SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

IV SEMESTER

1905403 –Transmission and Distribution

Regulation – 2019

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Prepared by

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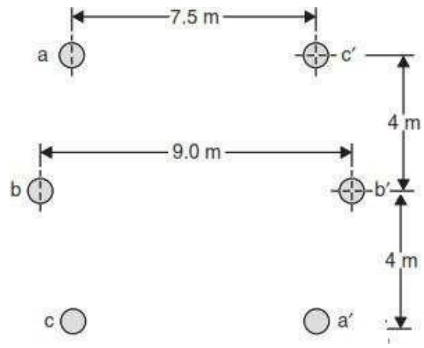
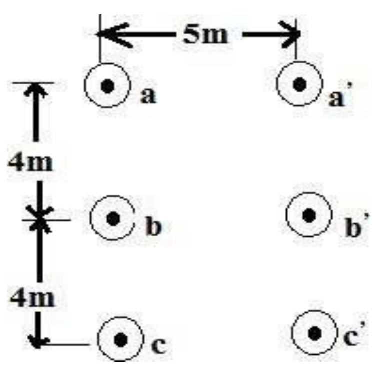
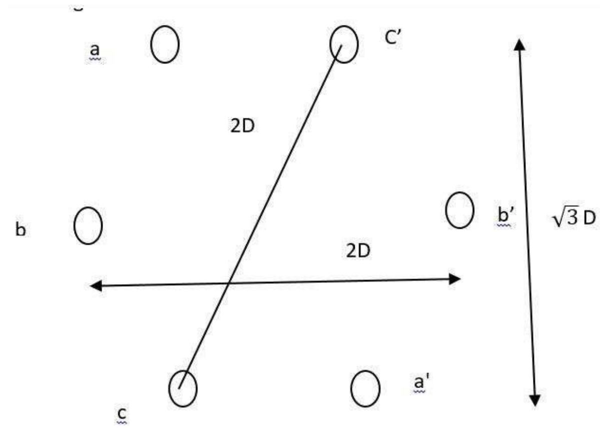
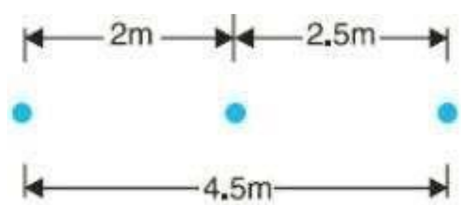
UNIT I TRANSMISSION LINE PARAMETERS

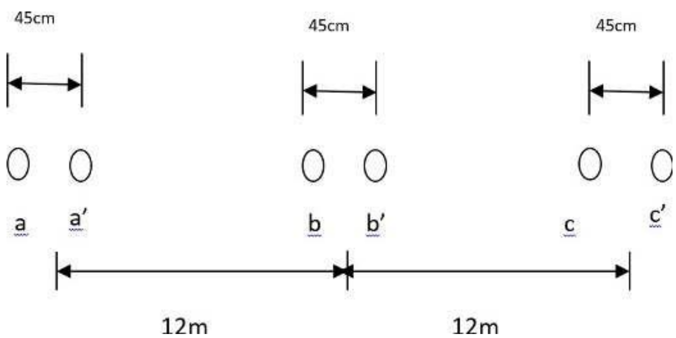
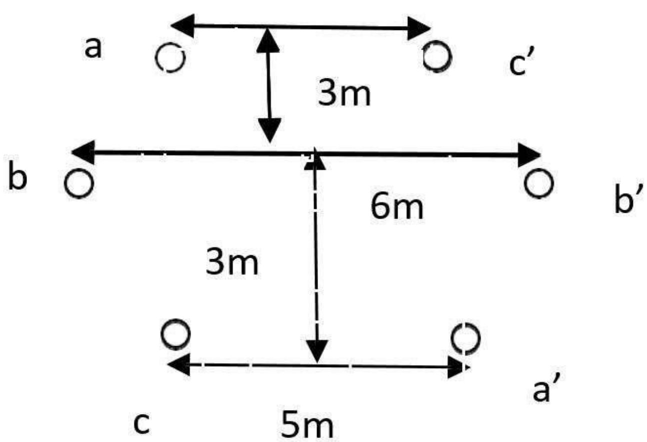
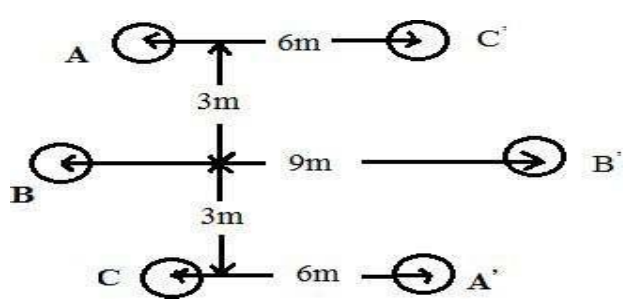
Structure of Power System - Parameters of single and three phase transmission lines with single and double circuits -Resistance, inductance and capacitance of solid, stranded and bundled conductors, Symmetrical and unsymmetrical spacing and transposition - application of self and mutual GMD; skin and proximity effects - Typical configurations, conductor types and electrical parameters of EHV lines. Interference with Neighboring Communication circuits.

