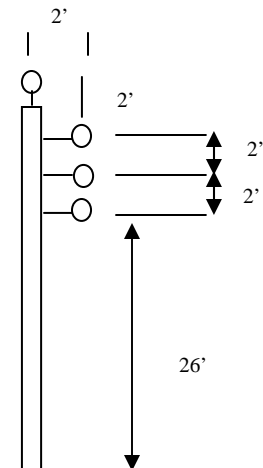
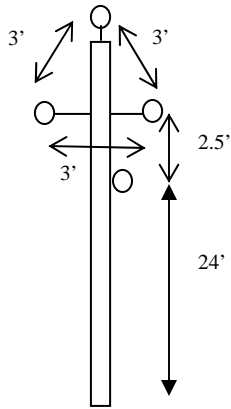


EE544 Homework 3

1.



Phases 556,500 26/7 ACSR
Neutral 4/0

Phases 336,400 26/7 ACSR
Neutral 336,400 26/7 ACSR

For the lines above compute the primitive (4x4) impedance matrix and the phase impedance matrix at 60Hz, 50 deg. C and an earth resistivity of 100 ohm-meter

2. Do a moderate amount of library/web literature search. Tell me the definition of earth resistivity and tell me how to measure the same. Also tell me how neutrals are typically grounded and if there is some sort of impedance involved between neutral and ground.

ACSR

Aluminum Conductor Steel Reinforced

ASTM: B230, Specification for Aluminum 1350-H19 Wire for Electrical Purposes
 B232, Specification for Concentric-Lay-Stranded Aluminum Conductors, Coated Steel Reinforced (ACSR)
 B498, Specification for Zinc-Coated (Galvanized) Steel Core Wire for Aluminum Conductors,
 Steel Reinforced (ACSR)

