SRM VALLIAMMAI ENGINEERING COLLEGE

An Autonomous Institution

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

I SEMESTER M.E (PSE)

1916103–ANALYSIS AND COMPUTATION OF ELECTROMAGNETIC TRANSIENTS IN POWERSYSTEMS

Regulation – 2019

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Prepared by

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

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SUBJECT : 1916103 - ANALYSIS AND COMPUTATION OF ELECTROMAGNETIC TRANSIENTS IN POWERSYSTEMS

SEM / YEAR: I SEM/1st YEAR M.E. (PSE)

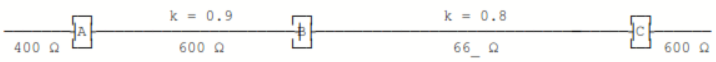
UNIT I -REVIEW OF TRAVELLING WAVE PHENOMENA

Lumped and Distributed Parameters – Wave Equation – Reflection, Refraction, Behaviour of Travelling waves at the line terminations – Lattice Diagrams – Attenuation and Distortion.

PART –A

Q.No	Questions	BT Level	Competence	Course Outcom
1.	Define reflection coefficient of a traveling wave.	BTL-1	Remembering	CO1
2.	Interpret the concept of multivelocity waves.	BTL-1	Remembering	CO1
3.	Draw the behavior of a traveling waves over a receiving open circuited lossless transmission line.	BTL-1	Remembering	CO1
4.	Draw the behavior of a traveling waves over a receiving end short circuited lossless transmission line.	BTL-1	Remembering	CO1
5.	Outline the concept of surge Impedance.	BTL-1	Remembering	CO1
6.	Write the voltage and current wave equation.	BTL-1	Remembering	CO1
7.	State the coefficient of reflection and refraction for voltage wave?	BTL-2	Understanding	CO1
8.	Write the expression for velocity of the travelling waves over the transmission line.	BTL-2	Understanding	CO1
9.	State the coefficient of reflection and refraction for current wave?	BTL-2	Understanding	CO1
10.	Give the transmission line wave equation.	BTL-2	Understanding	CO1
11.	Discuss about bewley lattice diagram.	BTL-3	Applying	CO1
12.	Comment: Phase constant and attenuation factor.	BTL-3	Applying	CO1
13.	Give the concept behind kilometric fault?	BTL-3	Applying	CO1
14.	Discuss about incident wave?	BTL-4	Analyzing	CO1
15.	Draw Equivalent circuit of a differential-length	BTL-4	Analyzing	CO1
16.	Draw the lumpy representation of two wire line.	BTL-4	Analyzing	CO1

17.	A surge of 15 kV travels along a cable towards its junction with an overhead line. Find the voltage rise at the junction due to the surge if surge impedance of a cable and line are 40 ohm and 400 ohm.	BTL-5	Evaluating	CO1
18.	Comment: Transmission line as distortion less.	BTL-5	Evaluating	CO1
19.	Infer the concept behind propagation constant.	BTL-6	Creating	CO1
20.	Infer the principle behind backward wave.	BTL-6	Creating	CO1
PART – B				
1.	Explain the behavior of rectangular traveling wave at (i) Line terminated with resistance equal to surge impedance. (ii) Line terminated by a transformer. (iii) Line terminated with capacitor.	BTL-1	Remembering	CO1
2.	Explain the reflection and refraction at T-junction.	BTL-1	Remembering	CO1
3.	Explain the over voltages induced by faults.	BTL-1	Remembering	CO1
4.	Construct a bewley lattice diagram for open circuited lossless transmission line.	BTL-2	Understanding	CO1
5.	With an example explain Lattice diagram?	BTL-2	Understanding	CO1
6.	Derive Wave equation of travelling waves in transmission lines?	BTL-2	Understanding	CO1
7.	Construct a bewley lattice diagram for and short circuited lossless transmission line.	BTL-2	Understanding	CO1
8.	Explain Attenuation and Distortion of traveling waves.	BTL-3	Applying	CO1
9.	Explain the switching operations involving transmission lines.	BTL-3	Applying	CO1
10.	Explain reflection and refraction of transmission waves?	BTL-4	Analyzing	CO1
11.	A long transmission line is energized by a unit step voltage of 1.0 V at the sending end. Construct the bewley lattice diagram and obtain the value of the voltage at the receiving end after long time. Take the attenuation factor as 0.8.	BTL-4	Analyzing	CO1
12.	Explain the reflection and refraction of travelling waves in detail.	BTL-4	Analyzing	CO1

