Ref No:

Sri Krishna Institute of Technology,
Bangalore

COURSE PLAN

Academic Year 2019-2020

Program:	B E – Electrical and Electronics Engineering
Semester :	4
Course Code:	17EE43
Course Title:	TRANSMISSION AND DISTRIBUTION
Credit / L-T-P:	4 / 4-0-0
Total Contact Hours:	50
Course Plan Author:	Vinutha S

Academic Evaluation and Monitoring Cell

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Note : Remove “Table of Content” before including in CP Book
Each Course Plan shall be printed and made into a book with cover page
Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

A. COURSE INFORMATION

1. Course Overview

Degree:	BE	Program:	EE
Semester:	4	Academic Year:	2019-20
Course Title:	TRANSMISSION AND DISTRIBUTION	Course Code:	17EE43
Credit / L-T-P:	4-0-0	SEE Duration:	180 Minutes
Total Contact Hours:	50 Hours	SEE Marks:	60 Marks
CIA Marks:	30 Marks	Assignment	1 / Module
Course Plan Author:	Vinutha S	Sign ..	
Checked By:		Sign ..	
CO Targets	CIA Target :	SEE Target:	

Note: Define CIA and SEE % targets based on previous performance.

2. Course Content

Content / Syllabus of the course as prescribed by University or designed by institute.

Module	Content	Teaching Hours	Blooms Learning Levels
1	**Introduction to power system:** Structure of electric power system: generation, transmission and distribution. Advantages of higher voltage transmission: HVAC, EHVAC, UHVAC and HVDC. Interconnection. Feeders, distributors and service mains. **Overhead transmission lines:** A brief introduction to types of supporting structures and line conductors-Conventional conductors; Aluminium Conductor steel reinforced (ACSR), All – aluminium alloy conductor (AAAC) and All –aluminium conductor (AAC). High temperature conductors; Thermal resistant aluminium alloy (ATI),Super thermal resistant aluminium alloy (ZTAI), Gap type thermal resistant aluminium alloy conductor steel reinforced (GTACSR), Gap type super thermal resistant aluminium alloy conductor steel reinforced (GZTACSR). Bundle conductor and its advantages. Importance of sag, Sag calculation – supports at same and different levels, effect of wind and ice. Line vibration and vibration dampers. Overhead line protection against lightening; ground wires. **Overhead line Insulators:** A brief introduction to types of insulators, material used- porcelain, toughened glass and polymer (composite). Potential distribution over a string of suspension insulators. String efficiency, Methods of increasing string efficiency. Arcing horns.	12	UnderstandingL2, UnderstandingL2
2	**Line parameters:** Introduction to line parameters- resistance, inductance and capacitance. Calculation of inductance of single phase and three phase lines with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines. Inductance of composite – conductors, geometric mean radius (GMR) and geometric mean distance (GMD). Calculation of capacitance of single phase and three phase lines with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines. Capacitance of composite – conductor, geometric mean radius (GMR) and geometric mean distance (GMD). Advantages of single circuit and double circuit lines.	12	Applying L3, Applying L3
3	**Performance of transmission lines:** Classification of lines – short, medium and long. Current and voltage relations, line regulation and Ferranti effect in short length lines, medium length lines considering Nominal T and nominal π circuits,	12	Analyzing L4, Analyzing L4

	and long lines considering hyperbolic form equations. Equivalent circuit of a long line. ABCD constants in all cases.		
4	**Corona:** Phenomena, disruptive and visual critical voltages, corona loss. Advantages and disadvantages of corona. Methods of reducing corona. **Underground cable:** Types of cables, constructional features, insulation resistance, thermal rating, charging current, grading of cables – capacitance and inter-sheath. Dielectric loss. Comparison between ac and dc cables. Limitations of cables. Specification of power cables.	10	UnderstandingL2, Analyzing L4
5	**Distribution:** Primary AC distribution systems – Radial feeders, parallel feeders, loop feeders and interconnected network system. Secondary AC distribution systems – Three phase 4 wire system and single phase 2 wire distribution, AC distributors with concentrated and uniform loads. Effect of disconnection of neutral in a 3 phase four wire system. **Reliability and Quality of Distribution system:** Introduction, definition of reliability, failure, probability concepts, limitation of distribution systems, power quality, Reliability aids.	10	Analyzing L4, Analyzing L4
-	**Total**	**56**	

3. Course Material

Books & other material as recommended by university (A, B) and additional resources used by course teacher (C).