CODE WORD	SIZE	STRANDING # & DIA OF STRANDS IN.		DIAMETER (IN.)		Rated Strength Lbs.	WEIGHT			PERCENT OF TOTAL WEIGHT	
	AWG or KCMIL	Aluminum	Steel	Complete Conductor	Steel Core		LBS./1000 FT.			Aluminum	Steel
							Total	Aluminum	Steel		
TURKEY	6	6 x 0.0661	1 x 0.0661	0.198	0.066	1190	36.0	24.4	11.6	67.9	32.1
SWAN	4	6 x 0.0834	1 x 0.0834	0.250	0.083	1860	57.4	39.0	18.4	67.9	32.1
SWANATE	4	7 x 0.0772	1 x 0.1029	0.257	0.102	2360	67.0	39.0	28.0	58.1	41.9
SPARROW	2	6 x 0.1052	1 x 0.1052	0.316	0.105	2850	91.2	61.9	29.3	67.9	32.1
SPARATE	2	7 x 0.0974	1 x 0.1299	0.325	0.129	3640	107.0	62.3	44.7	58.1	41.9
ROBIN	1	6 x 0.1181	1 x 0.1181	0.355	0.118	3550	115.0	78.1	36.9	67.9	32.1
RAVEN	1/0	6 x 0.1327	1 x 0.1327	0.398	0.132	4380	145.0	98.4	46.6	67.9	32.1
QUAIL	2/0	6 x 0.1489	1 x 0.1489	0.447	0.149	5300	183.0	124.2	58.8	67.9	32.1
PIGEON	3/0	6 x 0.1672	1 x 0.1672	0.502	0.167	6620	230.0	155.9	74.1	67.9	32.1
PENGUIN	4/0	6 x 0.1878	1 x 0.1878	0.563	0.187	8350	291.0	197.6	93.4	67.9	32.1
WAXWING	266.8	18 x 0.1217	1 x 0.1217	0.609	0.121	6880	289.0	249.8	39.2	86.45	13.55
PARTRIDGE	266.8	26 x 0.1013	7 x 0.0788	0.642	0.236	11300	366.0	250.4	115.6	68.6	31.4
MERLIN	336.4	18 x 0.1367	1 x 0.1367	0.684	0.136	8700	365.0	315.5	49.5	86.45	13.55
LINNET	336.4	26 x 0.1137	7 x 0.0884	0.721	0.265	14100	462.0	316.5	145.5	68.6	31.4
ORIOLE	336.4	30 x 0.1059	7 x 0.1059	0.741	0.317	17300	526.0	317.0	209.0	60.35	39.65
CHICKADEE	397.5	18 x 0.1486	1 x 0.1486	0.743	0.148	9900	431.0	372.5	58.5	86.45	13.55
IBIS	397.5	26 x 0.1236	7 x 0.0961	0.783	0.288	16300	546.0	374.1	171.9	68.6	31.4
LARK	397.5	30 x 0.1151	7 x 0.1151	0.806	0.345	20300	622.0	375.1	246.9	60.35	39.65
PELICAN	477	18 x 0.1628	1 x 0.1628	0.814	0.162	11800	517.0	446.8	70.2	86.45	13.55
FLICKER	477	24 x 0.1410	7 x 0.0940	0.846	0.282	17200	614.0	449.5	164.5	73.25	26.75
HAWK	477	26 x 0.1354	7 x 0.1053	0.858	0.316	19500	655.0	448.6	206.4	68.6	31.4
HEN	477	30 x 0.1261	7 x 0.1261	0.883	0.378	23800	746.0	449.7	296.3	60.35	39.65
OSPREY	556.5	18 x 0.1758	1 x 0.1758	0.879	0.175	13700	603.0	521.1	81.9	86.45	13.55
PARAKEET	556.5	24 x 0.1523	7 x 0.1015	0.914	0.304	19800	716.0	524.2	191.8	73.25	26.75