13.	A superconducting power cable comprises two very thin coaxial cylinders of niobium- tin, separated by a dielectric with a relative permittivity of 3.5. Current flows down one cylinder and returns by other. If the ratio of the radii of the cylinders $r_2/r_1 = \varepsilon$ (the base of natural algorithm). Calculate from the first principles, the surge impedance and the velocity of wave propagation for this cable.	BTL-5	Evaluating	CO1
14.	Derive an expression for the voltage developed across the inductance for the case study: A step waveform with a magnitude of ‘E’ volts is propagating in a line which terminated at an inductance. Illustrate the propagation of wave using lattice diagram.	BTL-6	Creating	CO1
	PART – C			
1.	3 substations A, B and C are spaced 75 km apart as shown in figure 4.10. B and C are connected together by a cable (velocity of propagation 2×10^8 m/s), and the remaining connections are all overhead lines (velocity of propagation 3×10^8 m/s). The attenuation factors and the surge impedances of the lines are shown alongside the lines. The overhead lines beyond A and C on either side are extremely long and reflections need not be considered from their far ends. Determine using the Bewley lattice diagram the overvoltages at the 3 substations, at an instant 1_ms after a voltage surge of magnitude unity and duration ¾ reaches the substation A from the outside. 	BTL-6	Creating	CO1
2.	A transmission line of surge impedance 400 ohm, is terminated in a load that can be represented by a parallel LC circuit with L=2.5 H, C= 0.01 µF. A step voltage wave of 500 kV travels along the line and arrives at the load. Compute the load voltage 5µs after The surge arrives.	BTL-5	Evaluating	CO1
3.	With mathematical equation discus the wave traveling in the single phase circuits in the presence of ground.	BTL-5	Evaluating	CO1

4.	A 10MVA, 132 kV transformer is connected to the end of a transmission line of surge impedance 400Ω. The transformer has an equivalent capacitance of 0.002μF and leakage inductance of 16H. If a rectangular wave of 1000kV travels through a line and strike the transformer, find the surge voltage on the transformer.	BTL-6	Creating	CO1

UNIT II - LIGHTNING, SWITCHING AND TEMPORARY OVERVOLTAGES

Lightning overvoltages: interaction between lightning and power system- ground wire voltage and voltage across insulator; switching overvoltage: Short line or kilometric fault, energizing transients - closing and re-closing of lines, methods of control; temporary overvoltages: line dropping, load rejection; voltage induced by fault; very fast transient overvoltage (VFTO).

PART – A

Q.No	Questions	BT Level	Competence	Course Outcome
1.	State the objectives of switching a capacitor banks?	BTL-1	Remembering	CO2
2.	List the various sources of over voltages.	BTL-1	Remembering	CO2
3.	Define standard switching surge voltage and switching surge current.	BTL-1	Remembering	CO2
4.	How the over voltages due to lightning strokes can be avoided?	BTL-1	Remembering	CO2
5.	Define standard lightning Impulse.	BTL-1	Remembering	CO2
6.	How load switching leads to transient?	BTL-1	Remembering	CO2
7.	Infer the principle behind reignition current?	BTL-2	Understanding	CO2
8.	Draw the mathematical model of lightning.	BTL-2	Understanding	CO2
9.	Explore the concept of double frequency transients?	BTL-5	Creating	CO2
10.	Differentiate Normal and abnormal switching transients?	BTL-4	Analyzing	CO2
11.	Write the breakdown strength of air.	BTL-3	Applying	CO2
12.	Draw the Equivalent circuits for line-to-line fault?	BTL-3	Applying	CO2
13.	Comment: "Load Rejection".	BTL-4	Analyzing	CO2
14.	Comment: Restriking occurs when CB opens due to Fault and methods to avoid.	BTL-4	Analyzing	CO2
15.	Define VFTO.	BTL-1	Remembering	CO2
16.	List out the causes of Switching over voltages?	BTL-4	Analyzing	CO2
17.	Generalize the types of faults that causes the over voltages in power systems.	BTL-6	Creating	CO2

