Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

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

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

Q1 (a) The reliability of underground cable network depends on the proper laying and attachment fitting, There are three main methods of laying underground cables, which are direct laying, draw-in system and the solid system.

(i) Draw and label clearly the method of direct laying.

(3 marks)

(ii) Based on your drawing in **Question Q1 (a)(i),** briefly explain how this method work.

(3 marks)

(iii) State **TWO (2)** advantages of direct laying method.

(2 marks)

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

(i) capacitance of the cable per phase.

(3 marks)

(ii) charging current per phase.

(2 marks)

(iii) total charging kVar.

(1 marks)

(c) A single core lead sheathed cable is graded by using three dielectrics of relative permittivity 5, 4 and 3 respectively. The conductor diameter is 2 cm and overall diameter is 8 cm.

(i) If the three dielectrics are worked at the same maximum stress of 40 kV/cm, determine the safe working voltage of the cable.

(6 marks)

(ii) Assuming the same conductor and 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. Briefly explain what is corona.

(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 275 m between level supports. The conductor has an effective diameter of 1.96 cm and weighs 0.865 kg/m. Its ultimate strength is 8060 kg. If the conductor has ice coating of radial thickness 1.27 cm and is subjected to a wind pressure of 3.9 gm/cm^2 of projected area, calculate sag for a safety factor of 2. Weight of 1 cm^3 of ice is 0.91 g.

(8 marks)

(c) An overhead transmission line at a river crossing is supported from two towers at heights of 40 m and 90 m above water level, the horizontal distance between the towers being 400 m. If the maximum allowable tension is 2000 kg, Refer **Figure Q2(c)**, determine the clearance between the conductor and water at a point mid-way between the towers. The weight of conductor is 1 kg/m.

(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) The successful operation of an overhead line depends to a considerable extent upon the proper selection of insulators. Define what is the safety factor of insulator.

(2 marks)

(b) The self-capacitance of each unit in a string of three suspension insulators is C. The shunting capacitance of the connecting metal work of each insulator to earth is 0.15 C while for line it is 0.1 C as shown in **Figure Q4(b)**.

(i) Estimate the voltage across each insulator as a percentage of the line voltage to earth

(11 marks)

(ii) Determine the string efficiency.

(2 marks)

(c) Determine the most economical size of a 3-phase line which supplies the following loads at 10 kV :

1. 1000 kW at 0·8 p.f. (lag) for 10 hours
2. 500 kW at 0·9 p.f. (lag) for 8 hours
3. 100 kW at unity p.f. for 6 hours.

The above gives the daily load cycle. The cost per km of the completely erected line is RM (8000 a +1500) where a is the area of cross-section of each conductor. The combined interest and depreciation is 10% per annum of capital cost. Cost of energy losses is 5 cent per kWh. Resistivity of conductor material = 1.72×10^{-6} Ω cm.

(10 marks)

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

(5 marks)

(b) Solve the inductance per phase per meter of double circuit 3-phase line whose phase conductor have a radius of 5.3 cm with the horizontal conductor arrangement as shown in **Figure Q5(b)**.

(10 marks)

(c) A 220 kV 3-phase, 50 Hz single circuit bundled conductor line with two sub-conductor per phase has a configuration as the center distance between adjacent phases is 5 m and distance between sub-conductors of a phase is 40 cm. The radius of each sub-conductor is 0.75 cm.

(i) Draw and clearly label the arrangement of the conductor.

(3 marks)

(ii) From your drawing, determine the capacitance per phase per km and charging current per phase.

(7 marks)

- END OF QUESTIONS –

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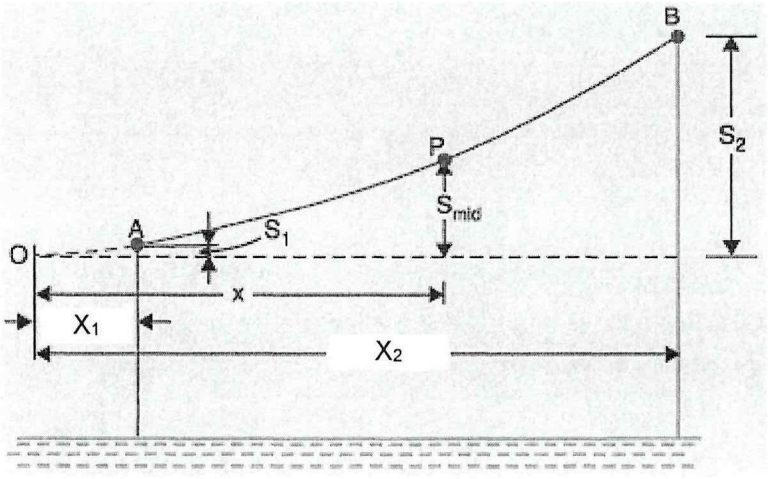

Figure Q2(c)

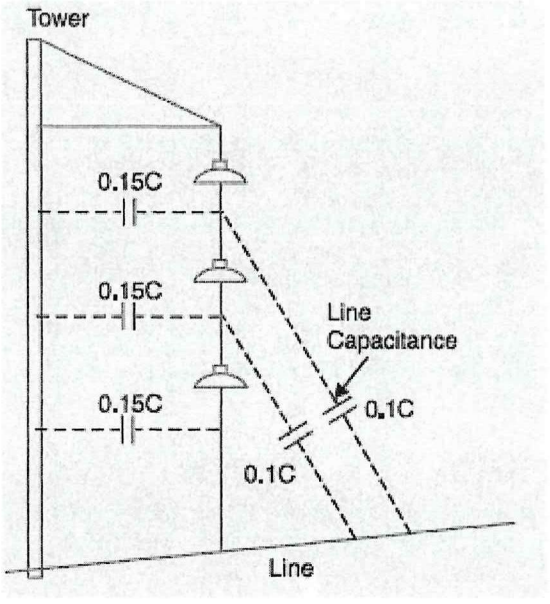

Figure Q4(b)

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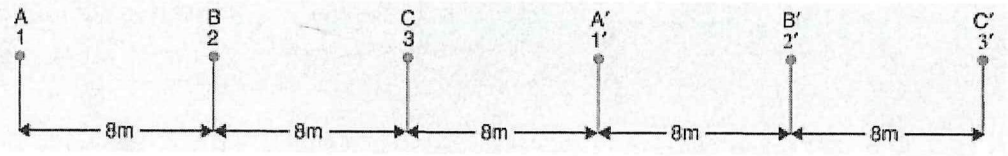

Figure Q5(b)