Name _____

E-mail _____

EE 4221

Hour Exam 3

December 7, 2017

Directions:

1. DO NOT START until told to do so.

2. There are 4 problems in this examination. All problems are equal valued.

3. The correct answer is a necessary but not sufficient condition to receive full credit for a problem. You MUST show you work! Disorderly or illegible work cannot and thus will not be graded.

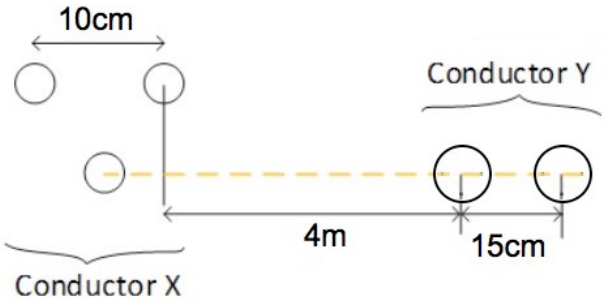
4. You are allowed use of any reference materials of your choice during the exam. You may not however classify your fellow classmate(s) as "reference materials" The exam is meant to be an individual effort!

5. Please return the exam by noon on Monday, December 11th, 2017. On-campus students submit to box 49, 7th floor EERC. Off-campus students submit as an e-mail attachment.

1. I plan to use a 7 strand all copper conductor (cable) for a low-loss, sub-transmission application.
Each strand in the cable is 3.0mm in diameter.
The spiral construction adds 2.25% to the actual length of each strand.

Determine the resistance for 1km of cable at 20°C and 50°C given:
The resistivity of copper is 1.72μΩ cm at 20°C and the temperature constant for copper is 234.5°C.

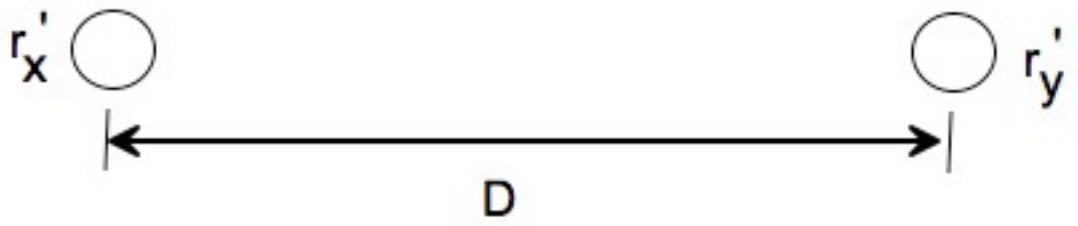
2. The conductor configuration of a bundled, single phase transmission line is shown below.



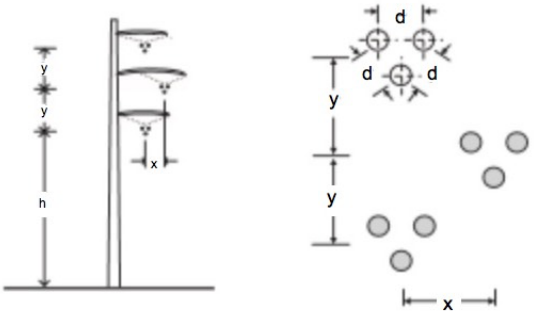
The "X" line features three solid conductors at the corners of an equilateral triangle with 10 cm spacing. Each X conductor has a diameter of 2.0 cm.

The "Y" line is comprised of two solid conductors in a horizontal configuration. The conductors are separated by 15 cm and each has a diameter of 4.0cm.

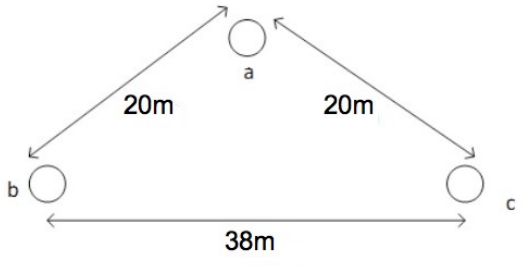
Assuming we wish to calculate the loop inductance of this single phase line, determine:
a) the effective radius of a single equivalent X conductor
b) the effective radius of a single equivalent Y conductor
c) the equivalent spacing between the single equivalent X and Y conductors.



3. The fully-transposed, 60Hz, 500kV, transmission line shown below features 3 “Cardinal” conductors on corners of an equilateral triangle with 35 centimeter spacing (d), between conductors. The bundles are arranged vertically as shown below with x = 3.0m, y = 6.5m and h = 20m. Determine the per phase, 60Hz, 50°C, series impedance (R + jX) for the line in ohms per mile. Use ACSR wire table provided after question #4.



4. Determine the per phase capacitance to neutral (in F/mile) and, shunt admittance (in S/mile) for the fully transposed, 3 phase, 60Hz, 220kV line shown (below). Each phase is comprised of a single "Flicker" conductor. You may neglect the effect of the earth.