PART – A

Q. No	Questions	BT Level	Competence	Course Outcome
1	List the advantages of using bundled conductors.	BTL1	Remembering	CO1
2	Discuss how inductance and capacitance of transmission line are affected by the spacing between the conductors.	BTL2	Understanding	CO1
3	Describe about composite conductors.	BTL1	Remembering	CO1
4	Define transposition. Identify why are transmission line transposed.	BTL2	Understanding	CO1
5	Discover the advantages of transposition of conductors.	BTL3	Applying	CO1
6	A three-phase transmission line has its conductor at the corners of an equilateral triangle with side 3m. The diameter of each conductor is 1.63cm. Examine the inductance per phase per km of the line.	BTL3	Applying	CO1
7	List the different types of overhead conductor.	BTL1	Remembering	CO1
8	Discriminate between self and Mutual GMD.	BTL5	Evaluating	CO1
9	Briefly explain ACSR	BTL2	Understanding	CO1
10	Point out the advantages of bundled conductor.	BTL4	Analyzing	CO1
11	Define proximity effect.	BTL1	Remembering	CO1
12	Explain why the concept of self GMD is not applicable for capacitance calculation.	BTL4	Analyzing	CO1
13	Write the primary distribution voltage in India.	BTL2	Understanding	CO1
14	Write the expression for a capacitance of a single-phase transmission line	BTL4	Analyzing	CO1
15	What is double circuit line and what are the necessity for a double circuit?	BTL2	Understanding	CO1
16	Describe what happens if the capacitance of a transmission line is very high.	BTL1	Remembering	CO1
17	Give the expression for inductance of 3 phase double circuit line with symmetrical spacing.	BTL1	Remembering	CO1 CO1
18	Generalize the reason for absent of skin effect in DC system.	BTL6	Creating	CO1
19	State skin effect in transmission line. Mention its effects on the resistance of the line.	BTL6	Creating	CO1
20	List out the parameters affecting skin effect in transmission line.	BTL5	Evaluating	CO1
21.	Distinguish Between GMD and GMR.	BTL2	Understanding	CO1
22.	What are the factors governing the inductance of a transmission line?	BTL1	Remembering	CO1
23.	Give an expression for the loop inductance of single phase two wire system.	BTL1	Remembering	CO1
24.	On what factors does the skin effect depend?	BTL4	Analyzing	CO1
	PART – B			
1	Derive the expression for calculation the internal and external flux linkages for a conductor carrying current. Use these expressions to derive the equation for the inductance of a single-phase transmission line.	BTL6	Creating	CO1
2	Derive the inductance of a three-phase transmission line with symmetrical spacing.	BTL4	Analyzing	CO1

3	Determine the inductance per km of a transposed double circuit 3-φ line shown in Fig. below. Each circuit of the line remains on its own side. The diameter of the conductor is 2.532 cm.  	BTL2	Understanding	CO1
4	Derive the expression for inductance of three phase line with unsymmetrical spacing.	BTL4	Analyzing	CO1
5	Calculate the loop inductance per km of a single-phase line comprising of 2 parallel (i) Copper of relative permeability 1 (7) (ii) Steel of relative permeability 50. (6)	BTL5	Evaluating	CO1
6	Derive the inductance of three phase double circuit line by (i) Symmetrical spacing. (7) (ii) Unsymmetrical spacing. (6)	BTL6	Creating	CO1
7	(i) Calculate the GMR of a conductor having seven strands each of 3mm radius. (ii)Explain why and how transposition of three phase lines are done (6)	BTL5 BTL4	Evaluating Analyzing	CO1
8	(i) Derive the expression for inductance for bundled conductor. (8) (ii)Explain the advantages of bundled conductor when used for overhead line. (5)	BTL6 BTL6	Creating Creating	CO1
9	Derive the capacitance of three phase line with symmetrical and spacing.	BTL4	Analyzing	CO1
10	Determine the capacitance per phase of the double circuit line as shown in fig, the diameter is 2.1793cm.  	BTL4	Analyzing	CO1
11	Derive from first principle the capacitance per km to neutral of three phases overhead transmission line with unsymmetrical spacing of conductors assuming transposition.	BTL6	Creating	CO1

12	(i) Derive the expression for capacitance of a single-phase overhead line. (5) (ii) Find out the capacitance of single-phase line of 30km long consisting of two parallel wires each 15mm diameter and 1.5m apart. (8)	BTL6 BTL5	Creating Evaluating	CO1
13	A 220kV,50Hz, 200km long three phase line has its conductors on the corners of a triangle with sides 6m,6m and 12m. The conductor radius is 1.81cm. Find the capacitance per phase per km. Capacitive reactance per phase, Charging current and Charging Mega volt-amperes	BTL4	Analyzing	CO1
14	(i) What is method of images? How can it be used to take into account the of ground in calculation the capacitance of single-phase lines? (5) (ii) A three-phase double circuit line has the conductors at the vertices of a hexagon as Shown in figure  If D=3.5m and the radius of conductor is 1.09cm find the capacitance per phase per km. If the line voltage is 132kV and the line length is 100km, find the charging current. (8)		Applying	CO1
15	A 3-phase, 50 Hz, 66 kV overhead line conductors are placed in a horizontal plane as shown in Fig. The conductor diameter is 1·25 cm. If the line length is 100 km, calculate (i) capacitance per phase, (ii) charging current per phase, assuming complete transposition of the line. 	BTL6	Creating	CO1
16	Explain clearly the skin effect and proximity effects when referred to overhead lines.	BTL4	Analyzing	CO1
17	(i) Deduce an expression for line to neutral capacitance of a three-phase overhead transmission line with unsymmetrical spacing when the conductors spaced. (5) (ii) A 50Hz transposed line has its line conductors arranged in a line with unsymmetrical spacing. Radius of each conductor is 3cm and the distance between conductors is 3m. Find the line to neutral capacitor for 1km and the reactance. (10)	BTL6	Creating	CO1

