UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2010/2011

COURSE	:	ELECTRICAL POWER TRANSMISSION AND DISTRIBUTION SYSTEM
COURSE CODE	:	BEK 4213
PROGRAMME	:	BACHELOR OF ELECTRICAL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	APRIL/MAY 2011
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER ALL QUESTIONS

THIS PAPER CONSISTS OF SEVEN (07) PAGES

Q1 (a) A 3-phase double circuit line is arranged in the horizontal plane as shown in Figure Q1 (a). Assume balanced loads equally distributed in two circuits and the radius of each conductor is r.

(i) Derive an expression for the inductance of the line.

(6 marks)

(ii) Use the derived expression to find the inductance per km per phase if r = 0.9×10^{-2} m and d=3.5m.

(2 marks)

(b) The overhead lines conductors should be supported on the poles or towers in such a way that currents from the conductors do not flow to earth through supports. This is achieved by using the insulators which provide necessary insulation between the line conductors and supports.

(i) List down two advantages of suspension type insulator.

(2 mark)

(ii) An insulator string for 66kV line has 4 discs. The shunt capacitance between each joint and metal work is 10% of the capacitance of each disc. Find the voltage across the different discs and string efficiency.

(6 marks)

(iii) If the voltages across the units in a 2-unit suspension insulator are 60% and 40% of the line voltage, show that the ratio of capacitance of insulator to that of its capacitance to earth is equal to 2.

(3 marks)

(c) An overhead transmission line conductor having a parabolic configuration weight 1.925 kg per meter of length. The area of cross section of the conductor is $2.2cm^2$ and the ultimate strength is 8000 kg/cm^2. The supports are 600m apart having 15m difference of levels. Calculate the sag from the taller of the two supports which must be allowed so that the factor of safety shall be 5. Assume that ice load is 1kg per meter and there is no wind pressure. Refer Figure Q1(c).

(6 marks)

Q2 (a) The power factor plays an importance role in a.c. circuits since the power depends on this factor.

(i) Discuss the two disadvantages of having low power factor in the practical situation.

(4 marks)

(ii) A single phase motor connected to 400V, 50Hz supply takes 31.7 amperes at a power factor of 0.7 lagging. Propose the capacitance required parallel with the motor to raise the power factor to 0.9 lagging.

(5 marks)

(b) Design and briefly explain the following primary distribution line circuits from primary distribution line,

(i) Radial primary circuit
(ii) Loop primary circuit
(iii) Ring primary circuit

(6 marks)

(c) A single phase ring distributor ABC is fed at A as shown in Figure Q2(c). The loads at B and C are 20 A at 0.8 p.f. lagging and 15A at 0.6 p.f. lagging respectively. Both expressed with reference to the voltage at A. The total impedance of the three sections AB, BC and CA are (1 +j1), (1+j2) and (1+j3) ohms respectively. Find the total current fed at A and the current in each section.

(10 marks)

Q3 (a) Underground cable is normally consists of one or more conductors covered with suitable insulation and surrounded by a protecting cover.

(i) List the various parts of the cable.

(3 marks)

(ii) Draw the cross-section of 3-core belted cable. Discuss the function of each part.

(8 marks)

(b) A 33kV, 50Hz, 3-phase underground cable, 4km long use three single core cables. Each of the conductor has a diameter of 2.5cm and the radial thickness of insulation is 0.5 cm. The relative permittivity of insulation is 3.

(i) Determine the capacitance of cable per phase.

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(2 marks)

(ii) Find charging current per phase.

(2 marks)

(iii) Calculate the total charging kVAR.

(1 mark)

(c) There are several methods for locating the faults in underground cables. The most popular methods known as loop tests are Murray loop test and Varley loop test.

(i) Construct the circuit diagram for locating ground fault in underground cables using Murray loop test.