DOVE	556.5	26 x 0.1463	7 x 0.1138	0.927	0.341	22600	765.0	523.9	241.1	68.6	31.4
EAGLE	556.5	30 x 0.1362	7 x 0.1362	0.953	0.409	27800	871.0	523.3	345.7	60.35	39.65
PEACOCK	605	24 x 0.1588	7 x 0.1059	0.953	0.318	21600	779.0	570.2	208.8	73.25	26.75
SWIFT	636	36 x 0.1329	1 x 0.1329	0.930	0.133	13800	643.0	596.0	47.0	92.7	7.3
KINGBIRD	636	18 x 0.1880	1 x 0.1880	0.940	0.188	15700	690.0	596.4	93.6	86.45	13.55
ROOK	636	24 x 0.1628	7 x 0.1085	0.977	0.326	22600	818.0	598.8	219.2	73.25	26.75
GROSBEAK	636	26 x 0.1564	7 x 0.1216	0.990	0.365	25200	874.0	598.7	275.3	68.6	31.4
EGRET	636	30 x 0.1456	19 x 0.0874	1.019	0.437	31500	987.0	600.2	386.8	60.9	39.1
FLAMINGO	666.6	24 x 0.1667	7 x 0.1111	1.000	0.333	23700	858.0	628.2	229.8	73.25	26.75
STARLING	715.5	26 x 0.1659	7 x 0.1290	1.051	0.387	28400	984.0	674.2	309.8	68.6	31.4
REDWING	715.5	30 x 0.1544	19 x 0.0926	1.081	0.463	34600	1109	675	434	60.9	39.1
COOT	795	36 x 0.1486	1 x 0.1486	1.040	0.148	16800	804	745	59	92.7	7.3
TERN	795	45 x 0.1329	7 x 0.0886	1.063	0.266	22100	895	748.9	146.1	83.7	16.3
CUCKOO	795	24 x 0.1820	7 x 0.1213	1.092	0.364	27900	1024	750	274	73.2	26.8
CONDOR	795	54 x 0.1213	7 x 0.1213	1.093	0.364	28200	1022	748	274	73.25	26.75
DRAKE	795	26 x 0.1749	7 x 0.1360	1.108	0.408	31500	1093	749	344	68.6	31.4
MALLARD	795	30 x 0.1628	19 x 0.0977	1.140	0.489	38400	1234	751	483	60.9	39.1
RUDDY	900	45 x 0.1414	7 x 0.0943	1.131	0.283	24400	1013	847	166	83.7	16.3
CANARY	900	54 x 0.1291	7 x 0.1291	1.162	0.387	31900	1158	848	310	73.25	26.75
CORNCRAKE	954	20 x 0.2184	7 x 0.0971	1.165	0.291	25600	1074	899	175	83.7	16.3
REDBIRD	954	24 x 0.1994	7 x 0.1329	1.196	0.399	33500	1228	899	329	73.2	26.8
TOWHEE	954	48 x 0.1410	7 x 0.1097	1.175	0.329	28500	1123	899	224	80.1	19.9
RAIL	954	45 x 0.1456	7 x 0.0971	1.165	0.291	25900	1075	899	176	83.7	16.3
CARDINAL	954	54 x 0.1329	7 x 0.1329	1.196	0.399	33800	1228	899	329	73.25	26.75
ORTOLAN	1033.5	45 x 0.1515	7 x 0.1010	1.213	0.303	27700	1163	973	190	83.7	16.3
CURLEW	1033.5	54 x 0.1383	7 x 0.1383	1.246	0.415	36600	1329	973	356	73.25	26.75
BLUEJAY	1113.0	45 x 0.1573	7 x 0.1049	1.259	0.315	29800	1254	1049	205	83.8	16.2
FINCH	1113.0	54 x 0.1436	19 x 0.0862	1.293	0.431	39100	1430	1054	376	73.7	26.3