PART - C				
1.	Derive the expression for inductance of a three-phase double circuit line flat vertical spacing with transposition.	BTL6	Creating	CO1
2.	(i) Show that the inductance per unit length of an overhead line due to internal flux linkage is constant and independent of size of conductors (5) (ii) A 400kV 3 phase bundled conductor line with sub-conductor per phase a horizontal configuration as shown in figure. The radius of each of sub-conductor is 1.6cm  Find the inductance per phase per km of the line. Also Compute the inductance of the line with only one conductor per phase having the same cross-sectional area of the conductor of each phase. (10)	BTL5	Evaluating	CO1
3	Solve the inductance /phase /km of double circuit 3phase line shown in fig.the line is completely Transposed and operates at a frequency of 50Hz. Radius r = 6mm 	BTL5	Evaluating	CO1
4	Derive the expression for capacitance of symmetrical and unsymmetrical double circuit three phase line.	BTL6	Creating	CO1
5	A three-phase circuit line consists of 7/4.5 mm hard drawn copper conductors. The arrangements of the conductors is shown in fig. The line is completely transposed. Calculate inductive reactance per phase per km of the system. 	BTL5	Evaluating	CO1

UNIT II MODELLING AND PERFORMANCE OF TRANSMISSION LINES

Performance of Transmission lines - short line, medium line and long line - equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance - transmission efficiency and voltage regulation, real and reactive power flow in lines - Power Circle diagrams - Formation of Corona – Critical Voltages – Effect on Line Performance.

PART - A

Q. No	Questions	BT Level	Competence	Course Outcome
1	What is the effect of leading load power factor on voltage regulation of a short transmission line?	BTL3	Applying	CO2
2	Give the range of surge impedance value for a overhead transmission line and a underground cable.	BTL2	Understanding	CO2
3	Give the equivalent circuit and phasor diagram for short transmission line.	BTL2	Understanding	CO2
4	Define transmission efficiency.	BTL1	Remembering	CO2
5	Show the nominal T and π model of medium transmission line with its parameters filled.	BTL3	Applying	CO2
6	Identify what is meant by natural loading of transmission lines.	BTL1	Remembering	CO2
7	Point out any two reasons for line loss in transmission line.	BTL4	Analyzing	CO2
8	How are transmission line classified?	BTL2	Understanding	CO2
9	Define voltage regulation of a transmission line.	BTL1	Remembering	CO2
10	Write ABCD constants of medium T network.	BTL2	Understanding	CO2
11	Draw the equivalent circuit of long transmission line.	BTL4	Analyzing	CO2
12	Draw the power angle diagram of transmission line.	BTL5	Evaluating	CO2
13	Examine the factors which affecting corona.	BTL3	Applying	CO2
14	Explain how you will reduce corona loss.	BTL4	Analyzing	CO2
15	Distinguish between attenuation and phase constant.	BTL4	Analyzing	CO2
16	Identify the use of power circle diagram.	BTL1	Remembering	CO2
17	Describe Visual critical voltage and Disruptive critical voltage.	BTL2	Understanding	CO2
18	What is surge impedance?	BTL1	Remembering	CO2
19	Summarize the significance of surge impedance loading.	BTL2	Understanding	CO2
20	Define Ferranti effect.	BTL1	Remembering	CO2
21	What are the disadvantages of Corona?	BTL1	Remembering	CO2
22	What is the use of Power circle diagram?	BTL2	Understanding	CO2
23	What is the different between nominal T and nominal л method?	BTL1	Remembering	CO2
24	How to improve power handling capacity of long line?	BTL2	Understanding	CO2

PART - B

Q. No	Questions	BT Level	Competence	Course Outcome
1	A 50Hz, 3 phase transmission line 30km long has a total series impedance of (40+j125) and shunt admittance of 10^{-3} mho. The load is 50MW at 220kV with 0.8pf lag. Find the sending end voltage, current, power factor, efficiency and regulation using nominal π-method.	BTL5	Evaluating	CO2
2	A balanced three phase load of 30MW is supplied 132kV, 50Hz and 0.85 p.f lagging by means of a transmission line. The series impedance of a single conductor (20+j52) ohm and the total phase neutral admittance is 315×10^{-6} Siemen. Using nominal T method. Determine (i) A,B,C and D constants of the line (ii) Sending end voltage (iii) regulation of the line. (7+3+3)	BTL6	Creating	CO2

