INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

Department of Electrical and Electronics Engineering

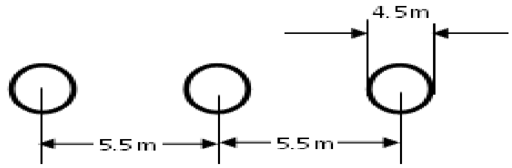
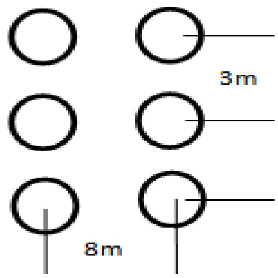
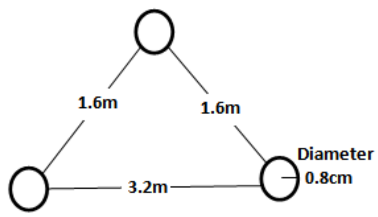
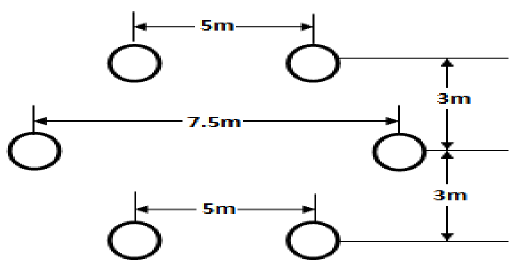
ASSIGNMENT

Course Name	**:**	**POWER SYSTEMS-II**
Course Code	**:**	**A50221**
Class	**:**	**III B. Tech I Semester**
Branch	**:**	**Electrical and Electronics Engineering**
Year	**:**	**2017 - 2018**
Course Faculty	**:**	K.Raju, Assistant Professor

OBJECTIVE:

Power systems-II course is one of the important courses in the Electrical discipline. In this course, detailed modeling of transmission line parameters and its impact on the system performance will be discussed.

S. No	Question	Blooms Taxonomy Level	Program Outcome
	UNIT - 1 TRANSMISSION LINE PARAMETERS		
	Part - A (Short Answer Questions)		
1	What is a transmission line?	Remember	1
2	Define a two –wire transmission system?	Understand	1
3	What do you mean by internal and external flux linkage?	Remember	1
4	Define permeability of a conductor?	Understand	1
5	What is a composite conductor?	Remember	1
6	Define inductive reactance spacing factor?	Remember	1
7	What is the difference between single and double circuit?	Understand	1
8	Give the expansion of GMR and GMD.	Understand	1
9	What is transposed line?	Remember	1
10	What is skin effect?	Remember	1
	Part - B (Long Answer Questions)		
1	Derive an expression for inductance of a conductor due to external flux	Apply	1
2	With a diagram explain equilateral and unsymmetrical spacing of conductors.	Understand	1
3	Compare the capacitance of a three phase double circuit line with symmetrical spacing with the capacitance of a three phase double circuit line with unsymmetrical spacing.	Analyze	1
4	Discuss effect of earth on the capacitance of the line.	Analyze	1
5	Explain the concept of self and mutual GMDs.		1
6	A 3-phase , 50hz, 66kv over head transmission line has conductors arranged at the corners of an equivalent triangular of 3m sides and the diameter of each conductor is 1.5cm determine 'L' and 'C' per phase, if l=100km. also calculate charging current.	Analyze	1

<table>
<tr><td>7</td><td>Determine L/km/phase of a single circuit 3-phase,20kv line given

</td><td>Analyze</td><td>1</td></tr>
<tr><td>8</td><td>Calculate the inductance/ph if diameter=1.5cm

</td><td>Analyze</td><td>1</td></tr>
<tr><td>9</td><td>Determine the capacitance and the charging inductance per Km. when the transmission line of figure operating at 132kv.

</td><td>Analyze</td><td>1</td></tr>
<tr><td>10</td><td>Determine the inductance per Km of a double circuit 3-phase line is transposed with in each circuit and each circuit remains at its out side. The diameters of each conductor in 15mm.

</td><td>Analyze</td><td>1</td></tr>
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UNIT – II
PERFORMANCE OF SHORT,MEDIUM AND LONG LENGTH TRANSMISSION LINES

Part - A (Short Answer Questions)

1	Give classification of overhead transmission line.	Understand	2
2	Draw equivalent T and π network.	Creating	2
3	What is surge impedance loading?	Understand	2
4	What are ABCD constants in a transmission line?	Remember	2
5	What is reflected and refracted wave?	Remember	2
6	What are the limitations of T and π methods?	Understand	2
7	Define characteristic impedance of a transmission line.	Remember	2
8	What is the purpose of using series reactors on a transmission line?	Apply	2
9	Why do we analyze a three phase transmission line on single phase basis?	Apply	2
10	What is the length of short long and medium transmission line?	Apply	2

Part - B (Long Answer Questions)