4b. Given the line is 100 miles long, determine the charging current at the nominal line-to-line system voltage of 220kV.

Code word	Aluminum	Stranding	Layers	Outside	Resistance	R - AC 60 Hz	R - Ac, 60 Hz	GMR	Reactance per conductor 1-ft spacing, 60 Hz		
	Area	Al/St	of	diameter	DC, 20°C,	20°C,	50°C,	feet	Inductive Xa	Capacitive Xa'	
	CMIL		Al	inches	Ω/1,000ft	Ω/mile	Ω/mile		Ω/mile	MΩ-mile	
Waxwing	266,800	18/1	2	0.609	0.0646	0.3488	0.3831	0.0198	0.476	0.109	Waxwing
Partridge	266,800	26/7	2	0.642	0.064	0.3452	0.3792	0.0217	0.465	0.1074	Partridge
Ostrich	300,000	26/7	2	0.68	0.0569	0.307	0.3372	0.0229	0.458	0.1057	Ostrich
Merlin	336,400	18/1	2	0.684	0.0512	0.2767	0.3037	0.0222	0.462	0.1055	Merlin
Linnet	336,400	26/7	2	0.721	0.0507	0.2737	0.3006	0.0243	0.451	0.104	Linnet
Oriole	336,400	30/7	2	0.741	0.0504	0.2719	0.2987	0.0255	0.445	0.1032	Oriole
Chickadee	397,500	18/1	2	0.743	0.0433	0.2342	0.2572	0.0241	0.452	0.1031	Chickadee
Ibis	397,500	26/7	2	0.783	0.043	0.2323	0.2551	0.0264	0.441	0.1015	Ibis
Pelican	477,000	18/1	2	0.814	0.0361	0.1957	0.2148	0.0264	0.441	0.1004	Pelican
Flicker	477,000	24/7	2	0.846	0.0359	0.1943	0.2134	0.0284	0.432	0.0992	Flicker
Hawk	477,000	26/7	2	0.858	0.0357	0.1931	0.212	0.0289	0.43	0.0988	Hawk
Hen	477,000	30/7	2	0.883	0.0355	0.1919	0.2107	0.0304	0.424	0.098	Hen
Osprey	556,500	18/1	2	0.879	0.0309	0.1679	0.1843	0.0284	0.432	0.0981	Osprey
Parakeet	556,500	24/7	2	0.914	0.0308	0.1669	0.1832	0.0306	0.423	0.0969	Parakeet
Dove	556,500	26/7	2	0.927	0.0307	0.1663	0.1826	0.0314	0.42	0.0965	Dove
Rook	636,000	24/7	2	0.977	0.0269	0.1461	0.1603	0.0327	0.415	0.095	Rook
Grosbeak	636,000	26/7	2	0.99	0.0268	0.1454	0.1596	0.0335	0.412	0.0946	Grosbeak
Drake	795,000	26/7	2	1.108	0.0215	0.1172	0.1284	0.0373	0.399	0.0912	Drake
Tern	795,000	45/7	3	1.063	0.0217	0.1188	0.1302	0.0352	0.406	0.0925	Tern
Rail	954,000	45/7	3	1.165	0.0181	0.0997	0.1092	0.0386	0.395	0.0897	Rail
Cardinal	954,000	54/7	3	1.196	0.018	0.0988	0.1082	0.0402	0.39	0.08	Cardinal
Ortolan	1,033,500	45/7	3	1.213	0.0167	0.0924	0.1011	0.0402	0.39	0.0885	Ortolan
Bluejay	1,113,000	45/7	3	1.259	0.0155	0.0861	0.0941	0.0415	0.386	0.0874	Bluejay
Finch	1,113,000	54/19	3	1.293	0.0155	0.0856	0.0937	0.0436	0.38	0.0866	Finch
Bittern	1,272,000	45/7	3	1.345	0.0136	0.0762	0.0832	0.0444	0.378	0.0855	Bittern
Pheasant	1,272,000	54/19	3	1.382	0.0135	0.0751	0.0821	0.0466	0.372	0.0847	Pheasant
Bobolink	1,431,000	45/7	3	1.427	0.0121	0.0684	0.0746	0.047	0.371	0.0837	Bobolink
Plover	1,431,000	54/19	3	1.465	0.012	0.0673	0.0735	0.0494	0.365	0.0829	Plover
Lapwing	1,590,000	45/7	3	1.502	0.0109	0.0623	0.0678	0.0498	0.364	0.0822	Lapwing
Falcon	1,590,000	54/19	3	1.545	0.0108	0.0612	0.0667	0.0523	0.358	0.0814	Falcon
Bluebird	2,156,000	84/19	4	1.762	0.008	0.0476	0.0515	0.0586	0.344	0.0776	Bluebird