BUNTING	1192.5	45 x 0.1628	7 x 0.1085	1.302	0.326	32000	1342	1123	219	83.8	16.2
GRACKLE	1192.5	54 x 0.1486	19 x 0.0892	1.338	0.446	41900	1531	1128	403	73.7	26.3
SKYLARK	1272.0	36 x 0.1880	1 x 0.1880	1.317	0.188	26400	1286	1192	94	92.7	7.3
BITTERN	1272.0	45 x 0.1681	7 x 0.1121	1.345	0.336	34100	1432	1198	234	83.8	16.2
PHEASANT	1272.0	54 x 0.1535	19 x 0.0921	1.382	0.461	43600	1634	1205	429	73.7	26.3
DIPPER	1351.5	45 x 0.1733	7 x 0.1155	1.386	0.347	36200	1521	1273	248	83.8	16.2
MARTIN	1351.5	54 x 0.1582	19 x 0.0949	1.424	0.475	46300	1735	1279	456	73.7	26.3
BOBOLINK	1431.0	45 x 0.1783	7 x 0.1189	1.427	0.357	38300	1611	1348	263	83.8	16.2
PIOYER	1431.0	54 x 0.1628	19 x 0.0977	1.465	0.489	49100	1838	1355	483	73.7	26.3
LAPWING	1590.0	45 x 0.1880	7 x 0.1253	1.504	0.376	42200	1790	1498	292	83.8	16.2
FALCON	1590.0	54 x 0.1716	19 x 0.1030	1.545	0.515	54500	2042	1505	537	73.7	26.3
CHUKAR	1780.0	84 x 0.1456	19 x 0.0874	1.602	0.437	51000	2072	1685	387	81.3	18.7
MOCKINGBIRD	2034.5	72 x 0.1681	7 x 0.1122	1.681	0.336	46800	2163	1929	234	89.2	10.8
BLUEBIRD	2156.0	84 x 0.1602	19 x 0.0961	1.762	0.481	60300	2508	2040	468	81.4	18.6
KIWI	2167.0	72 x 0.1735	7 x 0.1157	1.735	0.347	49800	2300	2051	249	89.2	10.8
THRASHER	2312.0	76 x 0.1744	19 x 0.0814	1.802	0.407	56700	2523	2188	335	86.7	13.3
JOREA	2515.0	76 x 0.1819	19 x 0.0850	1.880	0.425	61700	2749	2384	365	86.7	13.3
High Strength ACSR											
GROUPSE	80.0	8 x 0.1000	1 x 0.1670	0.367	0.1670	5200	149.0	75.1	73.9	50.4	49.6
PETREL	101.8	12 x 0.0921	7 x 0.0921	0.461	0.2763	10400	254.0	95.9	158.1	37.8	62.2
MINORCA	110.8	12 x 0.0961	7 x 0.0961	0.481	0.2883	11300	276.0	103.9	172.1	37.8	62.2
LEGHORN	134.6	12 x 0.1059	7 x 0.1059	0.530	0.3177	13600	336.0	127.0	209.0	37.8	62.2
GUINEA	159.0	12 x 0.1151	7 x 0.1151	0.576	0.3453	16000	396.0	149.1	246.9	37.8	62.2
DOTTEREL	176.9	12 x 0.1214	7 x 0.1214	0.607	0.3642	17300	441.0	166.4	274.6	37.8	62.2
DORKING	190.8	12 x 0.1261	7 x 0.1261	0.631	0.3783	18700	476.0	179.7	296.3	37.8	62.2
COCHIN	211.3	12 x 0.1327	7 x 0.1327	0.663	0.3981	20700	527.0	198.8	328.2	37.8	62.2
BRAHMA	203.2	16 x 0.1127	19 x 0.0977	0.714	0.4885	28400	675.0	189.9	485.1	28.3	71.7