1	What do you mean by medium transmission line? How capacitance effect is taken to account.	Understand	2

2	Show how regulation and efficiency are determined in nominal T and nominal π method.	Understand	2
3	Using rigorous method, derive expression for sending end voltage for a long transmission line.	Analyze	2
	Explain how voltages and currents are evaluated in long transmission lines.	Understand	2
5	Derive expression for surge impedance.	Apply	2
6	A 1-phase transmission line has a resistance of 0.20 ohm and an inductance of 0.40 ohm. Find the voltage at the sending end to give 500KVA at 2KV at the receiving end at power factor of (i) Unity (ii) 0.707 lagging. Illustrate with suitable phaser diagrams.	Analyze	2
7	A 60 Hz short line has resistance of 0.62 ohm/ph and inductance of 93.24 mh/ph. The line supplies a load(Y connected) of 100µW at 0.9 p.f.(lag) and at 215KV(L-L). Calculate sending-end voltage per phase	Analyze	2
8	Calculate the distance over which a load of 15MW at 0.85 p.f. can be delivered by a 3 phase transmission line having conductorseah of resistance 0.905 ohm/km. The receiving end voltage is 132kv and the loss is to be 7.5% of the load.	Analyze	2
9	Determine the sending end voltage current, power and power factor for a 160km section of 3-phase line delivering 50MVA at 132kv and p.f. 0.8 lagging. Also find the efficiency and regulation of the line. Resistance per line 0.1557 ohm per km, spacing 3.7 m, 6.475 m, 7.4 m transposed. Evaluate the A,B,C,D parameters also. Diameter is 1.956cm.	Analyze	2
10	Show that for a transmission line receiving end voltage and current(Vr and Ir) in terms of sending end voltage and current(Vs and Is) and auxiliary constants are given by Vr= DVs – Bis and Ir= -CVs + AIs.	Analyze	2

UNIT – III
POWER SYSTEM TRANSIENTS AND FACTORS GOVERNING THE PERFORMANCE OF TRANSMISSION LINES

Part - A (Short Answer Questions)

1	What are the types of power system transients?	Remember	3
2	Name the various types of Transients in power system.	Remember	3
3	What are the specifications of a traveling wave?	Remember	3
4	Write the expression for series and shunt lumped parameters in distributed	Apply	3
5	What is meant by reflection and refraction of traveling waves.	Understand	3
6	What is Ferranti effect?	Understand	3
7	Define voltage regulation and efficiency of a transmission line.	Understand	3
8	What are disruptive and visual critical voltages?	Understand	3
9	What is corona?	Understand	3
10	What are the factors affecting corona?	Apply	3

Part - B (Long Answer Questions)

1	Discuss transient response of systems with series and shunt lumped parameters and distributed lines.	Understand	3
2	With neat sketch explain Bewley's Lattice diagram.	Remember	3
3	Derive the reflection and refraction coefficients of a traveling wave.	Apply	3
4	Describe the phenomenon of corona? How can the corona loss are minimized in transmission lines.	Understand	3
5	Derive the expression for wave equation of a travelling wave	Apply	3
6	An overhead transmission line with surge impedance 400Ω is 300 km long. One end of this line is short circuited and at the other end a source of 11KV is suddenly switched on. Calculate the current at source end 0.005 sec after the voltage is applied.	Analyze	3
7	A Step wave of 110 KV travels through a line having a surge impedance of 5000µH. Find the voltage across the inductance and reflection wave.	Analyze	3

8	The two long transmission lines A and C are connected by a cable of 1 Km long. The surge impedance of A, B, C are 400, 50 and 500 Ohms respectively. A rectangular value wave of 25 KV magnitude and of infinite length is initiated in A and travels to C. Determine the first and second voltage impedance	Analyze	3
9	Estimate the corona loss for a three-phase, 110 kV, 50 Hz, 150 km long transmission line consisting of three conductors each of 10 mm diameter and spaced 2·5 m apart in an equilateral triangle formation. The temperature of air is 30ºC and the atmospheric pressure is 750 mm of mercury. Take irregularity factor as 0·85. Ionisation of air may be assumed to take place at a maximum voltage gradient of 30 kV/ cm.	Analyze	3
10	A 3-phase, 220 kV, 50 Hz transmission line consists of 1·2 cm radius conductors spaced 2 m at the corners of an equilateral triangle. Calculate the corona loss per km of the line. The condition of the wire is smoothly weathered and the weather is fair with temperature of 20ºC and barometric pressure of 72·2 cm of Hg.	Analyze	3
UNIT – IV (OVERHEAD LINE INSULATORS AND SAG TENSION CALCULATIONS)			
Part - A (Short Answer Questions)			
1	What is sag?	Understand	6
2	What is the significance of stringing chart?	Remember	6
3	A single phase overhead line consists of two conductors of dia 2cm with a spacing of 1.5m between centres. Determine line voltage for commencing of corona. Dielective strength of air =21kv/cm.	Analyze	6
4	What are the disadvantages of corona?	Understand	6
5	What is the significance of shunt compensation?	Remember	6
6	What are the various types of insulators?	Remember	6
7	Define string efficiency	Understand	6
8	What are the various methods to improve string efficiency?	Remember	6
9	What are the various tests conducted on insulators?	Remember	6
10	What is insulation failure?	Understand	6
Part - B (Long Answer Questions)			
1	Show how the sag of an overhead line can be calculated in case of supports at different levels.	Apply	6
2	Show how the sag of an overhead line can be calculated in case of supports at same level	Apply	6
3	Write a note on stringing charts and sag template.	Remember	6
4	Write short notes on different types of insulators used for overhead lines and their application.	Remember	6
5	Show that in a string of suspension insulators, the disc nearest to the conductor has the highest voltage across it.	Apply	6
6	In a 33 kV overhead line, there are three units in the string of insulators. If the capacitance between each insulator pin and earth is 11% of self-capacitance of each insulator, find (i) the distribution of voltage over 3 insulators and (ii) string efficiency.	Analyze	6
7	A 132 kV transmission line has the following data : Wt. of conductor = 680 kg/km ; Length of span = 260 m Ultimate strength = 3100 kg ; Safety factor = 2 Calculate the height above ground at which the conductor should be supported. Ground clearance required is 10 meters.	Analyze	6
8	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	Analyze	6