(5 marks)

(ii) In a test by Murray Loop for ground fault on 500m of cable having resistance of 1Ω per 1000m, the faulty cable is looped with a sound cable of the same length but having a resistance of 2.25Ω per 1000m. The resistance of the other two arms of the testing network at balance are in the ratio 2.75:1. Calculate the distance of the fault from the testing end of the cable.

(4 marks)

Q4 (a) List four methods of voltage control in the modern power system.

(2 marks)

(b) Construct the synchronous condenser method of voltage control for a transmission line. Explains your answer with vector diagram.

(7 marks)

(c) A load of 10,000 kW at a power factor of 0.8 lagging is supplied by a 3-phase line whose voltage has to be maintained at 33kV at each end. If the resistance and reactance per phase are 5Ω and 10Ω respectively, determine the capacity of the synchronous condenser to be installed for the purpose. Comment on the result.

(9 marks)

(d) A simple power system network is shown in Figure Q4(d). For the respective network:

(i) Develop the protective zone for the network
(ii) State two characteristics of the protective zones
(iii) Deduce which circuit breaker should open for a fault at location $\mathbf{P_1}$ and $\mathbf{P_2}$
(iv) Illustrate the location of fault within the network if breakers **CB23, CB32** and **CB3** are opened

(7 marks)

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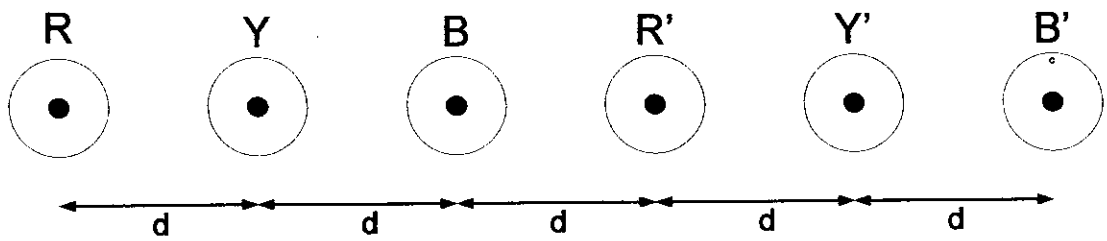

Figure Q1(a)

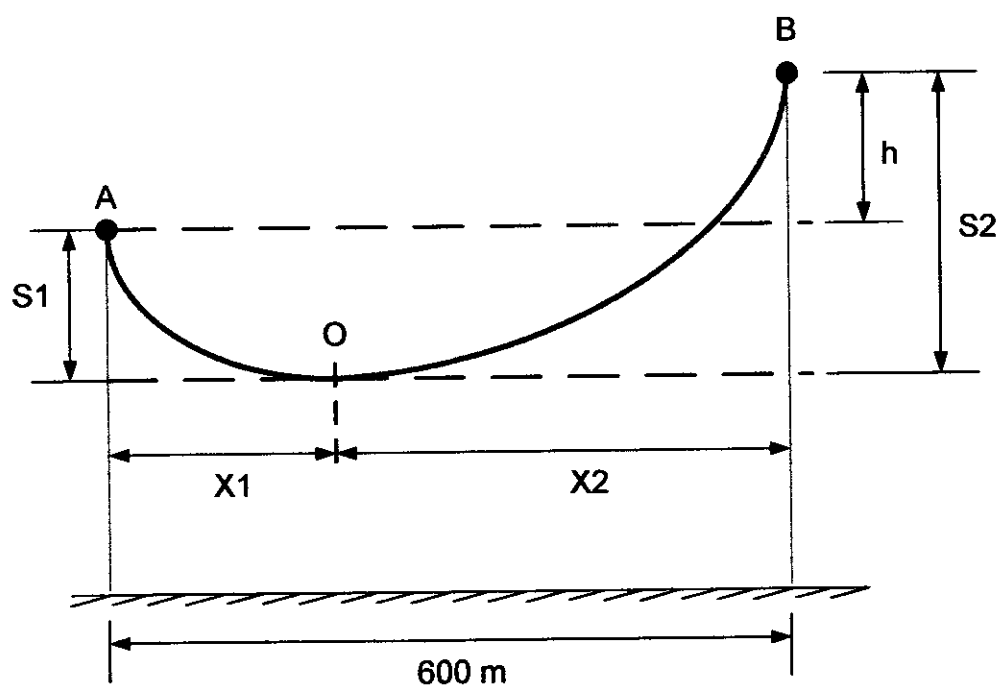

Figure Q1(c)