1. Understanding: Concept simulation / video ; one per concept ; to understand the concepts ; 15 – 30 minutes
2. Design: Simulation and design tools used – software tools used ; Free / open source
3. Research: Recent developments on the concepts – publications in journals; conferences etc.

Modules	Details	Chapters in book	Availability
A	**Text books (Title, Authors, Edition, Publisher, Year.)**	**-**	**-**
1, 2, 3, 4, 5	A Course in Electrical Power, Soni Gupta and Bhatnagar, DhanpatRai	1, 2, 3, 4, 5	In Lib
B	**Reference books (Title, Authors, Edition, Publisher, Year.)**	**-**	**-**
1, 2	Power System Analysis and Design, J. Duncan Gloverat el, Cengage Learning, 4th Edition 2008		In Lib
2,3	Electrical power Generation, Transmission and Distribution, S.N. Singh, 2nd, Edition 2009		In Lib
2,3	Electrical Power, SL Uppal, Khanna Publications		In Lib
3,4	Electrical Power systems, CL Wadwa, New Age, 5th Edition, 2009		In Lib
1,2	Electrical Power systems, AshfaqHussain, CBS Publication		Not available
2,3	Electric Power Distribution, AS Pabla, McGraw-Hill, 6th Edition,2012		available
C	**Concept Videos or Simulation for Understanding**	**-**	**-**
C1	https://www.youtube.com/watch?v=uyglZCdkQIM Lecture Series on Power System Generation, Transmission and Distribution https://www.youtube.com/watch?v=gd1nruo4_iA Insulators for Overhead Lines		
C2	https://www.youtube.com/watch?v=lr1jgbR5ca8 https://www.youtube.com/watch?v=dhmYOIBcwOU Transmission Line parameters		
	https://www.youtube.com/watch?v=lr1jgbR5ca8 https://www.youtube.com/watch?v=dhmYOIBcwOU Transmission Line parameters		

C3	https://nptel.ac.in/courses/108102047/12 Performance of transmission lines https://nptel.ac.in/courses/108102047/12 Performance of transmission lines		
C4	https://nptel.ac.in/courses/108105104/21 Disruptive critical voltage for single and three phase transmission lines, Formula for disruptive critical voltage, Visual critical voltage https://nptel.ac.in/courses/108102047/18 Underground cable		
C5	https://www.youtube.com/watch?v=_iz8ZkjD7z8 Distribution Systems https://nptel.ac.in/courses/108107112/3 Distribution Systems		
D	**Software Tools for Design**	**-**	**-**
1	Auto CAD		
E	**Recent Developments for Research**	**-**	**-**
	https://ieeexplore.ieee.org/document/7836860		
F	**Others (Web, Video, Simulation, Notes etc.)**	**-**	**-**
1			

4. Course Prerequisites

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.
Students must have learnt the following Courses / Topics with described Content . . .

Modules	Course Code	Course Name	Topic / Description	Sem	Remarks	Blooms Level
1	17EE43	Power Generation and Economics	To understand the concepts of various methods of generation of power	4		L2

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.
Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Modules	Topic / Description	Area	Remarks	Blooms Level
1	Load Forecasting Grounding Types of Transmission and Distribution Systems Testing of insulators	Advanced Topics		L3,L4
3	Characteristics of Transmission Line Methods of voltage Control	Advanced Topics		L3,L4
5	Electrical Distribution system analysis	Certificate Courses		L3,L4

B. OBE PARAMETERS

1. Course Outcomes

Expected learning outcomes of the course, which will be mapped to POs. Identify a max of 2 Concepts per Module. Write 1 CO per Concept.