3	Derive A, B, C, D constants using nominal T method and nominal л method for medium lines.	BTL6	Creating	CO2
4	(i) With reference to long transmission lines, gives the physical interoperation of the following terms (1) Characteristics impedance (2) Surge impedance (3) Surge impedance loading (4) Propagation constant. (8) (ii) Derive the ABCD constants of medium transmission line with π configuration. (5)	BTL2 BTL6	Understanding Creating	CO2
5	Draw the phasor diagram and explain the procedure for determining the transmission efficiency and voltage regulation of medium lines (use л of T model).	BTL4	Analyzing	CO2
6	(i) Briefly explain the procedure for drawing receiving end power circle diagram. (7) (ii) Derive the power flow performance equation of three phase transmission line in the form and sending-end receiving-end power and voltages at the two ends of the line. (6)	BTL2 BTL6	Understanding Creating	CO2
7	A 3 phase 100km line has the following constants. Resistance/phase /km =0.153ohm, inductance/phase /km=1.21mH, Capacitance/phase /km= 0.00958μF. If the line supplies a load of 20MW at 0.9 pf lagging at 110kV at the receiving end calculate sending end current, sending end power factor, regulation and transmission efficiency using nominal T method.	BTL5	Evaluating	CO2
8	A 3 phase.50Hz power transmission line has line resistance of 30 0hm and inductive reactance of 70 ohm per phase. The capacitive susceptance is 4×10-4 mho per phase. If the load at the receiving end is 50MVA at 0.8pf lagging with 132kV line voltage. Calculate (i) Voltage and current at sending end (ii) regulation and (iii) efficiency of the line for this load. Use nominal πmethod. (7+3+3)	BTL6	Creating	CO2
9	Draw the nominal T circuit of a medium length transmission line and derive expression for sending end voltage and current. Also draw the respective phasor diagram.	BTL6	Creating	CO2
10	(i) Explain the classification of transmission lines with their (6) (ii) What is Ferranti effect? Explain them with phasor diagram. (7)	BTL2 BTL2	Understanding Understanding	CO2
11	Using rigorous method, derive expression for sending end voltage and current for a long transmission line	BTL6	Creating	CO2
12	Explain various steps involved in receiving end power circle diagram with neat sketches.	BTL2	Understanding	CO2
13	Estimate the corona loss for a 3 phase, 110kV, 50Hz, 150km long transmission line consisting of three conductors each of 10mm diameter and spaced 2.5m apart in a equilateral triangle formation. The temperature of air is 30^{o} C and the atmospheric pressure is 750mm of mercury. Assume the irregularity factor as 0.85. Ionization of air may be assumed to take place at a maximum voltage gradient of 30kv/cm.	BTL5	Evaluating	CO2
14	The constants of a three-phase line are A=0.9∟2˚ and B= 70 ohms per phase. The line delivers 60MVA at 132kV and 0.8 pf lagging. Draw power circle diagrams find (i) sending end voltage and power angle (ii) the maximum power which the line can deliver with the above values of sending and receiving end end power and power factor (iv) line losses. (4+3+3+3)	BTL5	Evaluating	CO2

15	Find the critical disruptive voltage and the critical voltages for local and general corona on a 3-phase overhead transmission line, consisting of three stranded copper conductors spaced 2.5m apart at the corners of an equilateral triangle. Air temperature and pressure are 21˚C and 73.6cm Hg respectively. The conductor dia, irregularity factor and surface factors are 10.4mm.0.85,0.7 and 0.8 respectively	BTL5	Evaluating	CO2
16	A three- phase overhead line has resistance and reactance per phase as 5 ohm and 20ohm respectively. The load at the receiving end is 25MW, 33kV at 0.8pf lagging. By drawing receiving end power circle find the voltage at the sending end.	BTL5	Evaluating	CO2
17	Explain the formation corona in transmission line.	BTL4	Analyzing	CO2
PART - C				
1	Explain the procedure for determining the transmission efficiency and voltage regulation of a long transmission line.	BTL4	Analyzing	CO2
2	Determine the efficiency and regulation of a 3 phase 100km , 50Hz transmission line delivering 20MW at a p.f of 0.8 lagging and 66kV to a balanced load. The conductors are copper, each having resistance 0.1Ω/km,1.5cm outside dia, spaced equilaterally 2m between centers. Neglect reactance and use (i) Nominal T (ii) Nominal π method. (8+7)	BTL5	Evaluating	CO2
3	A 3 phase., 50Hz power transmission line has line resistance of 30 0hm and inductive reactance of 70 ohm per phase. The capacitive susceptance is 4×10-4 mho per phase. If the load at the receiving end is 50MVA at 0.8pf lagging with 132kV line voltage. Calculate (i) Voltage and current at sending end (ii) regulation and (iii) efficiency of the line for this load. Use nominal π method. (5+5+5)	BTL6	Creating	CO2
4	Determine the corona characteristics of a 3phase line 160km long, conductor diameter 1.036cm,2.44m delta spacing, air temperature 26.67˚, altitude 2440m, corresponding to an approximate barometric pressure of 73.15cm, operating voltage 110kV at 50Hz.	BTL6	Creating	CO2
5	Derive the expression power flow through transmission line and explain various steps involved in sending end power circle diagram with neat sketch.	BTL6	Creating	CO2

UNIT III MECHANICAL DESIGN OF LINES

Mechanical design of OH lines – Line Supports – Types of towers – Stress and Sag Calculation – Effects of Wind and Ice loading. Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators. Standards for testing of Insulators.

