UNIVERSITI TUN HUSSEIN ONN MALAYSIA

PEPERIKSAAN AKHIR
SEMESTER II
SESI 2008/2009

NAMA MATA PELAJARAN	:	PENGGUNAAN TENAGA ELEKTRIK
KOD MATA PELAJARAN	:	BEE 4213
KURSUS	:	4 BEE
TARIKH PEPERIKSAAN	:	APRIL/MEI 2009
JANGKA MASA	:	3 JAM
ARAHAN	:	JAWAB EMPAT (4) SOALAN SAHAJA DARIPADA ENAM (6) SOALAN.

KERTAS SOALAN INI MENGANDUNGI 9 MUKA SURAT

Q1 (a) Tenaga National Berhad (TNB) plans to upgrade the national grid system to 500 kV in various phases in recent years. List any two advantages of upgrading to 500 kV as compared to the existing 275 kV system.

(5 marks)

(b) There are differences between the North American electrical distribution system and the European system. Name any two such differences.

(5 marks)

(c) A moulded case circuit breaker (MCCB) has two current ratings. Name the ratings and specify what each is for.

(5 marks)

(d) What is meant by combined-cycle generation? What are the incentives of using this scheme?

(5 marks)

(e) What is renewable energy? Name any two means of generating electricity by using renewable energy in Malaysia.

(5 marks)

Q2 (a) In general, any cable put into service required two kinds of protection. List the protection and briefly describe how the protection is achieved in a 3-phase, 415 V system as mentioned.

(8 marks)

(b) A three-phase circuit breaker is installed in a 415Y/240 V panel board to serve the following loads:

No.	Load	Rating	Demand Factor
1	Lighting	12.0 kVA, PF=0.95	1.25
2	Kitchen	3.0 kVA, PF=0.90	0.65
3	Water heating	5.5 kW	1.00
4	Air Conditioning	7.0 kVA, PF=0.85	1.00
5	Spare Capacity	8.0 kVA, PF=0.88	1.00

Show clearly all steps and calculations done to choose correct rating of the circuit breaker.

(17 marks)

Q3 (a) (i) List benefits of improving power factor.

(3 Marks)

(ii) Determine four significant effects of harmonics in electric power systems.

(3 Marks)

(b) An industrial consumer has the following loads:
5 kW of lighting at unity PF

A motor taking 15 kVA at 0.75 PF lagging
Other consumable loads 10 kW at 0.6 PF lagging.

The loads are balanced over the three phases of 400 V, 50Hz supply system. Calculate:

(i) The total active power (kW), total reactive power (kVAr), total apparent power (kVA)
(ii) The overall power factor
(iii) The line current

(14 Marks)

(c) In order to improve the power factor in Q3(b), the capacitors 250μF (in delta) are connected to the load system. Determine:

(i) The total reactive power (kVAr), total apparent power (kVA).
(ii) The power factor

(5 Marks)

Q4 (a) List four types of lamp.

(8 Marks)

(b) Three lamps with 3000 lumens is placed at *B* and 5000 lumens are placed at *A* and *C*, respectively. The arrangement is shown in Figure Q4(b). *D* is the midway between the lamps *A* and *C*.

(i) Determine the illumination on the floor at position *E*.

(9 Marks)

(ii) Determine the illumination on the floor at position *F*.

(8 Marks)

Q5 (a) Give the definition of the following parameters:

(i) the symmetrical short circuit current
(ii) the asymmetrical short circuit current
(iii) the instantaneous peak short circuit current

(9 marks)

(b) Figure Q5(b) shows a three-phase industrial distribution power system. Determine the RMS symmetrical, RMS asymmetrical and peak short circuit magnitudes for a three-phase fault occurring at *F2*.

(16 marks)

**Note:

– *Table of Alternating-Current Resistance and Reactance for 600-Volt Cables* is provided for question Q5(b).

Q6 (a) State what is meant by the term 'earth' as applied to an electrical installation. Explain the object of earthing and the method of carrying it out. What are the other alternatives to earthing that could be employed.

(8 marks)

(b) State four common causes of excessive resistance found in the earth continuity paths of consumers' installations.