Modules	Course Code.#	Course Outcome **At the end of the course, student should be able to . . .**	Teach. Hours	Instr Method	Assessment Method	Blooms' Level
1	17EE43.1	Explain the scheme of transmission and distribution of power system and to find the importance of types of insulators	12	Lecture / PPT	unit Test and Assignment	L2
2	17EE43.2	Calculate the system parameters and characteristics for different system state.	12	Lecture / PPT	unit Test and Assignment	L3
3	17EE43.3	Analyze the performance of overhead lines	12	Lecture / PPT	unit Test and Assignment	L3
4	17EE43.4	Explain the types and features of underground cable and corona	10	Lecture / PPT	unit Test and Assignment	L2
5	17EE43.5	Explain the primary and secondary AC distribution and to test their reliability and quality	10	Lecture / PPT	unit Test and Assignment	L2
-	**-**	**Total**	**56**	**-**	**-**	**L2-L3**

2. Course Applications

Write 1 or 2 applications per CO.
Students should be able to employ / apply the course learnings to . . .

Modules	Application Area Compiled from Module Applications.	CO	Level
1	An electric power system is a network of electrical components deployed to supply, transfer, and use electric power. An example of an electric power system is the grid that provides power to an extended area An overhead power line Explain about the types of structures used for supporting overhead lines & types of conductors used for overhead transmission & distribution. Explaining about the importance of sag and derive an expression for sag of a transmission line when supports at same and different level and analyze the performance of transmission line when effected by atmospheric conditions Understanding about the different types of insulators and to design insulators for a given voltage level.is a structure used in electric power transmission and distribution to transmit electrical energy along large distances. Insulators are used in the electrical system to obstruct the flow of unwanted current to earth from its supporting points.	CO1	L2
2	Transmission line parameters provide the link between the supply and receiving end voltages and currents, considering the circuit elements to be linear in nature. Transmission line parameters provide the link between the supply and receiving end voltages and currents, considering the circuit elements to be linear in nature.	CO2	L3
3	Performance of transmission lines includes the calculation of sending end voltage, sending end current, sending end power factor, power loss in the lines, efficiency of transmission, regulation and limits of power flows during steady state and transient conditions. Performance calculations are helpful in system planning.	CO3	L3

	Performance of transmission lines includes the calculation of sending end voltage, sending end current, sending end power factor, power loss in the lines, efficiency of transmission, regulation and limits of power flows during steady state and transient conditions. Performance calculations are helpful in system planning.		
4	Due to corona formation, the air surrounding the conductor becomes conducting and hence virtual diameter of the conductor is increased. The increased diameter reduces the electrostatic stresses between the conductors. Corona reduces the effects of transients produced by surges such as lightning. Underground cables are used for power transmission where overhead transmission is not possible. They are mostly used in urban areas, industries, and even to supply power from the overhead to the consumer premises.	CO4	L2
5	Electric power distribution is the final stage in the delivery of electric power; it carries electricity from the transmission system to individual consumers. The distribution system reliability evaluation considers the ability of the distribution system to transfer energy from bulk supply points such as typical transmission system end -stations, and from local generation points, to customer loads	CO5	L2

3. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

-	-	Course Outcomes	Program Outcomes														-
Modules	CO.#	**At the end of the course student should be able to . . .**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	Level
1	CO1	Explain the scheme of transmission and distribution of power system and to find the importance of types of insulators	2	1											1		2	
2	CO2	Calculate the system parameters and characteristics for different system state.	2		2										2			
3	CO3	Analyze the performance of overhead lines	3	2	2										2			
4	CO4	Explain the types and features of underground cable and corona	2	2											2		2	
5	CO5	Explain the primary and secondary AC distribution and to test their reliability and quality	2	1											2		2	
-	**15EE662.**	Average																**-**
-	*PO, PSO*	*1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning;* *PSO 1: Apply fundamental knowledge to identify, formulate, design and investigate various problems of electrical and electronic circuits, power electronics, and power systems.* *PSO 2: Use latest Electrical and Electronics related software for simple design, drafting, manufacturing, maintenance and documentation of Electrical and Electronics components.* *PSO 3: Manage the Electrical process by selection and scheduling right type of machinery, Conductors, Electrical equipment, power quality control techniques, operational parameters and software for a particular power transmission process to achieve reliability and economical operation.*																