PART - A

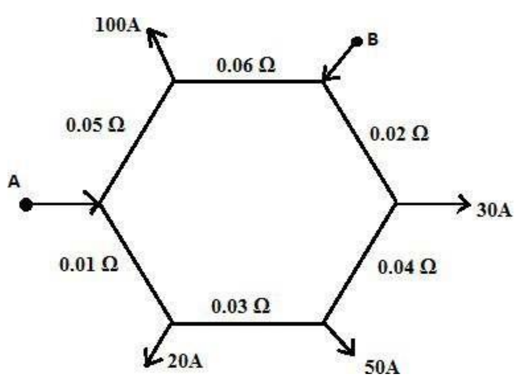
Q. No	Questions	BT Level	Competence	Course Outcome
1	Generalize the factors affecting sag in a transmission line.	BTL6	Creating	CO3
2	Criticize about stringing chart.	BTL5	Evaluating	CO3
3	Describe about tower spotting.	BTL1	Remembering	CO3
4	Explain about sag template.	BTL1	Remembering	CO3
5	List the factors on which conductors spacing and ground clearance depend.	BTL1	Remembering	CO3
6	Give any two factors that affect sag in an overhead line.	BTL2	Understanding	CO3
7	What is insulators?	BTL1	Remembering	CO3
8	State the advantages of suspension type insulators	BTL4	Analyzing	CO3
9	Classify the tests performed on the insulators.	BTL4	Analyzing	CO3
10	Generalize the different types of insulators.	BTL6	Creating	CO3
11	Deduce the desirable properties of insulator.	BTL5	Evaluating	CO3
12	List the methods of improving string efficiency in line insulators.	BTL1	Remembering	CO3
13	Define string efficiency.	BTL1	Remembering	CO3
14	Classify the tests performed on the insulators.	BTL4	Analyzing	CO3
15	A single core cable, 1.7 km long, has a conductor radius of 13mm and insulation thickness of 5.8mm. The dielectric has a relative permittivity of 2.8. Calculate the capacitance per meter length of cable.	BTL3	Applying	CO3
16	Define safety factor of insulator. Why it is desired to have this value be high.	BTL1	Remembering	CO3
17	Discuss the use of insulators in overhead lines.	BTL2	Understanding	CO3
18	How does electrical breakdown occur in an insulator?	BTL4	Analyzing	CO3
19	What are the types of line supports used in transmission and distribution	BTL1	Remembering	CO3
20	Give the range of surge impedance for an Over Head transmission line.	BTL2	Understanding	CO3
21	What is a guard ring or static shielding?	BTL1	Remembering	CO3
22	What is arching horn?	BTL1	Remembering	CO3
23	Express the relation for finding surge impedance of transmission line	BTL5	Evaluating	CO3
24	How are voltage distribution and the string efficiency affected by rain?	BTL4	Analyzing	CO3
	PART - B			
1	An overhead line at a river crossing is supported from two towers of heights 30 metres and 90 metres above water level with a span of 300 metres. The weight of the conductor is 1 kg/metre and the working tension is 2000 kg. Determine the clearance between the conductor and the water level mid-way between the towers.	BTL3	Applying	CO3
2	A transmission line has a span of 275m between level supports. The conductor has an effective diameter of 1.96cm and weighs 0.865kg/m. If the conductor has ice coating of radial thickness 1.27cm and is subjected to a wind pressure of 3.9gm/sq.cm of projected area. The ultimate strength of the conductor is 8060kg. Calculate the sag if the factor of safety is 2 and weight of 1c.c of ice is 0.91gm.	BTL3	Applying	CO3
3	Derive an expression for sag of a line supported between two supports of the same height. Also Explain the effect of ice and wind loading.	BTL6	Creating	CO3
4	(i) An overhead line has the following data: Span length 160 metres, conductor dia 0.95 cm, weight per unit length of the conductor 0.65 kg/metre. Ultimate stress 4250 kg/cm^2, wind pressure 40 kg/m^2 of projected area. Factor of safety 5. Calculate the sag. (8) (ii)What is a sag-template? Explain how this is useful for location of towers and stringing of power conductors? (5)	BTL3 BTL2	Applying Understanding	CO3

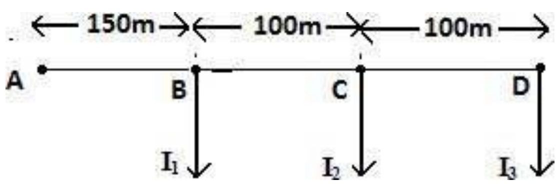
5	Derive an expression for sag of a line supported between two supports of Different height.	BTL2	Understanding	CO3
6	(i) Explain different types of insulator. (5) (ii) A string of five insulator units has mutual capacitance equal to 10 times the pin to earth capacitance, find voltage distribution across various units as the per cent of the total voltage across the string and string efficiency.	BTL2 BTL3	Understanding Applying	CO3
7	Explain the effect of wind and ice loading in OH line.	BTL4	Analyzing	CO3
8	(i) Discuss how string efficiency is improved by capacitance grading suspension insulators. (5) (ii) A string of eight suspension insulator is to be graded to obtain uniform distribution of voltage across the string. If the capacitance of the top unit is 10 times the capacitance to ground of each unit, determine the capacitance of the remaining seven units. (8)	BTL4	Analyzing	CO3
9	(i) Define string efficiency of suspension insulator string. List the methods to improve it. (5) (ii) Each line of 3 phase system is suspended by the string of 3 identical insulators of self-capacitance 'C" F. The shunt capacitance of connecting metal work of each insulator is 0.2C to earth and 0.1C 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 0.3C. (8)	BTL1 BTL3	Remembering Applying	CO3
10	Draw the neat sketches and explanation of pin and suspension type insulators. Compare their merits and demerits.	BTL2	Understanding	CO3
11.	(i) Explain various types of insulators. (5) (ii) Calculate the maximum voltage that a string of 2 suspension insulators and that of 3 suspension insulators can withstand, if the maximum voltage for each insulator is not to exceed 170kV. The capacitance between each link pin and earth is 20% of that of self-capacitance of each insulator. (8)	BTL2 BTL3	Understanding Applying	CO3
12	With neat diagram, explain the strain and stay insulators.	BTL4	Analyzing	CO3
13	Define string efficiency and calculate its value for a string 3 insulators units if the capacitance of each unit to earth and line be 20% and 5% of the self-capacitance of the unit. Derive any formula that might be used.	BTL1	Remembering	CO3
14	(i) Writ short notes on (i) Properties of insulation material used for cable. (5) (ii) The capacitance per kilometer of a 3-phase bolted core cable 0.2 micro farad/km between two cores with the third core connected to sheath. Calculate the KVA. The supply voltage 6.6kV and 30km long. (8)	BTL2 BTL3	Understanding Applying	CO3
15	A string of eight suspension insulators is to be fitted with a grading ring. If the pin to earth capacitances are all equal to C, find the values of line to pin capacitances that would give a uniform voltage distribution over the string.	BTL6	Creating	CO3
16	What are the different types of testing of Insulators? Explain any one method.	BTL4	Analyzing	CO3
17	Explain the various Standards for testing of Insulators.	BTL5	Evaluating	CO3
	PART – C			
1	Assume that the shape of an overhead line can be approximated by a parabola; deduce expression for calculating sag and conductor length. How can the effect of wind and ice loading be taken into account?	BTL6	Creating	CO3
2	An overhead line has a span of 160m of stranded copper conductor between level supports. The sag is 3.96 m at -5.5˚ C with 9.53 mm thick in ice coating and wind pressure of 40 Kgf/m2 of projected area. Calculate the temperature at which the sag will remain the same under conditions of no ice and no wind. The particulars of the conductor are as follows: size of conductor =7/3.45mm, Area of cross section = 64.5mm^2 weight of conductor = 0.594Kgf/m, Modulus of elasticity = 12700 Kgf/mm^2, coefficient of linear expansion = 1.7X10-5 /˚ C, Assume 1 m^3 of ice to weight 913.5Kgf.	BTL6	Creating	CO3
3	What are the various properties of insulators? Also briefly explain about suspension type and pin type insulators. Draw the schematic diagram.	BTL5	Evaluating	CO3
4	A string of 6 insulators units has self-capacitance equal to 10 times the pin to earth capacitance. Determine (i) The voltage distribution from top to bottom insulators as a percentage of the total voltage. (10) (ii) The string efficiency, Derive the expressions required. (5)	BTL6	Creating	CO3
5	A 3-phase overhead line is supported on 4-disc suspension insulator. The voltage across the 2nd and 3rd discs are 13.8kV and 15.2 kV respectively. Calculate line voltage and mention the nearest standard voltage in practice and string efficiency.	BTL6	Creating	CO3