(6 marks)

(c) A single phase circuit is protected by a 60 A fuse having a fusing factor of 1.5. A fault occurs in an appliance causes a current of 75 A to flow through the earth continuity path. As a result of poor contact due to a lock nut and bush connecting a steel conduit to a metal box, the resistance of this conduit connection alone is 0.75 Ω. Regulation D22 regarding the basic earthing requirements is given in Table Q6(c). State:

(i) whether the fuse will rupture
(ii) the amount of heat produced at the metal box
(iii) the degree of risk, if any, of a fire developing

(6 marks)

(d) With the help of a schematic diagram, explain briefly the operation of an earth leakage current operated circuit breaker.

(5 marks)

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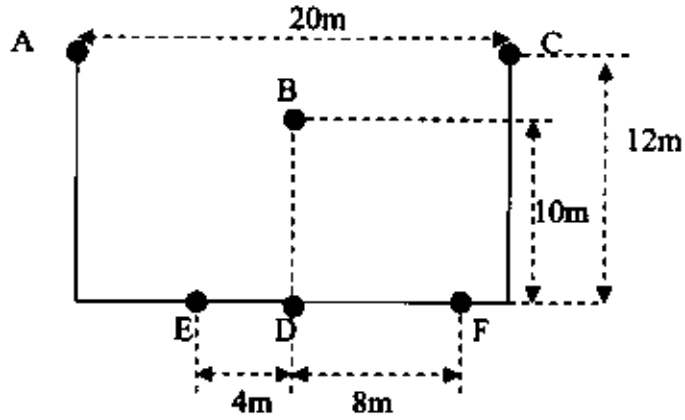

Figure Q4(b)

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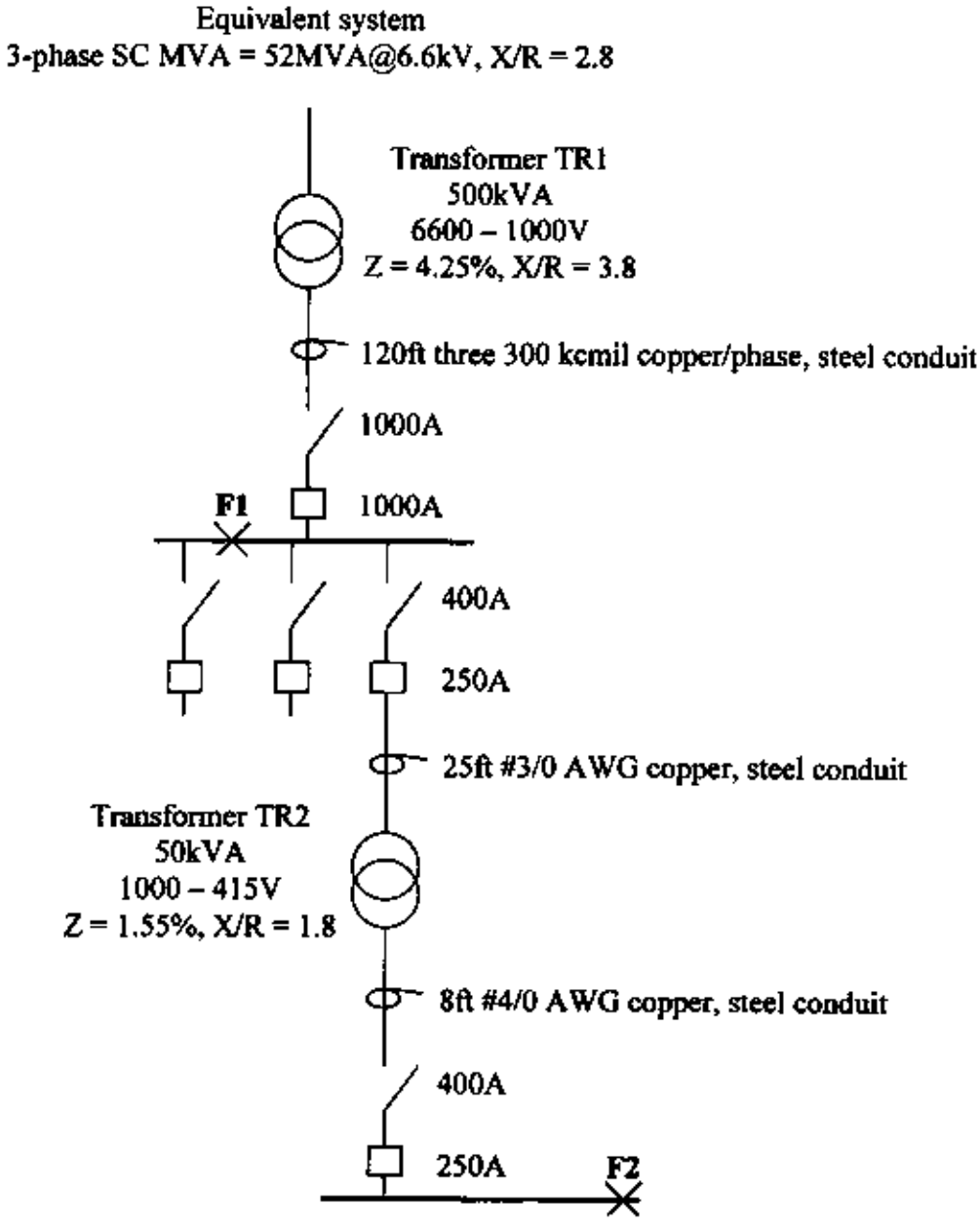