18.	Outline the concept temporary over voltages?	BTL-2	Understanding	CO2
19.	Comment on –"Shadow angle and shield angle"	BTL-5	Creating	CO2
20.	Discuss phenomenon in switching transients?	BTL-6	Creating	CO2
PART – B				
1.	Explain Normal and abnormal switching	BTL- 1	Remembering	CO2
2.	What is the function of protective shadow? How to calculate the striking distance?	BTL-1	Remembering	CO2
3.	Explain the mechanism of lightning.	BTL-1	Remembering	CO2
4.	Summarize the interaction between lightning and power system.	BTL-2	Understanding	CO2
5.	Develop the electromagnetic model for lightning strike without shield wires in detail.	BTL-2	Understanding	CO2
6.	Discuss short line or kilometric fault.	BTL-2	Understanding	CO2
7.	Explain the mechanism of charge formation in clouds.	BTL-4	Analyzing	CO2
8.	Examine the transients initiated during closing and reclosing of lines.	BTL-1	Remembering	CO2
9.	Illustrate the methods to control the over voltages caused by switching.	BTL-3	Applying	CO2
10.	Demonstrate the voltage induced by faults.	BTL-3	Applying	CO2
11.	Pointout about line dropping.	BTL-4	Analyzing	CO2
12.	Explain the very fast transient over Voltages(VFTO).	BTL-4	Analyzing	CO2
13.	Explain over voltages caused by load rejection.	BTL-5	Evaluating	CO2
14.	Demonstrate the causes of temporary over voltage due to load rejection.	BTL-6	Creating	CO2
PART – C				
1.	Develop the Mathematical model of lightning for power system studies and give the typical parameter values.	BTL-6	Creating	CO2
2.	With numerical value analysis the high currents and high voltages induced in power system due to switching of capacitor for power factor correction.	BTL-5	Evaluating	CO2
3.	Explain the causes of power frequency over voltages in power system.	BTL-5	Evaluating	CO2

4.	The field winding of a 377 MVA generator has an inductance of 0.638H.In steady state, its exciter is putting out 1.2 MW at 480 V when the generator is running unloaded. How much energy is stored in the field winding at this time? How much the exciter output voltage be changed to reduce the field current to zero in 5s?	BTL-6	Creating	CO2

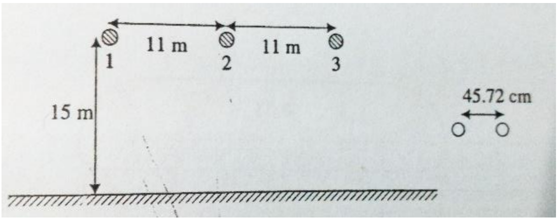
UNIT III - PARAMETERS AND MODELING OF OVERHEAD LINES

Review of line parameters for simple configurations: series resistance, inductance and shunt capacitance; bundle conductors : equivalent GMR and equivalent radius; modal propagation in transmission lines: modes on multi-phase transposed transmission lines, a-ß-0 transformation and symmetrical components ransformation, modal impedances; analysis of modes on untransposed lines; effect of ground return and skin effect; transposition schemes; introduction to frequency-dependent line modeling.