4. Curricular Gap and Content

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Modules	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping

C. COURSE ASSESSMENT

1. Course Coverage

Assessment of learning outcomes for Internal and end semester evaluation. Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Modules	Title	Teach. Hours	No. of question in Exam						CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Introduction to power system Overhead transmission Lines Overhead line insulators	12	2	-	-	1	1	2	CO1	L2
2	Line parameters	12	2	-	-	1	1	2	CO2	L3
3	Performance of transmission lines	12	-	2	-	1	1	2	CO3	L3
4	Corona Underground cable	10	-	2	-	1	1	2	CO4	L2
5	Distribution Reliability and Quality of Distribution system	10	-	-	4	1	1	2	Co5	L2
-	**Total**	**56**	**4**	**4**	**4**	**5**	**5**	**10**	**-**	**-**

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Modules	Evaluation	Weightage in Marks	CO	Levels
1, 2	CIA Exam – 1	30	CO1, CO2	L2,L3
3, 4	CIA Exam – 2	30	CO3, CO4	L3, L3
5	CIA Exam – 3	30	CO5	L2
1, 2	Assignment - 1	10	CO1, CO2	L2,L3
3, 4	Assignment - 2	10	CO3, CO4	L3, L3
5	Assignment - 3	10	CO5	L2
1, 2	Seminar - 1		-	-
3, 4	Seminar - 2		-	-
5	Seminar - 3		-	-
1, 2	Quiz - 1		-	-
3, 4	Quiz - 2		-	-
5	Quiz - 3		-	-
1 - 5	Other Activities – Mini Project	-		
	Final CIA Marks	**40**	**-**	**-**

D1. TEACHING PLAN - 1

Module - 1

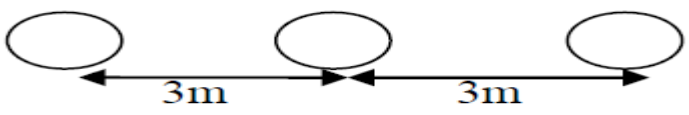
Title:	Introduction to power systems, Overhead transmission lines and insulators	Appr Time:	12 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
1	Explain the scheme of transmission and distribution of power system and to find the importance of types of insulators	CO1	**L2**
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
1	Introduction to Power system-Generation, Transmission and distribution	CO1	L2
2	Single line diagram of power system, advantages of higher voltage transmission	CO1	L2
3	Feeders, distributors, service mains and HVAC, EHVAC, UHVAC, HVDC	CO1	L2
4	Overhead Transmission Lines-Introduction to supporting structures and line conductors, types of conventional conductors	CO1	L2
5	Sag and Sag calculation at different and same support levels	CO1	L3
6	Numericals on Sag	CO1	L3
7	Effect of wind and ice on sag, line vibration and vibration dampers	CO1	L3
8	Protection of overhead lines against lightening, ground wires	CO1	L2
9	Over head line insulators-types of insulators, materials used for insulators	CO1	L2
10	Potential distribution over a string of suspension insulators, arcing horns	CO1	L2
11	String efficiency and methods to increase string efficiency	CO1	L3
12	Numerical on String efficiency	CO1	L3
e	**Experiences**	-	-
1			
2			