UNIT IV UNDER GROUND CABLE				
Underground cable - Types of cable – Construction of single core and 3 core Cables - Insulation Resistance – Potential Gradient - Capacitance of Single-core and 3 core cables - Grading of cables - Power factor and heating of cables – DC cables.				
PART – A				
Q. No	**Questions**	**BT Level**	**Competence**	**Course Outcome**
1	Point out any four insulating materials used for underground cables.	BTL4	Analyzing	CO4
2	Give the expression for the insulation resistance of a single core cable.	BTL1	Remembering	CO4
3	Classify the cables used for three phase service.	BTL3	Applying	CO4
4	List the desirable characteristics of insulating materials used in cables.	BTL3	Applying	CO4
5	How are cables classified based on an operating voltage?	BTL2	Understanding	CO4
6	What are the main requirements of the insulating materials used for cable?	BTL1	Remembering	CO4
7	List five insulating materials used for cables.	BTL3	Applying	CO4
8	What is the operating voltage range of pressure cables?	BTL2	Understanding	CO4
9	Compare overhead lines and underground cables.	BTL1	Remembering	CO4
10	List the types of screened cable.	BTL1	Remembering	CO4
11	What is armouring in an underground cable?	BTL2	Understanding	CO4
12	What is belted cable?	BTL1	Remembering	CO4
13	Give two methods for elimination of void formation in the cable.	BTL2	Understanding	CO4
14	A single core cable, 1.7 km long, has a conductor radius of 13mm and insulation thickness of 5.8mm. The dielectric has a relative permittivity of 2.8. Calculate the capacitance per meter length of cable.	BTL5	Evaluating	CO4
16	List the properties of insulating materials used for cables?	BTL3	Applying	CO4
17	Discuss grading of cable and its types.	BTL2	Understanding	CO4
18	Write the expression to determine capacitance of a single core cable.	BTL2	Understanding	CO4
19	What are the sources of heat generation in an underground cable?	BTL1	Remembering	CO4
20	Prepare the list of advantages and disadvantages of grading.	BTL6	Creating	CO4
21	Explain the purpose of intersheath in cable.	BTL5	Evaluating	CO4
22	Discuss capacitance grading.	BTL2	Understanding	CO4
23	What are the modern practices adopted to avoid grading of cables?	BTL2	Understanding	CO4
24	What are the methods of achieving uniformity in dielectric stress?	BTL1	Remembering	CO4
PART - B				
1	Explain in detail about the insulating materials used in cable.	BTL4	Analyzing	CO4
2	i) Describe the general construction of an underground cable with a neat sketch (6) (ii) A single core cable used on 33kV, 50Hz has conductor diameter 10mm and inner diameter of sheath 25mm. The relative permittivity of insulating material used is 3.5 Find (1) Capacitance of the cable per km (2) Maximum and minimum electrostatic stress in the cable (3) Charging current per km (7)	BTL2 BTL3	Understanding Applying	CO4
3	(i) Describe the general construction of 3-conductor cable with neat sketch. (6) (ii) A single core cable for 66kV, 3phase system as a conductor of 2cm diameter and sheath of inside diameter 5.3cm. It is required to have two inter sheaths so that the stress varies between the same maximum and minimum values in the three layers of dielectric. Find the positions of inter sheaths, maximum and minimum stress and voltages on the inter sheaths. Also find the maximum and minimum stress if the inter sheath are not used. (7)	BTL2 BTL3	Understanding Applying	CO4