PART – A

Q. No	Questions	BT Level	Competence	Course Outcom
1.	Describe about series Resistance of the Transmission line.	BTL-1	Remembering	CO3
2.	Collect internal and External flux linkage equations of single conductor.	BTL-1	Remembering	CO3
3.	Identify the expression for inductance of single conductor.	BTL-1	Remembering	CO3
4.	Examine the expression for flux linkage &inductance of two conductors.	BTL-1	Remembering	CO3
5.	Collect the inductance of multi conductor lines.	BTL-1	Remembering	CO3
6.	Define GMR.	BTL-4	Analyzing	CO3
7.	Express the generalized self &mutualflux linkage Maxwell coefficients.	BTL-2	Understanding	CO3
8.	Give the Shunt capacitance of a two conductor line.	BTL-2	Understanding	CO3
9.	Describe about Bundled and stranded conductor.	BTL-2	Understanding	CO3
10.	Discuss Maxwell potential coefficient for two conductor line.	BTL-2	Understanding	CO3
11.	Show the Self and mutual Maxwell potential coefficient.	BTL-3	Applying	CO3
12.	Illustrate the Equivalent radius of N-conductor bundle arranged uniformly along the circumference of a circle of radius 'R'.	BTL-3	Applying	CO3
13.	Draw the modes vibration of a three mass system on an elastic string.	BTL-3	Applying	CO3
14.	Define model transformation equations.	BTL-1	Remembering	CO3

15.	Pointout the Practical applications of model analysis.	BTL-4	Analyzing	CO3
16.	Draw the Transposition scheme for single circuit three phase line and explain how it will reduce the telephone interference?	BTL-4	Analyzing	CO3
17.	Draw the Transposition scheme for double circuit three phase line.	BTL-5	Evaluating	CO3
18.	Summarize the skin effect.	BTL-5	Evaluating	CO3
19.	Generalize why electric field strength is an important design consideration.	BTL-6	Creating	CO3
20.	Formulate The voltage and current equations for a 3phase transposed & Un-transposed Line at a single frequency.	BTL-6	Creating	CO3
PART – B				
1.	Describe series resistance of a transmission line.	BTL-1	Remembering	CO3
2.	Derive the expression for capacitance of single phase overhead transmission line.	BTL-1	Remembering	CO3
3.	Obtain the expression for self and mutual Maxwell coefficient for Two conductor line and Multi conductor lines.	BTL-1	Remembering	CO3
4.	Obtain the expression for shunt capacitance of a two conductor line and also derive the Maxwell potential coefficient.	BTL-1	Remembering	CO3
5.	Discuss briefly about modes of Propagation in Transmission lines.	BTL-2	Understanding	CO3
6.	Discuss briefly about analysis of modal propagation in multiphase transmission lines.	BTL-2	Understanding	CO3
7.	Prove power invariance of normalized $o\alpha\beta$ and symmetrical components.	BTL-2	Understanding	CO3
8.	Write a short note on the following: 1.voltage and current equations in the modal domain. 2.Velocities of modal propagation.	BTL-3	Applying	CO3
9.	Examine the preliminary analysis of modes on Untransposed lines.	BTL-3	Applying	CO3
10.	Explain about the effect of ground return path on the modelling of the transmission lines.	BTL-4	Analyzing	CO3
11.	Explain about frequency dependence of line parameters.	BTL-4	Analyzing	CO3
12.	Derive the impedance matrix of transposed single circuit three phase lines.	BTL-4	Analyzing	CO3

13.	Explain about the Transposition scheme for double circuit three phase lines.	BTL-5	Evaluating	CO3
14.	Generalize briefly about skin effect.	BTL-6	Creating	CO3
PART – C				
1.	The geometrical configuration of a 400 kV line is shown in figure below. Each phase consists of a twin conductor bundle: 2 × 3.18 cm diameter and separation between conductors = 45.72 cm. Neglect inductance. Evaluate, (a) The inductance for 1 km length of the line assuming that the line is untransposed. (b) The same when the line is transposed. 	BTL-5	Evaluating	CO3
2.	The bundled conductor details for some EHV lines are given below. Deduce the equivalent radius in each case. (a) 400 kV, number of conductors in the bundle is 2, diameter of subconductor is 3.18 cm and the diameter of the bundle is 45 cm. (b) 750 kV, number of conductors in the bundle is 4, diameter of subconductor is 3.46 cm and the distance between adjacent conductors is 45 cm. (c) 1200 kV, number of conductors in the bundle is 8, diameter of subconductor is 4.6 cm and the radius of the bundle is 0.6 m.	BTL-5	Evaluating	CO3
3.	Generalize about the model analysis of untransposed lines.	BTL-6	Creating	CO3
4.	Summarize Briefly about the positive and zero sequence impedances of balanced M-phase lines.	BTL-6	Creating	CO3