Aluminum Conductor Steel Reinforced

Electrical Properties

CODE WORD	SIZE & STANDING		RESISTANCE				60 HZ REACTANCE 1 FT. EQUIVALENT SPACING				
	AWG or KCMIL	Alum/ Steel	DC Ohms/1000 ft. @20° C	AC 60 HZ (OHMS/1000 FT.)			Capacitive (Megohm- 1000 Ft.)	INDUCTIVE (OHMS/1000 FT.)			
				@25° C	@50° C	@75° C		@25° C	@50° C	@75° C	
TURKEY	6	6/1	0.6419	0.6553	0.7500	0.8159	0.7513	0.1201	0.1390	0.1439	
SWAN	4	6/1	0.4032	0.4119	0.4794	0.5218	0.7149	0.1152	0.1314	0.1369	
SWANATE	4	7/1	0.3989	0.4072	0.4633	0.5165	0.7102	0.1133	0.1239	0.1303	
SPARROW	2	6/1	0.2534	0.2591	0.3080	0.3360	0.6785	0.1100	0.1235	0.1277	
SPARATE	2	7/1	0.2506	0.2563	0.2966	0.3297	0.6737	0.1081	0.1176	0.1206	
ROBIN	1	6/1	0.2011	0.2059	0.2474	0.2703	0.6600	0.1068	0.1191	0.1224	
RAVEN	1/0	6/1	0.1593	0.1633	0.1972	0.2161	0.6421	0.1040	0.1138	0.1163	
QUAIL	2/0	6/1	0.1265	0.1301	0.1616	0.1760	0.6241	0.1017	0.1117	0.1135	
PIGEON	3/0	6/1	0.1003	0.1034	0.1208	0.1445	0.6056	0.0992	0.1083	0.1095	
PENGUIN	4/0	6/1	0.0795	0.0822	0.1066	0.1157	0.5966	0.0964	0.1047	0.1053	
								Inductive Ohms/1000 Ft.		GMR (Ft.)	
WAXWING	266.8	18/1	0.0644	0.0657	0.0723	0.0788	0.576	0.0934	0.0197		
PARTRIDGE	266.8	26/7	0.0637	0.0652	0.0714	0.0778	0.565	0.0881	0.0217		
MERLIN	336.4	18/1	0.0510	0.0523	0.0574	0.0625	0.560	0.0877	0.0221		
LINNET	336.4	26/7	0.0506	0.0517	0.0568	0.0619	0.549	0.0854	0.0244		
ORIOLE	336.4	30/7	0.0502	0.0513	0.0563	0.0614	0.544	0.0843	0.0255		
CHICKADEE	397.5	18/1	0.0432	0.0443	0.0487	0.0528	0.544	0.0856	0.0240		
IBIS	397.5	26/7	0.0428	0.0438	0.0481	0.0525	0.539	0.0835	0.0265		
LARK	397.5	30/7	0.0425	0.0434	0.0477	0.0519	0.533	0.0824	0.0277		
PELICAN	477.0	18/1	0.0360	0.0369	0.0405	0.0441	0.528	0.0835	0.0263		
FLICKER	477.0	24/7	0.0358	0.0367	0.0403	0.0439	0.524	0.0818	0.0283		
HAWK	477.0	26/7	0.0357	0.0366	0.0402	0.0438	0.522	0.0814	0.0290		
HEN	477.0	30/7	0.0354	0.0362	0.0389	0.0434	0.517	0.0803	0.0304		
OSPREY	556.5	18/1	0.0309	0.0318	0.0348	0.0379	0.518	0.0818	0.0284		
PARAKEET	556.5	24/7	0.0307	0.0314	0.0347	0.0377	0.512	0.0801	0.0306		
DOVE	556.5	26/7	0.0305	0.0314	0.0345	0.0375	0.510	0.0795	0.0313		
EAGLE	556.5	30/7	0.0300	0.0311	0.0341	0.0371	0.505	0.0786	0.0328		
PEACOCK	605.0	24/7	0.0282	0.0290	0.0328	0.0378	0.505	0.0792	0.0319		
SWIFT	636.0	36/1	0.0267	0.0281	0.0307	0.0334	0.509	0.0806	0.0300		
KINGBIRD	636.0	18/1	0.0269	0.0278	0.0306	0.0332	0.507	0.0805	0.0301		
ROOK	636.0	24/7	0.0268	0.0277	0.0300	0.0330	0.502	0.0786	0.0327		
GROSBEAK	636.0	26/7	0.0267	0.0275	0.0301	0.0328	0.500	0.0780	0.0335		
EGRET	636.0	30/19	0.0266	0.0273	0.0299	0.0326	0.495	0.0769	0.0351		
FLAMINGO	666.6	24/7	0.0256	0.0263	0.0290	0.0314	0.498	0.0780	0.0335		
STARLING	715.5	26/7	0.0238	0.0244	0.0269	0.0292	0.490	0.0767	0.0355		
REDWING	715.5	30/19	0.0236	0.0242	0.0267	0.0290	0.486	0.0756	0.0372		
COOT	795.0	36/1	0.0217	0.0225	0.0247	0.0268	0.492	0.0780	0.0335		
TERN	795.0	45/7	0.0216	0.0225	0.0246	0.0267	0.488	0.0764	0.0352		
CUCKOO	795.0	24/7	0.0215	0.0223	0.0243	0.0266	0.484	0.0763	0.0361		
CONDOR	795.0	54/7	0.0215	0.0222	0.0244	0.0265	0.484	0.0759	0.0368		