4	With neat diagram, explain the various methods of grading of underground cables.	BTL4	Analyzing	CO4
5	i) Compare overhead lines and underground cables. (7) (ii) Explain different types of cables with neat diagram. (6)	BTL4 BTL2	Analyzing Understanding	CO4
6	Writ short notes on (1) Properties of insulation material used for cable (5) (2) The capacitance per kilometre of a 3phase bolted core cable 0.2 micro farad/km between two cores with the third core connected to sheath. Calculate the KVA. The supply voltage 6.6kV and 30km long. (8)	BTL2 BTL3	Understanding Applying	CO4
7	Derive an expression for the insulation resistance, capacitance and the electrostatic stress of a single core cable.	BTL6	Creating	CO4
8	(i) Describe the effect of thermal resistance in the underground cable.(7) (ii) Derive the expression for the most economical conductor seize in a cable. (6)	BTL3 BTL6	Applying Creating	CO4
9	A conductor of 1 cm dia passes Metal sheath centrally through a porcelain cylinder of internal dia 2 cms and external dia 7 cms. The cylinder is surrounded by a tightly fitting metal sheath. The permittivity of porcelain is 5 and the peak voltage gradient in air must not exceed 34 kV/cm. Determine the maximum safe working voltage.	BTL6	Creating	CO4
10	Derive an expression for capacitance of three core cable.	BTL6	Creating	CO4
11	The capacitance of a 3-core lead sheathed cable measured between any two of the conductors with sheath earthed is 0.19 μF per km. Determine the equivalent star connected capacity and the kVA required to keep 16 kms of the cable charged when connected to 20 kV, 50 Hz supply.	BTL5	Evaluating	CO4
12	(i) Explain any four insulating materials used in manufacturing cable. (5) (ii) Find the economic size of a single core cable working on a 132KV three phase system, if a dielectric stress of 60KV/cm can be allowed. (8)	BTL5	Evaluating	CO4
13	(i) Describe an experiment to determine the capacitance of a belted cable. (7) (ii) A 33kv single core cable has a conductor diameter of 1cm and a sheath of inside diameter 4cm. Find maximum and minimum stress in insulation. (6)	BTL5	Evaluating	CO4
14	The capacitance per kilometer of a 3phase belted core cable is 0.2μF/km between two cores with the third core connection to sheath. Calculate the KVA. The supply voltage is 6.6kV, and 30km long.	BTL5	Evaluating	CO4
15	(i) Draw and explain the construction of armored cable. (7) (ii) Explain inter sheath grading of cables. (6)	BTL4	Analyzing	CO4
16	(i) List out the properties of insulating materials used for cables. (7) (ii) What are the advantages of underground cables over overhead lines? (6)	BTL1	Remembering	CO4
17	A 11kv 3 phase underground feeder, 2km long uses three single core cables. The diameter of each conductor is 28mm and an insulation thickness of 4.4 mm and the relative permittivity of 4. Determine (i) Capacitance of the cable per phase (ii) charging current per phase (iii) total charging KVAR (iv) Dielectric loss per phase if the power factor of unloaded cable is 0.04.	BTL5	Evaluating	CO4
	PART - C			
1	A 2km long 3core,3 phase cable has capacitance 0.5μF/km between two conductors bunched with sheath and the third conductor. The capacitance between the conductors is also measured when bunched together and the sheath and found to be 0.75μF/km. Determine (i) Capacitance between phases (ii) Capacitance between the conductor and the sheath (iii) Effective per phase capacitance (iv) Capacitance between two conductors connecting third conductor to the sheath (v) Charging current if the supply voltage is 11kV,50Hz.	BTL6	Creating	CO4

2	Describe an experiment to determine the capacitance of belted cables.	BTL5	Evaluating	CO4
3	Describe the classification of cables and with a neat sketch explain their general construction.	BTL4	Analyzing	CO4
4	A cable is graded with three dielectrics of permittivity’s 4, 3 and 2. The maximum permissible potential gradient is same and equals to 30kv/cm.The core diameter is 1.5cm and internal sheath diameter is 5.5cm. Calculate the working voltage.	BTL3	Applying	CO4
5	Explain with expression the thermal Characteristics of cable.	BTL4	Analyzing	CO4

UNIT V DISTRIBUTION SYSTEMS				
Distribution Systems – General Aspects – Kelvin's Law – AC and DC distributions - Techniques of Voltage Control and Power factor improvement – Distribution Loss – Types of Substations - Methods of Grounding – Trends in Transmission and Distribution: EHVAC, HVDC and FACTS (Qualitative treatment only).				
PART - A				
Q.No	**Questions**	**BT Level**	**Competence**	**Course Outcome**
1	What do you understand by distribution system?	BTL2	Understanding	CO5
2	Classify distribution system.	BTL4	Analyzing	CO5
3	Draw the single line diagram of ring main distributor	BTL1	Remembering	CO5
4	Examine the various methods of voltage control in transmission line.	BTL3	Applying	CO5
5	How does a.c distribution differ from d.c distribution?	BTL4	Analyzing	CO5
6	What is feeders?	BTL1	Remembering	CO5
7	What is ring main distribution?	BTL1	Remembering	CO5
8	Examine the major equipment of a substation.	BTL3	Applying	CO5
9	What is a service main?	BTL2	Understanding	CO5
10	Explain the various methods of neutral grounding.	BTL4	Analyzing	CO5
11	Classify the substation according to service.	BTL4	Analyzing	CO5
12	Explain why the control of reactive power is essential for maintaining a desired voltage profile.	BTL4	Analyzing	CO5
13	Give types of grounding.	BTL2	Understanding	CO5
14	What is gas insulated substation	BTL1	Remembering	CO5
15	What are the limitations of kelvin's law?	BTL3	Applying	CO5
16	Classify substation.	BTL4	Analyzing	CO5
17	Discuss any two significances of neutral grounding.	BTL2	Understanding	CO5
18	List out various devices used in FACTS.	BTL6	Creating	CO5
19	Discuss why the transmission lines are 3phase, 3 wire system and the distribution lines are 3 phase 4 wire system.	BTL2	Understanding	CO5
20	What are the advantages of FACTS controllers	BTL1	Remembering	CO5
21	List the types of HVDC links	BTL4	Analyzing	CO5
22	Summarize the objectives of FACTs.	BTL5	Evaluating	CO5
23	Discover two advantages for choosing HVDC over EHV AC for high voltage long distance transmission.	BTL3	Applying	CO5
24	Generalize any two the existing HVDC system in India.	BTL6	Creating	CO5
PART - B				
1	(i) Draw and explain a ring main distributor scheme. (5) (ii) Find the current supplied at points A and B of the ring main distributor shown in fig, the loads are at unity power factor. (8)  	BTL5	Evaluating	CO5