UNIT IV- PARAMETERS AND MODELING OF UNDERGROUND CABLES				
Distinguishing features of underground cables: technical features, electrical parameters, overhead lines versus underground cables; cable types; series impedance and shunt admittance of single-core self-contained cables, impedance and admittance matrices for three phase system formed by three single-core self-contained cables; approximate formulas for cable parameters.				
PART – A				
Q. No	**Questions**	**BT Level**	**Competence**	**Course Outcom**
1.	List any two distinguishing technical features of underground cables.	BTL-1	Remembering	CO4
2.	List any two distinguishing electrical parameters of underground cables.	BTL-1	Remembering	CO4
3.	Compare overhead lines and underground cables.	BTL-4	Analyzing	CO4
4.	Classify the cables according to the level of voltage applications.	BTL-3	Applying	CO4
5.	Draw the cut view of single –core self-contained cable.	BTL-1	Remembering	CO4
6.	Identify the shunt admittance matrix of single core self-contained cable.	BTL-1	Remembering	CO4
7.	Draw a schematic of 3 single core cables laid close together under the earth surface to form a three phase system.	BTL-2	Understanding	CO4
8.	Express the phase impedance matrix for three phase cable system.	BTL-2	Understanding	CO4
9.	Summarize the mutual impedance matrix for three phase cable system.	BTL-2	Understanding	CO4
10.	Give the methods of cable installation.	BTL-2	Understanding	CO4
11.	Collect the admittance matrix for three phase cable system.	BTL-1	Remembering	CO4
12.	Illustrate the admittance sub matrix for phase a, b and c for three phase cable system.	BTL-3	Applying	CO4
13.	Draw a sketch of pipe- type cable and identify the various parts.	BTL-1	Remembering	CO4
14.	Sketch a cut- away view of self-contained oil-filled type cable and identify various layers.	BTL-4	Analyzing	CO4
15.	Pointout the typical electrical parameters of 230kv overhead line and underground cable.	BTL-4	Analyzing	CO4
16.	Illustrate the relative permittivity and loss factor of insulation material.	BTL-3	Applying	CO4