Module – 2

Title:	Line Parameters	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms Level**
2	Calculate the system parameters and characteristics for different system state.	**co2**	**L3**
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
13	Line parameters-introduction to line parameters like resistance, inductance and capacitance	co2	L2
14	Calculation of inductance of 1phase and 3phase lines with equilateral spacing and unsymmetrical spacing	co2	L3
15	Calculation of inductance for double circuit and transposed lines	co2	L3
16	GMD and GMR of inductance of composite conductors	co2	L4
17	Numerical	co2	L3
18	Advantages of single and double circuit lines	co2	L2
19	Calculation of capacitance of 1phase and 3phase lines with equilateral spacing	co2	L3

	and unsymmetrical spacing		
20	Calculation of capacitance for double circuit and transposed lines	co2	L3
21	GMD and GMR of capacitance of composite conductors	co2	L4
22	Advantages of single and double circuit lines	co2	L2
23	Problems	co2	L4
24	numerical	co2	L3
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Transmission line parameters provide the link between the supply and receiving end voltages and currents, considering the circuit elements to be linear in nature.	CO2	L3
2	Transmission line parameters provide the link between the supply and receiving end voltages and currents, considering the circuit elements to be linear in nature.	CO2	L3
d	**Review Questions**	-	-
-			
1	Draw the line diagram of a typical power supply scheme indicating the standard voltages.	CO1	L3
2	Write short note on advantages of HV transmission	CO1	L3
3	Write short note on feeders, distributors and service mains	CO1	L3
4	Write the comparison between. Overhead and underground transmission system	CO1	L3
5	What are the advantages and limitations of high voltage a.c transmission	CO1	L3
6	Explain about advantage of high voltage transmission?	CO1	L3
7	List out the advantages of EHVAC and UHVAC transmission system.	CO1	L3
8	Explain the different types of supporting structures used in transmission lines.	CO1	L3
9	Summarize the different types of conventional conductors used in transmission lines	CO1	L3
10	What are the line conductors? Why they are used?	CO1	L3
11	Discuss about the four types of conductors used for transmission and distribution.	CO1	L3
12	Why HTLS conductors used in transmission lines.	CO1	L3
13	Discuss different types of high temperature conductors based on their construction and operation.	CO1	L3
14	Why are bundled conductors used? Lits out the advantages.	CO1	L3
15	Show that a transmission line conductor suspended between level support assumes the shape of a catenory. Derive the expression for sag	CO1	L3
16	With usual notations derive an expression for maximum sag of a transmission. Line where the supports are at different levels	CO1	L3
17	Obtain the expression for sag in a freely suspended conductor when the supports are at equal levels	CO1	L3
18	Explain the effects of sag in overhead transmission. Line and about sag template	CO1	L3
19	Obtain the expression for sag in a power conductor when the supports are at equal levels, taking into the effect of wind and ice loading	CO1	L3
20	Write short note on effect of ice load and wind effect on sag of transmission. Line	CO1	L3
21	From the first principles derive the expression for sag in a freely suspended conductor when the supports are at unequal levels	CO1	L3
22	Explain about line vibrators	CO1	L3

