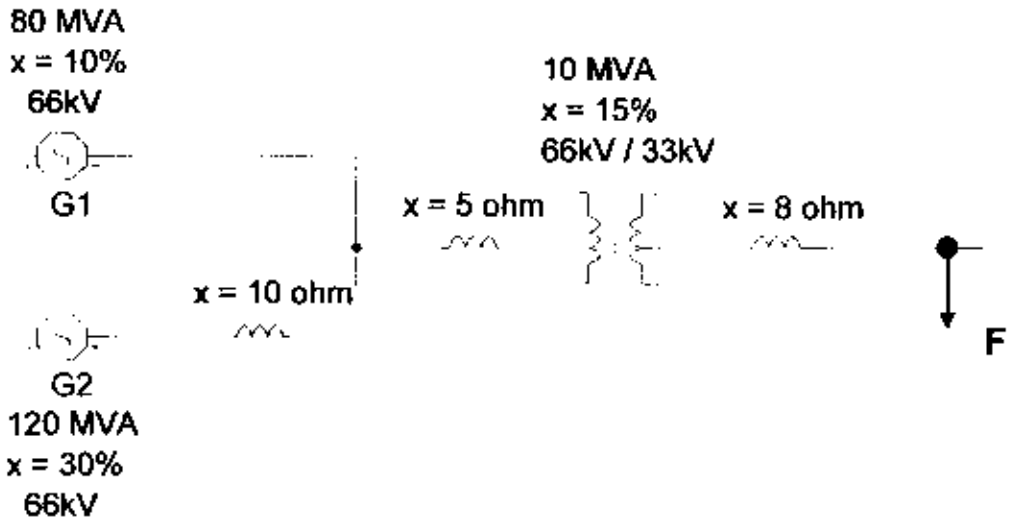

Figure Q4(b)

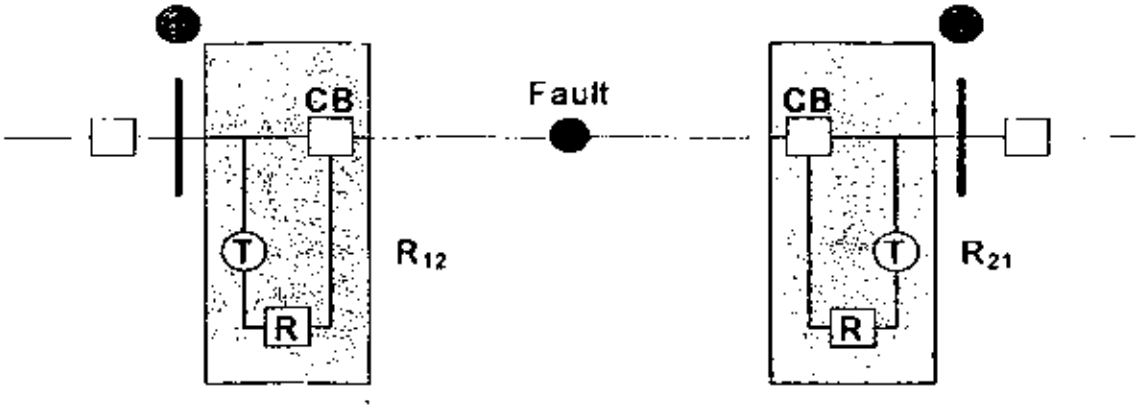

Figure Q5(c)

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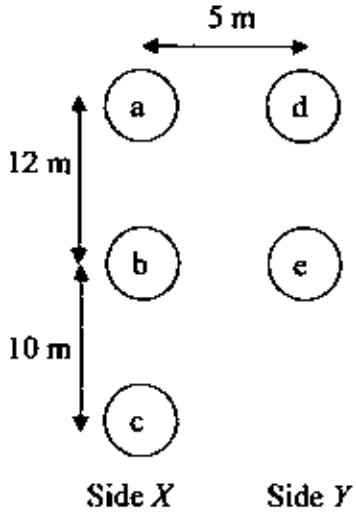

Figure Q6(a)

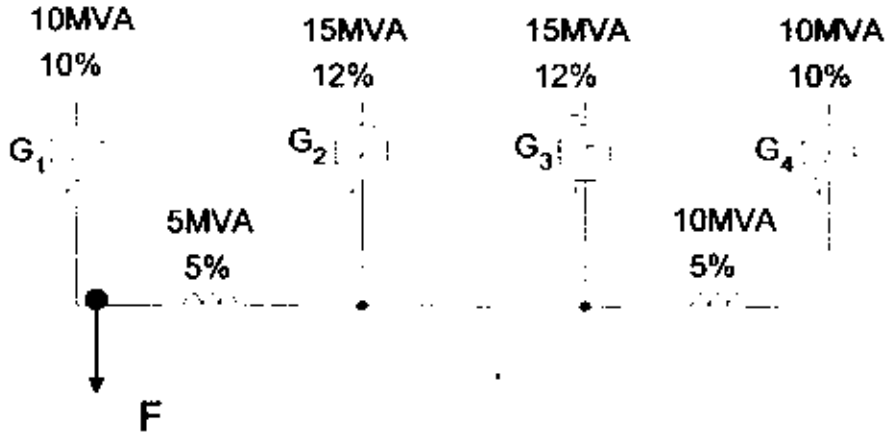

Figure Q6(b)

