Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	POWER TRANSMISSION AND DISTRIBUTION TECHNOLOGY
COURSE CODE	:	BNE 32703
PROGRAMME	:	BNE
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) In practice, underground cables are generally required to deliver three phase power by using either three-core cable or three single core cables. When the operating voltages are greater than 66kV, three core cable is preferred due to economic reasons. Screened cables are one of the cable types that are generally used for three phase service.

(i) Screened cables can be divided into two types, list **TWO (2)** types of screened cables.

(2 marks)

(ii) Based on your answers in **Q1(a)(i),** draw and label clearly **ONE (1)** type of screened cables.

(4 marks)

(iii) State the voltage limit that suite for screened cables.

(2 marks)

(b) A single-core lead sheath cable has a conductor diameter of 3 cm, the diameter of the cable being 9 cm. The cable is graded by using two dielectrics of relative permittivity 5 and 4 respectively with corresponding safe working stresses of 30kV/cm and 20kV/cm.

(i) Calculate the radial thickness of each insulation and the safe working voltage of the cable.

(12 marks)

(ii) Assuming the same conductor, overall diameter and the maximum dielectric stress, evaluate the value of safe working voltage for an ungraded cable and the percentage increase when compared to graded cable.

(5 marks)

Q2 (a) The phenomenon of corona plays an important role in the design of an overhead transmission line. Explain the terms when analysis of corona effects.

(i) Critical disruptive voltage.
(ii) Visual critical voltage.

(2 marks)

(b) While erecting an overhead line, it is very important that conductors are under safe tension. If the conductors are too much stretched between supports, the conductor may break due to excessive tension. Normally the conductors are allowed to have dip or sag.

(i) Explain sag in overhead lines, justify your answer with the aid of drawing.

(3 marks)

(ii) A transmission line has a span of 200 m between level supports. The conductor has a cross-sectional area of 1.29 cm^2, weighs 1170 kg/km and has a breaking stress of 4218 kg/cm^2. Calculate the sag for a safety factor of 5, allowing a wind pressure of 122 kg per square meter of projected area. Determine the vertical sag.

(8 marks)

(c) A transmission line over a hillside where the gradient is 1:20, is supported by two 22 m towers with a distance of 300 m between them. The lowest conductor is fixed 2 m below the top of each tower. Refer **Figure Q2 (c)**, determine the clearance of the conductor from the ground. Given that conductor weighs 1 kg/m and the allowable tension is 1500 kg.

(12 marks)

Q3 (a) A factory load consists of the following :

1. an induction motor of 50 H.P. (37.3 kW) with 0.8 p.f. and efficiency 0.85.
2. a synchronous motor of 25 H.P. (18.65 kW) with 0·9 p.f. leading and efficiency 0.9.
3. lighting load of 10 kW at unity p.f.

Calculate the annual electrical charges if the tariff is RM 60 per kVA of maximum demand per annum plus 5 cents per kWh; assuming the load to be steady for 2000 hours in a year.

(10 marks)

(b) The load on an installation is 800 kW, 0.8 lagging p.f. which works for 3000 hours per annum. The tariff is RM 100 per kVA plus 20 cent per kWh. If the power factor is improved to 0.9 lagging by means of loss-free capacitors costing RM 60 per kVAR, determine the annual saving effected. Allow 10 % per annum for interest and depreciation on capacitors.

(15 marks)

Q4 (a) In order to improve string efficiency of the insulator, various methods had been proposed.

(i) Name **TWO (2)** methods to improve string efficiency.

(2 marks)

(ii) Sketch, label and discuss on **ONE (1)** method named in question **Q4 (i)**.

(5 mark)

(b) Each line of a 3-phase system is suspended by a string of 3 identical insulators of self-capacitance C Farad as shown in **Figure Q4(b).** The shunt capacitance of connecting metal work of each insulator is 0.2 C to earth and 0.1 C to line. Calculate the string efficiency of the system if a guard ring increases the capacitance to the line of metal work of the lowest insulator to 0.3 C.

(8 marks)

(c) The cost of a 3-phase overhead transmission line is RM (25000a + 2500) per km where 'a' is the cross section area of each conductor in cm^2. The line is supplying a load of 5 MW at 33 kV and 0.8 p.f lagging assumed to be constant throughout the year. Energy cost 4 cent per kWh and interest and depreciation total 10 % per annum. Determine the most economical size of the conductor. Given that specific resistance of conductor material is 10^{-6} Ωcm. Assumed length of the cable, l =1 km.

(10 marks)

Q5 (a) Define skin effect and explain why is it absent in the d.c systems.

(4 marks)

(b) A 3-phase, 3-wire system consists of conductors that are arranged in a horizontal plane with spacing such that D_{31} = 4 m; $D_{12} = D_{23}$ = 2 m as shown in **Figure Q5 (b)**. The conductors are transposed and have a diameter of 2.5 cm. Solve the inductance and capacitance per phase per km of the line.

(7 marks)

(c) The arrangement of conductors of a single phase transmission line shown in **Figure Q5 (c)**. The forward circuit is composed of 3 solid wires 2.5 mm in radius and the return circuit of two wires of radius 5 mm placed symmetrically with respect to the forward circuit. Calculate the inductance of each side of the line and the complete line.