23	Explain about stringing chart	CO1	L3
24	A transmission line conductor is supported by the towers of unequal height. The first has a height of 30m and the second tower has a height of 50m.The distance between the towers is 150m.Tension in the conductor is 2200Kg and cross section of the conductor is 2 cm2.The specific gravity of the conductor material is 9.5gm/cm3 and the wind pressure is 150kg/m2.Calculate the sag.	CO1	L3
25	The towers of height 30m and 90m respectively support a transmission line conductor at water crossing. The horizontal distance between the towers is 500m. If the tension in the conductor is 600kg, find the minimum clearance of the conductor and water and also clearance midway between the supports. Weight of conductor is .5kg/m. base of the towers can be considered to be at water level?	CO1	L3
26	A transmission line conductor at a river crossing is supported from two towers of heights 50m and 80m above water level. The horizontal distance between the towers is 500m. if the tension in the conductor is 3000 kg. Find the minimum clearance between the conductor and water. Weight of the conductor per meter is 0.822kg?	CO1	L3
27	An overhead transmission line at a river crossing is supported from two towers at heights of 20m and 90m above water level, the horizontal distance between the towers being 200m. if the maximum allowable tension is 200kg, find the clearance between the conductor and water at a point mid-way between the towers, weight of conductor is kg/m?	CO1	L3
28	A 32 kv transmitting line uses ACSR conductor whose data are: nominal copper area 10mm2; size 30+7/2.79mm: weight 822kg/m2; ultimate strength 7950kg. The line is subjected to a horizontal wind pressure of 20kg/m2 of projected area and .25cm radial ice coating. If the maximum permissible sag is 6m, calculate the permissible span between the supports, allowing for a factor of safety of 2. Weight of ice is 95kg/m3?	CO1	L3
29	Write as short note on effect of wind effect and ice load on sag of transmitting line ?	CO1	L3
30	Obtain the expression for sag at erection	CO1	L3
31	Explain the various tests conducted on insulators	CO1	L3
32	Explain the properties of insulator	CO1	L3
33	Explain the materials used as insulator	CO1	L3
34	Explain pin type insulator	CO1	L3
35	Explain about different types of insulator	CO1	L3
36	Explain the various tests conducted on insulators.	CO1	L3
37	With usual notations, derive the general expression for the metal link of string to line capacitance, when guard ring is used for the string of insulators.	CO1	L3
38	What is string efficiency in the context of suspension insulators?	CO1	L3
39	Explain the methods of improving the sting efficiency.	CO1	L3
40	Explain the terms self GMD and mutual GMD and prove that the inductance of a group of parallel wires carrying current can be represented in terms of their geometric distances.	CO2	L3
41	Derive an expression for the capacitance of a unsymmetrically spaced but regularly transposed line.	CO2	L3
42	Derive the expression for the inductance of a 3 phase transmission line with unsymmetrical spacing without transposition. Use the Flux linkage concept	CO2	L3
43	Write short notes on transposition of transmission Lines	CO2	L3
44	Derive the expression for the inductance of a 3 phase unsymmetrically spaced but transmission line/km.	CO2	L3
45	Derive the expression for the capacitance of a 3 phase single circuit. Line with equilateral spacing	CO2	L3
46	Show how the inductance of 3 phase transmission. Line with equilateral and symmetrical spacing between conductors can be calculated.	CO2	L3

47	Derive the expression for the capacitance of a 3 phase line with unsymmetrical spacing.	CO2	L3
48	Derive from first principles, an expression for the inductance per phase per km of a 3 phase regularly transposed transmitting. Line. The conductors are of diameter d mt and placed at the corner of a triangle of sides a, b, c.	CO2	L3
49	Calculate the inductance of single phase two wire line starting from fundamentals	CO2	L3
50	Find the capacitance between the conductors of a single-phase 10 km long line. The diameter of each conductor is 1.213cm. The spacing between conductors is 1.25m. Also find the capacitance of each conductor to neutral.	CO2	L3
51	A 3 Φ overhead transmission line has its conductors arranged at the corners of an equilateral triangle of 2m side. Calculate the capacitance of each line conductor per km. Given the diameter of each conductor is 1.25cm	CO2	L3
52	Find the capacitance per km per phase of a 3Φ line arrangement in a Horizontal plane spaced 8 meters apart. The height of all conductors above the earth is 13 meters. The diameter of each conductor is 2.6 cm. the line is completely transposed and takes the effect of ground into account.	CO2	L3
53	A single phase transmission line has a resistance of 0.22 ohm and inductive reactance of 0.36ohm. Find the voltage at the sending end to give 500KVA at 2000V at the receiving end at a load power factor of 0.707 lagging. Also, find the efficiency of transmission at this load	CO2	L3
54	A two conductor single phase line operates at 50 Hz. The diameter of each conductor is 20mm and the spacing between the conductors is 3m. Calculate inductance of each conductor per km. also find the inductive reactance per km.	CO2	L3
55	A three phase line 100km long has its conductors of 0.5cm diameter spaced at the corners of the equilateral triangle of 120cm side. Find the inductance per phase of the system.	CO2	L3
56	The three conductors of a three phase, 3 wire lines are arranged at the corners of a triangle, the sides of which are 1m, 1.3m, and 2m. Calculate the inductance per km of the line, when the conductors are transposed.	CO2	L3
57	A two conductor single phase line operates at 50 Hz. The diameter of each conductor is 20mm and the Spacing between the conductors is 3m. Calculate inductance of each conductor per km. also find the inductive reactance per km.	CO2	L3
58	The three conductors of a 3 phase line are arranged at the corners of a triangle of side 2, 2.5 and 4.5m respectively as shown in fig. Calculate the inductance per km of the line if the conductors are regularly transposed. Diameter of each conductor is 1024mm	CO2	L3
59	A two conductor on single phase line operated at 50 Hz. The diameter of each conductor is 20mm and the spacing between the conductors is 3m calculate (i) the inductance of each conductor/km (ii) the loop inductance of the line /km (iii) the inductive reactance/km	CO2	L3
60	A 3 phase transmission line 100km long has its conductor of 0.6cmdiameter speed at the corners of an equilateral triangle of 10cm at each side. Find the inductance / phase/km of the system	CO2	L3
61	Determine the capacitance and charging current per unit length of the line when the arrangement of conductors are shown in the figure The conductor radius is 20mm 	CO2	L3