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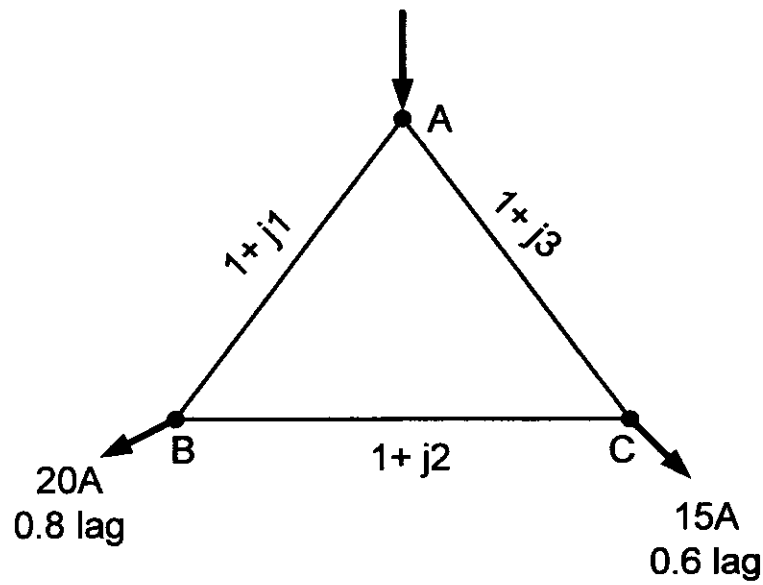

Figure Q2(c)

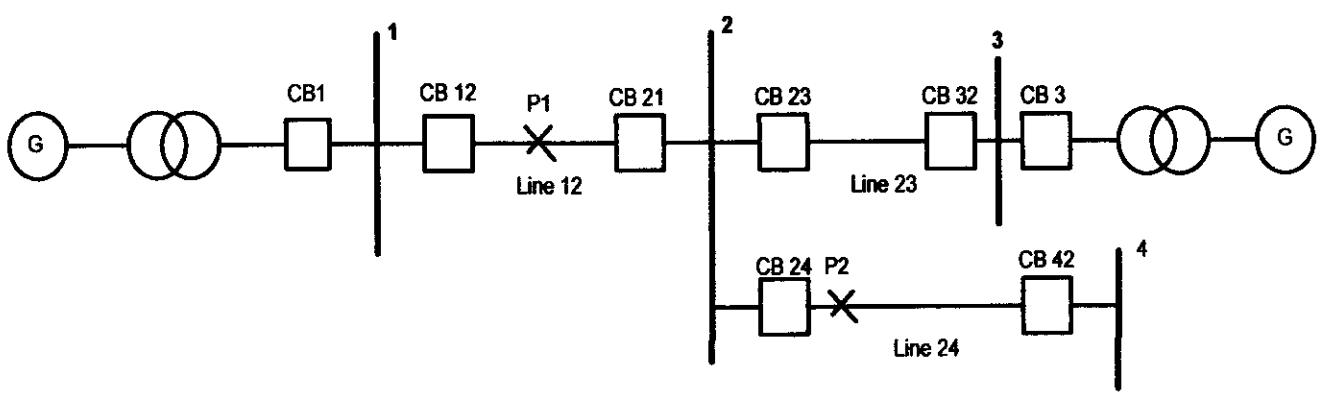

Figure Q4(d)