(14 marks)

- **END OF QUESTIONS –**

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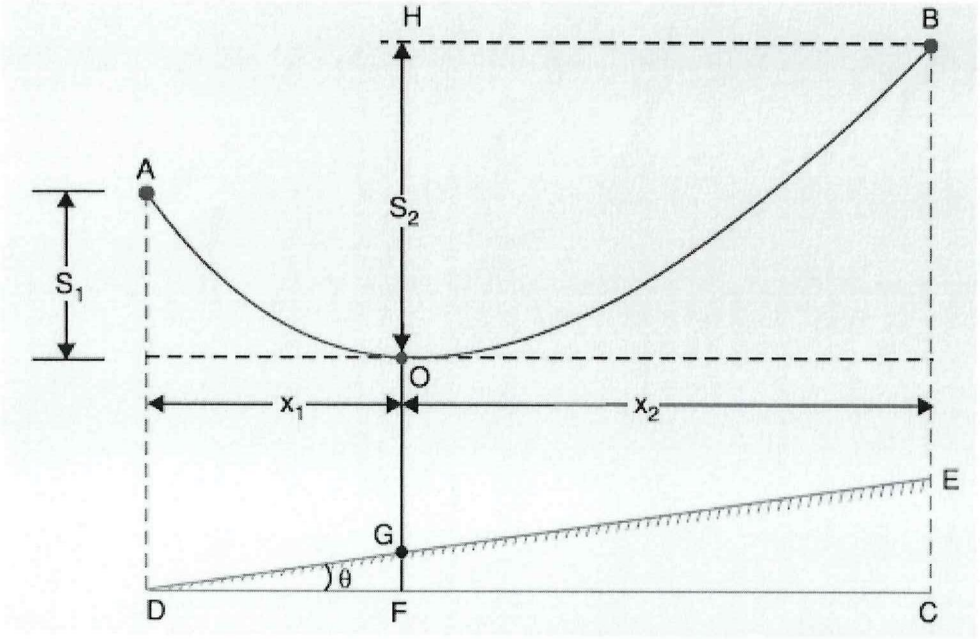

Figure Q2 (c)

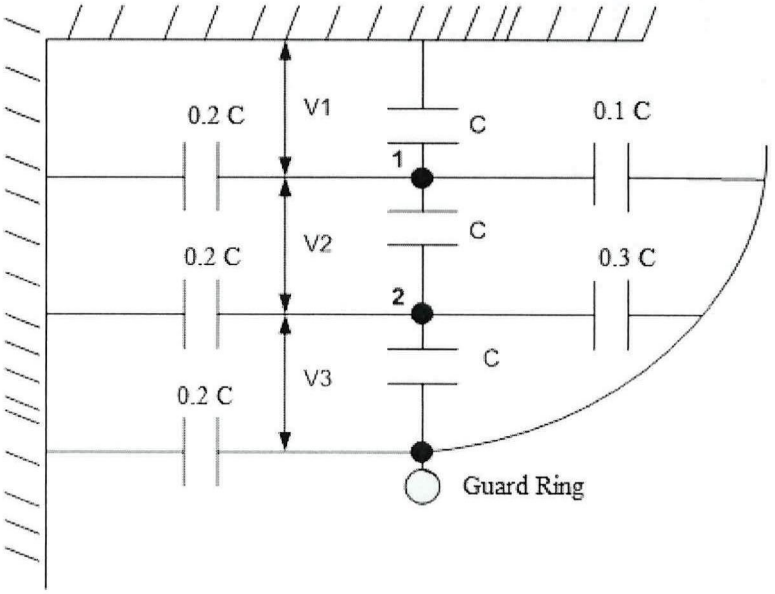

Figure Q4 (b)

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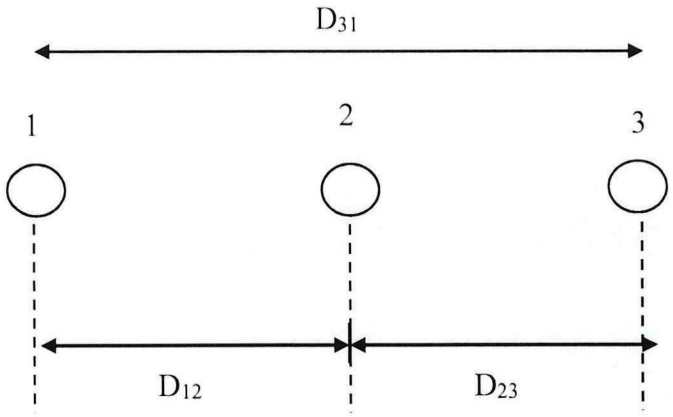

Figure Q5 (b)

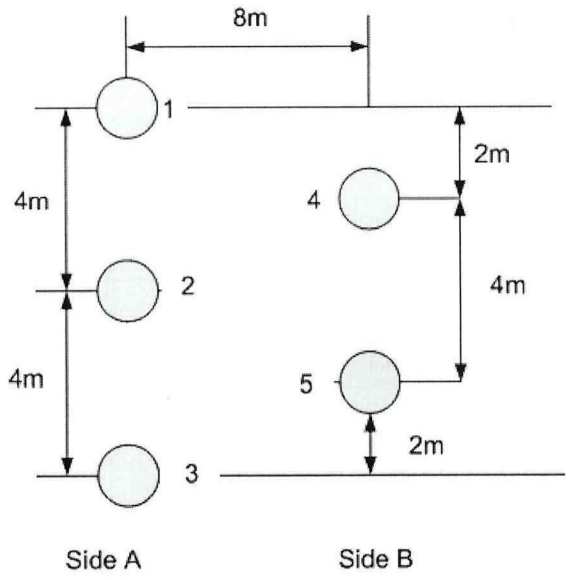

Figure Q5 (c)