E1. CIA EXAM – 1

a. Model Question Paper - 1

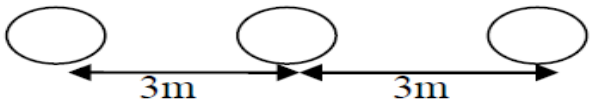
Crs Code:	17EE43	Sem:	IV	Marks:	30	Time:	75 minutes		
Course:	Transmission and Distribution								
-	**-**	**Note: Answer all questions, each carry equal marks. Module : 1, 2**					**Marks**	**CO**	**Level**
1	a	Draw the line diagram of a typical power supply scheme indicating the standard voltages.					5	CO1	L2
	b	Write short note on feeders, distributors and service mains					5	CO1	L2
	c	Why are bundled conductors used? Lits out the advantages.					5	CO1	L2
		OR							
1	a	Obtain the expression for sag in a power conductor when the supports are at equal levels, taking into the effect of wind and ice loading					7	CO1	L2
	b	A transmission line conductor is supported by the towers of unequal height. The first has a height of 30m and the second tower has a height of 50m.The distance between the towers is 150m.Tension in the conductor is 2200Kg and cross section of the conductor is 2 cm2.The specific gravity of the conductor material is 9.5gm/cm3 and the wind pressure is 150kg/ m2.Calculate the sag.					8	CO1	L2
2	a	Explain the methods of improving the sting efficiency.					7	CO1	L2
	b	A overhead transmission line at a river crossing is supported from two towers at heights of 20m and 90m above water level, the horizontal distance between the towers being 200m. if the maximum allowable tension is 200kg, find the clearance between the conductor and water at a point mid-way between the towers, weight of conductor is kg/m?					8	CO1	L2
		OR							
2	a	Derive the expression for the capacitance of a 3 phase single circuit. Line with equilateral spacing					7	CO2	L3
	b	The three conductors of a 3 phase line are arranged at the corners of a triangle of side 2, 2.5 and 4.5m respectively as shown in fig. Calculate the inductance per km of the line if the conductors are regularly transposed. Diameter of each conductor is 1024mm					8	CO2	L3

b. Assignment -1

Model Assignment Questions									
Crs Code:	17EE43	Sem:	IV	Marks:	10	Time:	90 – 120 minutes		
Course:	Transmission and Distribution				Module : 1, 2				
SNo	**Assignment Description**						**Marks**	**CO**	**Level**
1	Draw the line diagram of a typical power supply scheme indicating the standard voltages.						10	CO1	L2
2	Write short note on advantages of HV transmission						10	CO1	L2
3	Write short note on feeders, distributors and service mains						10	CO1	L2
4	Write the comparison between. Overhead and underground transmission system						10	CO1	L2
5	What are the advantages and limitations of high voltage a.c transmission						10	CO1	L2
6	Explain about advantage of high voltage transmission?						10	CO1	L2
7	List out the advantages of EHVAC and UHVAC transmission system.						10	CO1	L2
8	Explain the different types of supporting structures used in transmission lines.						10	CO2	L2
9	Summarize the different types of conventional conductors used in transmission lines						10	CO2	L2
10	What are the line conductors? Why they are used?						10	CO2	L2