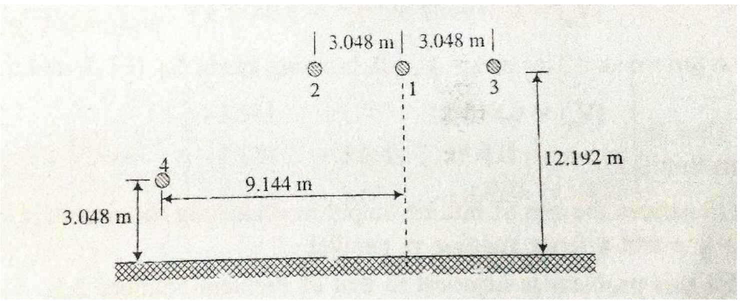
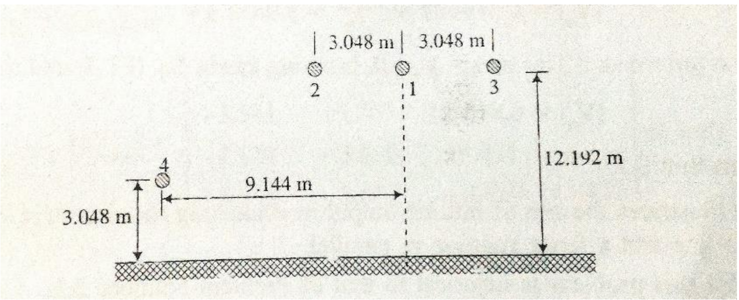
17.	Explain the different types of lumped parameter modelling of underground cables.	BTL-5	Evaluating	CO4
18.	Explain the different types of distributed parameter modelling of underground cables.	BTL-5	Evaluating	CO4
19.	Generalize the modelling requirements for low frequency transients.	BTL-6	Creating	CO4
20.	Generalize the modelling requirements for slow-front transients and very fast-front transients.	BTL-6	Creating	CO4
	PART – B			
1.	Derive the expression for capacitance, insulation resistance and dielectric loss of single core cable.	BTL-1	Remembering	CO4
2.	Tabulate the electrical parameters of underground cables.	BTL-1	Remembering	CO4
3.	Compare and contrast overhead lines versus underground cables.	BTL-4	Analyzing	CO4
4.	Briefly explain the classification of cables according to the level of voltage application.	BTL-1	Remembering	CO4
5.	Describe the series impedance matrix of single core self-contained cables.	BTL-2	Understanding	CO4
6.	Express the necessary modification of impedance loop equations of single core self - contained cable for interfacing with EMTP.	BTL-2	Understanding	CO4
7.	Derive the shunt admittance matrix of single core self-contained cable.	BTL-2	Understanding	CO4
8.	(i) Draw a schematic of 3-single core cables laid close together under the earth surface to form a three phase system. (3) (ii) Derive the impedance matrix for three phase cable system. (10)	BTL-3	Applying	CO4
9.	Explain special cases for number of tubular conductors in cable and the earth – return impedances in self and mutual impedance matrices.	BTL-3	Applying	CO4
10.	(i) A single core cable has a conductor diameter of 1cm and a insulation thickness of 0.4cm. the specific resistance of the insulation is 5×10^{14} Ωcm. Calculate the insulation resistance for 2km length of cable. (ii) Explain the construction of the cable with neat diagram.	BTL-4	Analyzing	CO4

11.	Explain the following: (i) Admittance matrix for three phase cable systems. (7) (ii) Approximate formulas for cable parameters. (6)	BTL-4	Analyzing	CO4
12.	Obtain the series impedance matrix of pipe-type cables.	BTL-4	Analyzing	CO4
13.	Deduce the shunt admittance matrix of pipe-type cables.	BTL-5	Evaluating	CO4
14.	Generalize the different types of modeling of underground cables.	BTL-6	Creating	CO4
PART – C				
1.	Explain the different components that make up the loop impedances of a single core cable consisting of core, sheath and armour.	BTL-5	Evaluating	CO4
2.	Deduce the expression for the 9X9 series impedance matrix for three single-core self – contained cables buried in earth.	BTL-5	Evaluating	CO4
3.	Deduce the expression for the 9X9 shunt admittance matrix for three single-core self – contained cables buried in earth.	BTL-5	Evaluating	CO4
4.	Generalize the sensitivity of cable transients to cable parameters.	BTL-6	Creating	CO4

UNIT V- COMPUTATION OF POWER SYSTEM TRANSIENTS				
Digital computation of line parameters: why line parameter evaluation programs? Salient features of a typical line parameter evaluation program; constructional features of that affect transmission line parameters; line parameters for physical and equivalent phase conductors elimination of ground wires bundling of conductors; principle of digital computation of transients: features and capabilities of electromagnetic transients program; steady state and time step solution modules: basic solution methods; case studies on simulation of various types of transients.				
PART – A				
Q. No	**Questions**	**BT Level**	**Competence**	**Course Outcome**
1.	List any four salient features of mt Line.	BTL-1	Remembering	CO5
2.	List any four salient features of fd Data.	BTL-1	Remembering	CO5
3.	Collect the assumptions made for elimination of ground wires.	BTL-1	Remembering	CO5