DRAKE	795.0	26/7	0.0214	0.0222	0.0242	0.0263	0.482	0.0756	0.0375		
MALLARD	795.0	30/19	0.0213	0.0220	0.0241	0.0261	0.477	0.0744	0.0392		
RUDDY	900.0	45/7	0.0191	0.0200	0.0218	0.0237	0.479	0.0755	0.0374		
CANARY	900.0	54/7	0.0190	0.0197	0.0216	0.0235	0.474	0.0744	0.0392		
CORNCRAKE	954.0	20/7	0.0180	0.0188	0.0206	0.0224	0.474	0.0751	0.0378		
REDBIRD	954.0	24/7	0.0179	0.0186	0.0204	0.0221	0.470	0.0742	0.0396		
TOWHEE	954.0	48/7	0.0180	0.0188	0.0205	0.0223	0.473	0.0745	0.0391		
RAIL	954.0	45/7	0.0180	0.0188	0.0206	0.0223	0.474	0.0748	0.0385		
CARDINAL	954.0	54/7	0.0179	0.0186	0.0205	0.0222	0.470	0.0757	0.0404		
ORTOLAN	1033.5	45/7	0.0167	0.0175	0.0191	0.0208	0.468	0.0739	0.0401		
CURLWEW	1033.5	54/7	0.0165	0.0172	0.0189	0.0205	0.464	0.0729	0.0420		
BLUEJAY	1113.0	45/7	0.0155	0.0163	0.0178	0.0193	0.462	0.0731	0.0416		
FINCH	1113.0	54/19	0.0154	0.0161	0.0176	0.0191	0.458	0.0702	0.0436		
BUNTING	1192.5	45/7	0.0144	0.0152	0.0167	0.0181	0.456	0.0723	0.0431		
GRACKLE	1192.5	54/19	0.0144	0.0151	0.0165	0.0179	0.452	0.0710	0.0451		
SKYLARK	1272.0	36/1	0.0135	0.0145	0.0159	0.0173	0.455	0.072	0.0427		
BITTERN	1272.0	45/7	0.0135	0.0144	0.0157	0.0170	0.451	0.072	0.0445		
PHEASANT	1272.0	54/19	0.0135	0.0142	0.0155	0.0169	0.447	0.070	0.0466		
DIPPER	1351.5	45/7	0.0127	0.0136	0.0148	0.0161	0.442	0.071	0.0459		
MARTIN	1351.5	54/19	0.0127	0.0134	0.0147	0.0159	0.442	0.070	0.0480		
BOBOLINK	1431.0	45/7	0.0120	0.0129	0.0141	0.0152	0.442	0.070	0.0472		
PLOVER	1431.0	54/19	0.0120	0.0127	0.0134	0.0151	0.438	0.069	0.0495		
LAPWING	1590.0	45/7	0.0108	0.0117	0.0127	0.0138	0.434	0.069	0.0498		
FALCON	1590.0	54/19	0.0108	0.0116	0.0126	0.0137	0.430	0.068	0.0521		
CHUKAR	1780.0	84/19	0.0097	0.0106	0.0115	0.0125	0.424	0.067	0.0534		
MOCKINGBIRD	2034.5	72/7	0.0085	0.0096	0.0104	0.0112	0.416	0.066	0.0553		
BLUEBIRD	2156.0	84/19	0.0080	0.0090	0.0098	0.0105	0.409	0.065	0.0588		
KIWI	2167.0	72/7	0.0080	0.0092	0.0099	0.0106	0.411	0.068	0.0570		
THRASHER	2312.0	76/19	0.0075	0.0086	0.0092	0.0100	0.405	0.065	0.0600		
JOREA	2515.0	76/19	0.0069	0.0081	0.0087	0.0093	0.399	0.064	0.0621		
								60 HZ REACTANCE 1 FT. EQUIVALENT SPACING			
								Capacitive (Megohm- 1000 Ft.)	INDUCTIVE (OHMS/1000 FT.)		
High Strength ACSR									@25° C	@50° C	@75° C
GROUSE	80.0	8/1	0.2065	0.2110	0.2362	0.2612	0.6547	0.1047	0.1129	0.1150	
PETREL	101.8	12/7	0.1583	0.1625	0.2072	0.2394	0.6193	0.1019	0.1161	0.1282	
MINORCA	110.8	12/7	0.1454	0.1491	0.1932	0.2233	0.6125	0.1017	0.1176	0.1269	
LEGHORN	134.6	12/7	0.1198	0.1233	0.1638	0.1894	0.5972	0.0998	0.1148	0.1227	
GUINEA	159.0	12/7	0.1014	0.1045	0.1426	0.1653	0.5845	0.0979	0.1117	0.1189	
DOTTEREL	176.9	12/7	0.0911	0.0945	0.1301	0.1513	0.5760	0.0970	0.1102	0.1169	
DORKING	190.8	12/7	0.0845	0.0875	0.1229	0.1424	0.5697	0.0956	0.1093	0.1150	
COCHIN	211.3	12/7	0.0763	0.0792	0.1125	0.1311	0.5618	0.0945	0.1074	0.1129	
BRAHMA	203.2	16/19	0.0764	0.0790	0.1089	0.1348	0.5507	0.0934	0.1047	0.1121	

DC resistance is based on 16.946 ohm-cmil/ft. 61.2% IACS for 1350 wires and 129.64 ohm-cmil/ft. 8% IACS for the steel core at 20° C with stranding increment as per ASTM B232.