	thickness 1·27 cm and is subjected to a wind pressure of 3·9 gm/ cm2 of projected area, calculate sag for a safety factor of 2. Weight of 1 c.c. of ice is 0·91 gm.		
9	The three bus-bar conductors in an outdoor substation are supported by units of post type insulators. Each unit consists of a stack of 3 pin type insulators fixed one on the top of the other. The voltage across the lowest insulator is 13·1 kV and that across the next unit is 11 kV. Find the bus-bar voltage of the station.	Analyze	6
10	An overhead line has a span of 150 m between level supports. The conductor has a cross-sectional area of 2 cm2. The ultimate strength is 5000 kg/cm2 and safety factor is 5. The specific gravity of the material is 8·9 gm/cc. The wind pressure is 1·5 kg/m. Calculate the height of the conductor above the ground level at which it should be supported if a minimum clearance of 7 m is to be left between the ground and the conductor.	Analyze	6
UNIT – V UNDERGROUND CABLES			
Part - A (Short Answer Questions)			
1	What are the practical difficulties in grading?	Apply	7
2	What is the purpose of guard ring?	Apply	7
3	What is the purpose of using inters heath in a cable.	Apply	7
4	A 3- core cable gives on test a capacitance measurement of 2μF between two cores find the line charging current of the cable when it is connected to 11kv,50Hz supply system.	Analyze	7
5	A single-core cable has a conductor diameter of 1cm and insulation thickness of 0·4 cm. If the specific resistance of insulation is 5 × 1014 Ω-cm, calculate the insulation resistance for a 2 km length of the cable.	Analyze	7
6	A single core cable has a conductor diameter of 1 cm and internal sheath diameter of 1·8 cm. If impregnated paper of relative permittivity 4 is used as the insulation, calculate the capacitance for 1 7km length of the cable.	Analyze	7
7	A7 33 kV single core cable has a conductor diameter of 1 cm and a sheath of inside diameter 4 cm. Find the maximum and minimum stress in the insulation.	Analyze	7
8	Find the most economical value of diameter of a single-core cable to be used on 50 kV, single-phase system. The maximum permissible stress in the dielectric is not to exceed 40 kV/cm.	Analyze	7
9	The capacitance per kilometer of a 3-phase belted cable is 0·3 μ F between the two cores with the third core connected to the lead sheath. Calculate the charging current taken by five kilometers of this cable when connected to a 3-phase, 50 Hz, 11 kV supply.	Analyze	7
10	Compare the merits and demerits of underground system versus overhead system.	Remember	7
Part - B (Long Answer Questions)			
1	Derive an expression for stress at the sheath in insulator.	Apply	7
2	Derive an expression for capacitance grading in cable.	Apply	7
3	State the classification of cables (according to voltage) and discuss their general construction.	Understand	7
4	What is meant by capacitance grading of a cable? Derive expression for capacitance and maximum potential gradients in two (or more) dielectrics of a graded cable in terms of dielectric constants and radius of core and overall radius etc.	Analyze	7
5	Explain why the potential distribution is not in general uniform over the string of suspension type insulators?	Remember	7
6	A string of 5 suspension insulators is to be graded for obtaining uniform voltage distribution across the string. If the pin to earth capacitances are all equal to “C” and the mutual capacitance of the top insulator is 10C, find the	Analyze	7

	mutual capacitance of each unit in terms of C.		
7	Calculate the insulation resistance for 5km length of a 1-core cable. Resistance of insulation(impregnated paper) is 5×10^14 ohm-cm, insulation thickness is 1 cm and radius of conductor is 1.25 cm.	Analyze	7
8	The capacitances of a 3-phase belted cable are 12·6 μF between the three cores bunched together and the lead sheath and 7·4 μF between one core and the other two connected to sheath. Find the charging current drawn by the cable when connected to 66 kV, 50 Hz supply.	Analyze	7
9	The insulation resistance of a single-core cable is 495 MΩ per km. If the core diameter is 2·5 cm and resistivity of insulation is 4·5 × 1014 Ω-cm, find the insulation thickness.	Analyze	7
10	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. Determine (i) capacitance of the cable/phase (ii) charging current/phase (iii) total charging kVAR. The relative	Analyze	7

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