4.	Tabulate the four groups of data needed for mt Line.	BTL-1	Remembering	CO5
5.	Describe the steady state problems at power frequency for detailed studies such as EMTP.	BTL-1	Remembering	CO5
6.	Describe the steady state problems at higher frequencies for detailed studies such as EMTP.	BTL-1	Remembering	CO5
7.	What are the features of EMTP?	BTL-2	Understanding	CO5
8.	Discuss the different constructional features that affect transmission line parameters.	BTL-2	Understanding	CO5
9.	Describe the effect of ground circulating current Ig.	BTL-2	Understanding	CO5
10	Sketch the 13 conductor bundle including ground conductor.	BTL-2	Understanding	CO5
11	Illustrate the shunt capacitance matrix.	BTL-3	Applying	CO5
12	Sketch the six conductor bundling.	BTL-3	Applying	CO5
13	What is the need for line parameter evaluation program?	BTL-3	Applying	CO5
14	Examine the general parameter group of cable constant evaluation program.	BTL-4	Analyzing	CO5
15	Examine the conductor group of cable constant evaluation program.	BTL-4	Analyzing	CO5
16	Examine the layout group of cable constant evaluation program.	BTL-4	Analyzing	CO5
17	Explain the principal of digital computation of transients.	BTL-5	Evaluating	CO5
18	Summarize the features and capabilities of EMTP.	BTL-5	Evaluating	CO5
19	Draw the EMTP model of a lossless two wire transmission line.	BTL-6	Creating	CO5
20	Draw the EMTP model of inductance, capacitance and resistance.	BTL-6	Creating	CO5
PART – B				
1.	Briefly describe the necessity of line parameter Evaluation Program.	BTL-1	Remembering	CO5
2.	Briefly explain the salient features of mt Line.	BTL-1	Remembering	CO5
3.	Briefly explain the salient features of fd Data.	BTL-1	Remembering	CO5
4.	Summarize briefly the constructional features that affect transmission line parameters.	BTL-2	Understanding	CO5

5.	Describe the theory behind the line parameter evaluation program mt Line.	BTL-2	Understanding	CO5
6.	Describe the rearrangement of Carson correction terms for mt Line implementation.	BTL-2	Understanding	CO5
7.	Discuss the following (i) Line parameters for equivalent phase conductors. (7) (ii) Elimination of ground wires and its validity of theassumptions. (6)	BTL-2	Understanding	CO5
8.	Examine the bundling of phase conductors.	BTL-3	Applying	CO5
9.	Illustrate the brief description of input for mtLine.	BTL-3	Applying	CO5
10	Explain about brief description of input for MT cable.	BTL-4	Analyzing	CO5
11	Briefly Explain the principal of digital computation Programs.	BTL-4	Analyzing	CO5
12	Briefly Explain the formulation and method of solution for the EMPT.	BTL-4	Analyzing	CO5
13	With necessary equations obtain the EMTP model of Resistor, Inductor and capacitor.	BTL-5	Evaluating	CO5
14	Generalize the principle of digital computation methods of transients.	BTL-6	Creating	CO5
PART – C				
1.	Draw and Explain the flow chart for transients program.	BTL-5	Evaluating	CO5
2.	From the solution of wave equation prepare the EMPT representation of lossless transmission line.	BTL-6	Creating	CO5

<table>
<tr><td>3.</td><td>For the line and fence configuration shown in figure below, deduce the voltage on the fence due to capacitive coupling if the line is energized for two cases:
(a) Symmetrical operation at 345 kV(RMS, line-line).
(b) Phase A (conductor no.1) grounded because of nearby single line- to- ground fault with phase B and C (conductor 2 & 3) at normal voltage.

</td><td>BTL-5</td><td>Evaluating</td><td>CO5</td></tr>
<tr><td>4.</td><td>For the line and fence configuration shown in figure below. The fence is 2 km long, grounded at one end, and open at the other end and insulated in between. Deduce the voltage at the open end of the fence for the two cases:
(a) Symmetrical operation with I_{phase}= 1 kA (RMS).
(b) I_A = 10 kA, I_B = I_C = 0 (because of a nearby single line to ground fault.
How much circulating current would flow in the fence if the fence where grounded at both ends (ignore grounding resistance but give an estimate of about the influence of grounding resistance if it where included)

</td><td>BTL-6</td><td>Creating</td><td>CO5</td></tr>
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