2	Explain the components of primary and secondary distribution system.	BTL4	Analyzing	CO5
3	(i) A 2-wire d.c distributor 200 meters long is uniformly loaded with 2A/m. Resistance of single wire is 0.3ohm/km. If the distributor is fed at one end calculate: (a) The voltage drop up to a distance of 150m from the feeding point. (b) The maximum voltage drop. (8) (ii)write short notes on the following (a) Ring main distributor (b) Current distribution in a 3-wire d.c system. (5)	BTL5	Evaluating	CO5
4	Explain the following: (a) Stepped or trapped distributor. (4) (b) Ring main distributor. (3) (c) DC distributor fed at one end. (3) (d) DC distributor fed at both ends. (3)	BTL4	Analyzing	CO5
5	Find the ratio of volume of copper required to transmit a given power over a distance by overhead system using: (a) dc 2 wire and 3 wire system. (7) (b) 3Φ, 3wire AC system. (6)	BTL6	Creatin g	CO5
6	(i) What are the various methods of neutral grounding? Describe any method in detail. (5) (ii) The DC distributor shown in fig is loaded as follows: I_1 =100A; I_2=150A; I_3 =200A. The resistance of conductor (go and return) is 0.1Ω per 1000m. Find the voltage at points C, D and B if voltage at A V_A=200V. (8) 	BTL1	Remembering	CO5
7	What are the different types of bus bar arrangements used in substations? Illustrate your answer with suitable diagrams.	BTL1	Remembering	CO5
8	Explain the different types of substations.	BTL4	Analyzing	CO5
9	A D.C ring main distributor is fed at A and the load is tapped at points B, C, D. The distributor length is 400m long and points B, C, D 250m, 375m from A. Loads are 150A, 40A, 200A respectively. If resistance /100m of single conductor is 0.04Ω and V_A =220V. Calculate (i) Current in each distributor, (ii) voltage at points B,C,D. are 150m,	BTL5	Evaluating	CO5
10	A 3 phase 4 wire distributor supplies a balanced voltage of 400/230 V to a load consisting of 100A at 0.84 power factor lagging and 60A at unity power factor on phases R, Y, B respectively. The resistance of each core is 0.3Ω. Determine the voltage at the supply end of R-phase relative to the load voltage.	BTL5	Evaluating	CO5
11	A two-wire distributor is 200m long, the loop resistance is 0.052Ω. the wire is uniformly loaded with 2A/m. Calculate (a) point of minimum potential when distributor fed from A at 220V and from B at 216V.(b) Current supplied by end A and B.	BTL3	Applying	CO5
12	Explain the method of earthing for domestic service connections.	BTL3	Applying	CO5
13	Explain the following: (a) Neutral grounding. (7) (b) Resistance grounding. (6)	BTL5	Evaluating	CO5

14	(i) Draw and explain a TCSC and STATCOM. (7) (ii) Compare constant current and constant voltage HVDC system. (6)	BTL4	Analyzing	CO5
15	(i) Draw and explain a simple model of UPFC. (7) (ii) Explain the applications of HVDC transmission systems. (6)	BTL4	Analyzing	CO5
16	Discuss the advantages of HVDC transmission over HVAC transmission in detail.	BTL2	Understanding	CO5
17	Explain the following (a) Solid grounding. (7) (b) Reactance grounding. (6)	BTL4	Analyzing	CO5
PART – C				
1	A 2 wire D.C street mains AB, 600m long if fed from both ends at 220V. Loads of 20A,40A,50A, and 30A are tapped at distances of 100m,250m,400m and 500m from the end A respectively. If the area of X- section of distributor conductor is 1 square centimetre, find the minimum consumer voltage, Take $\rho = 1.7 \times 10^{-6}\ \Omega$ -cm.	BTL4	Analyzing	CO5
2	A single-phase distributor 'AB' 300m long supplies a load of 200A at 0.8pf lagging at its far end 'B' and a load of 100A at 0.0707 pf lagging at 200m from sending end point A. Both pf is referred to the voltage at far end. The total resistance and reactance per km (go and return) of the distributor is 0.2ohm and 0.1ohm. Calculate the total voltage drop in the distributor.	BTL5	Evaluating	CO5
3	Discuss the methods of voltage control in transmission line.	BTL2	Understanding	CO5
4	An electric train runs between two sub-stations 6 km apart maintained at voltages 600 V and 590 V respectively and draws a constant current of 300 A while in motion. The track resistance of go and return path is 0·04 ohm/km. Calculate: (i) The point along the track where minimum potential occurs. (10) (ii) The current supplied by the two sub-stations when the train is at the point of minimum potential. (5)	BTL6	Creating	CO5
5	Derive the expression for touch potential and step potential.	BTL5	Evaluating	CO5

Course Outcome:

CO1: To understand the importance and the functioning of transmission line parameters.

CO2: To acquire knowledge on the performance of Transmission lines.

CO3: To understand the concepts of Lines and Insulators.

CO4: To acquire knowledge on Underground Cables.

CO5: To understand the importance of distribution of the electric power in power system and to become familiar with the function of different components used in T&D systems.