Figure Q5(b)

Table Q5(b)

Alternating-Current Resistance and Reactance for 600-Volt Cables, 3-Phase, 75°C (167°F) – Three Single Conductors in Conduit

Size (AWG or kcmil)	Ohms to Neutral per Kilometer / Ohms to Neutral per 1000 Feet														Size (AWG or kcmil)
	X_L (Reactance) for All Wires		Alternating-Current Resistance for Uncoated Copper Wires			Alternating-Current Resistance for Aluminum Wires			Effective Z at 0.85 PF for Uncoated Copper Wires			Effective Z at 0.85 PF for Aluminum Wires			
	PVC, Aluminum Conduits	Steel Conduit	PVC Conduit	Aluminum Conduit	Steel Conduit	PVC Conduit	Aluminum Conduit	Steel Conduit	PVC Conduit	Aluminum Conduit	Steel Conduit	PVC Conduit	Aluminum Conduit	Steel Conduit	
14	0.190 0.058	0.240 0.073	10.2 3.1	10.2 3.1	10.2 3.1	- -	- -	- -	8.9 2.7	8.9 2.7	8.9 2.7	- -	- -	- -	14
12	0.177 0.054	0.223 0.068	6.6 2.0	6.6 2.0	6.6 2.0	10.5 3.2	10.5 3.2	10.5 3.2	5.6 1.7	5.6 1.7	5.6 1.7	9.2 2.8	9.2 2.8	9.2 2.8	12
10	0.164 0.050	0.207 0.063	3.9 1.2	3.9 1.2	3.9 1.2	6.6 2.0	6.6 2.0	6.6 2.0	3.6 1.1	3.6 1.1	3.6 1.1	5.9 1.8	5.9 1.8	5.9 1.8	10
8	0.171 0.052	0.213 0.065	2.56 0.78	2.56 0.78	2.56 0.78	4.3 1.3	4.3 1.3	4.3 1.3	2.26 0.69	2.26 0.69	2.30 0.70	3.6 1.1	3.6 1.1	3.6 1.1	8
6	0.167 0.051	0.210 0.064	1.61 0.49	1.61 0.49	1.61 0.49	2.66 0.81	2.66 0.81	2.66 0.81	1.44 0.44	1.48 0.45	1.48 0.45	2.33 0.71	2.36 0.72	2.36 0.72	6
4	0.157 0.048	0.197 0.060	1.02 0.31	1.02 0.31	1.02 0.31	1.67 0.51	1.67 0.51	1.67 0.51	0.95 0.29	0.95 0.29	0.98 0.30	1.51 0.46	1.51 0.46	1.51 0.46	4
3	0.154 0.047	0.194 0.059	0.82 0.25	0.82 0.25	0.82 0.25	1.31 0.40	1.35 0.41	1.31 0.40	0.75 0.23	0.79 0.24	0.79 0.24	1.21 0.37	1.21 0.37	1.21 0.37	3
2	0.148 0.045	0.187 0.057	0.62 0.19	0.66 0.20	0.66 0.20	1.05 0.32	1.05 0.32	1.05 0.32	0.62 0.19	0.62 0.19	0.66 0.20	0.98 0.30	0.98 0.30	0.98 0.30	2
1	0.151 0.046	0.187 0.057	0.49 0.15	0.52 0.16	0.52 0.16	0.82 0.25	0.85 0.26	0.82 0.25	0.52 0.16	0.52 0.16	0.52 0.16	0.79 0.24	0.79 0.24	0.82 0.25	1
1/0	0.144 0.044	0.180 0.055	0.39 0.12	0.43 0.13	0.39 0.12	0.66 0.20	0.69 0.21	0.66 0.20	0.43 0.13	0.43 0.13	0.43 0.13	0.62 0.19	0.66 0.20	0.66 0.20	1/0
2/0	0.141 0.043	0.177 0.054	0.33 0.10	0.33 0.10	0.33 0.10	0.52 0.16	0.52 0.16	0.52 0.16	0.36 0.11	0.36 0.11	0.36 0.11	0.52 0.16	0.52 0.16	0.52 0.16	2/0
3/0	0.138 0.042	0.171 0.052	0.253 0.077	0.269 0.082	0.259 0.079	0.43 0.13	0.43 0.13	0.43 0.13	0.289 0.088	0.302 0.092	0.308 0.094	0.43 0.13	0.43 0.13	0.46 0.14	3/0
4/0	0.135 0.041	0.167 0.051	0.203 0.062	0.220 0.067	0.207 0.063	0.33 0.10	0.36 0.11	0.33 0.10	0.243 0.074	0.256 0.078	0.262 0.080	0.36 0.11	0.36 0.11	0.36 0.11	4/0
250	0.135 0.041	0.171 0.052	0.171 0.052	0.187 0.057	0.177 0.054	0.279 0.085	0.295 0.090	0.282 0.086	0.217 0.066	0.230 0.070	0.240 0.073	0.308 0.094	0.322 0.098	0.33 0.10	250
300	0.135 0.041	0.167	0.144	0.161 0.049	0.148	0.233	0.249 0.076	0.236	0.194	0.207 0.063	0.213	0.269	0.282 0.086	0.289	300