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TABLE A.3
Electrical characteristics of bare aluminum conductors steel-reinforced (ACSR)†

Code word	Aluminum area, cmil	Stranding Al/St	Layers of aluminum	Outside diameter, in	Resistance			GMR D_s, ft	Reactance per conductor 1-ft spacing, 60 Hz	
					Dc, 20°C, Ω/1,000 ft	Ac, 60 Hz			Inductive X_a, Ω/mi	Capacitive X'_a, MΩ·mi
						20°C, Ω/mi	50°C, Ω/mi			
Waxwing	266,800	18/1	2	0.609	0.0646	0.3488	0.3831	0.0198	0.476	0.1090
Partridge	266,800	26/7	2	0.642	0.0640	0.3452	0.3792	0.0217	0.465	0.1074
Ostrich	300,000	26/7	2	0.680	0.0569	0.3070	0.3372	0.0229	0.458	0.1057
Merlin	336,400	18/1	2	0.684	0.0512	0.2767	0.3037	0.0222	0.462	0.1055
Linnet	336,400	26/7	2	0.721	0.0507	0.2737	0.3006	0.0243	0.451	0.1040
Oriole	336,400	30/7	2	0.741	0.0504	0.2719	0.2987	0.0255	0.445	0.1032
Chickadee	397,500	18/1	2	0.743	0.0433	0.2342	0.2572	0.0241	0.452	0.1031
Ibis	397,500	26/7	2	0.783	0.0430	0.2323	0.2551	0.0264	0.441	0.1015
Pelican	477,000	18/1	2	0.814	0.0361	0.1957	0.2148	0.0264	0.441	0.1004
Flicker	477,000	24/7	2	0.846	0.0359	0.1943	0.2134	0.0284	0.432	0.0992
Hawk	477,000	26/7	2	0.858	0.0357	0.1931	0.2120	0.0289	0.430	0.0988
Hen	477,000	30/7	2	0.883	0.0355	0.1919	0.2107	0.0304	0.424	0.0980
Osprey	556,500	18/1	2	0.879	0.0309	0.1679	0.1843	0.0284	0.432	0.0981
Parakeet	556,500	24/7	2	0.914	0.0308	0.1669	0.1832	0.0306	0.423	0.0969
Dove	556,500	26/7	2	0.927	0.0307	0.1663	0.1826	0.0314	0.420	0.0965
Rook	636,000	24/7	2	0.977	0.0269	0.1461	0.1603	0.0327	0.415	0.0950
Grosbeak	636,000	26/7	2	0.990	0.0268	0.1454	0.1596	0.0335	0.412	0.0946
Drake	795,000	26/7	2	1.108	0.0215	0.1172	0.1284	0.0373	0.399	0.0912
Tern	795,000	45/7	3	1.063	0.0217	0.1188	0.1302	0.0352	0.406	0.0925
Rail	954,000	45/7	3	1.165	0.0181	0.0997	0.1092	0.0386	0.395	0.0897
Cardinal	954,000	54/7	3	1.196	0.0180	0.0988	0.1082	0.0402	0.390	0.0890
Ortolan	1,033,500	45/7	3	1.213	0.0167	0.0924	0.1011	0.0402	0.390	0.0885
Bluejay	1,113,000	45/7	3	1.259	0.0155	0.0861	0.0941	0.0415	0.386	0.0874
Finch	1,113,000	54/19	3	1.293	0.0155	0.0856	0.0937	0.0436	0.380	0.0866
Bittern	1,272,000	45/7	3	1.345	0.0136	0.0762	0.0832	0.0444	0.378	0.0855
Pheasant	1,272,000	54/19	3	1.382	0.0135	0.0751	0.0821	0.0466	0.372	0.0847
Bobolink	1,431,000	45/7	3	1.427	0.0121	0.0684	0.0746	0.0470	0.371	0.0837
Plover	1,431,000	54/19	3	1.465	0.0120	0.0673	0.0735	0.0494	0.365	0.0829
Lapwing	1,590,000	45/7	3	1.502	0.0109	0.0623	0.0678	0.0498	0.364	0.0822
Falcon	1,590,000	54/19	3	1.545	0.0108	0.0612	0.0667	0.0523	0.358	0.0814
Bluebird	2,156,000	84/19	4	1.762	0.0080	0.0476	0.0515	0.0586	0.344	0.0776

Table Q3