		0.051	0.044		0.045	0.071		0.072	0.059		0.065	0.082		0.088	
350	0.131 0.040	0.164 0.050	0.125 0.038	0.141 0.043	0.128 0.039	0.200 0.061	0.217 0.066	0.207 0.063	0.174 0.053	0.190 0.058	0.197 0.060	0.240 0.073	0.253 0.077	0.262 0.080	350
400	0.131 0.040	0.161 0.049	0.108 0.033	0.125 0.038	0.115 0.035	0.177 0.054	0.194 0.059	0.180 0.055	0.161 0.049	0.174 0.053	0.184 0.056	0.217 0.066	0.233 0.071	0.240 0.073	400
500	0.128 0.039	0.157 0.048	0.089 0.027	0.105 0.032	0.095 0.029	0.141 0.043	0.157 0.048	0.148 0.045	0.141 0.043	0.157 0.048	0.164 0.050	0.187 0.057	0.200 0.061	0.210 0.064	500
600	0.128 0.039	0.157 0.048	0.075 0.023	0.092 0.028	0.082 0.025	0.118 0.036	0.135 0.041	0.125 0.038	0.131 0.040	0.144 0.044	0.154 0.047	0.167 0.051	0.180 0.055	0.190 0.058	600

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Table Q6(c)

Regulation D22 (Basic Earthing Requirements)
States that earth leakage protection may be provided by means of fuses or excess current circuit breakers if the earth fault current available to operate the protective device and so make the faulty circuit dead exceeds: 1. 3 times the current rating of any semi enclosed fuse or any cartridge fuse having a fusing factor exceeding 1.5, used to protect the circuit, or 2. 2.4 times the rating of any cartridge fuse having a fusing factor not exceeding 1.5, used to protect the circuit, or 3. 1.5 times the tripping current of any excess current circuit breaker used to protect the circuit.