11	Discuss about the four types of conductors used for transmission and distribution.	10	CO2	L2
12	Why HTLS conductors used in transmission lines.	10	CO2	L2
13	Discuss different types of high temperature conductors based on their construction and operation.	10	CO2	L2
14	Why are bundled conductors used? Lits out the advantages.	10	CO2	L2
15	Show that a transmission line conductor suspended between level support assumes the shape of a catenory. Derive the expression for sag	10	CO2	L2
16	With usual notations derive an expression for maximum sag of a transmission. Line where the supports are at different levels	10	CO2	L2
17	Obtain the expression for sag in a freely suspended conductor when the supports are at equal levels	10	CO2	L2
18	Explain the effects of sag in overhead transmission. Line and about sag template	10	CO2	L2
19	Obtain the expression for sag in a power conductor when the supports are at equal levels, taking into the effect of wind and ice loading	10	CO2	L2
20	Write short note on effect of ice load and wind effect on sag of transmission. Line	10	CO2	L2
21	From the first principles derive the expression for sag in a freely suspended conductor when the supports are at unequal levels	10	CO2	L2
22	Explain about line vibrators	10	CO2	L2
23	Explain about stringing chart	10	CO2	L2
24	A transmission line conductor is supported by the towers of unequal height. The first has a height of 30m and the second tower has a height of 50m.The distance between the towers is 150m.Tension in the conductor is 2200Kg and cross section of the conductor is 2 cm2.The specific gravity of the conductor material is 9.5gm/cm3 and the wind pressure is 150kg/m2.Calculate the sag.	10	CO2	L2
25	The towers of height 30m and 90m respectively support a transmission line conductor at water crossing. The horizontal distance between the towers is 500m. If the tension in the conductor is 600kg, find the minimum clearance of the conductor and water and also clearance midway between the supports. Weight of conductor is .5kg/m. base of the towers can be considered to be at water level?	10	CO2	L2
26	A transmission line conductor at a river crossing is supported from two towers of heights 50m and 80m above water level. The horizontal distance between the towers is 500m. if the tension in the conductor is 3000 kg. Find the minimum clearance between the conductor and water. Weight of the conductor per meter is 0.822kg?	10	CO2	L2
27	A overhead transmission line at a river crossing is supported from two towers at heights of 20m and 90m above water level, the horizontal distance between the towers being 200m. if the maximum allowable tension is 200kg, find the clearance between the conductor and water at a point mid-way between the towers, weight of conductor is kg/m?	10	CO2	L2
28	A 32 kv transmitting line uses ACSR conductor whose data are: nominal copper area 10mm2; size 30+7/2.79mm: weight 822kg/m2; ultimate strength 7950kg. The line is subjected to a horizontal wind pressure of 20kg/m2 of projected area and .25cm radial ice coating. If the maximum permissible sag is 6m, calculate the permissible span between the supports, allowing for a factor of safety of 2. Weight of ice is 95kg/m3?	10	CO2	L2
29	Write as short note on effect of wind effect and ice load on sag of transmitting line ?	10	CO2	L2
30	Obtain the expression for sag at erection	10	CO2	L2
31	Explain the various tests conducted on insulators	10	CO2	L2
32	Explain the properties of insulator	10	CO2	L2
33	Explain the materials used as insulator	10	CO2	L2

34	Explain pin type insulator	10	CO2	L2
35	Explain about different types of insulator	10	CO2	L2
36	Explain the various tests conducted on insulators.	10	CO2	L2
37	With usual notations, derive the general expression for the metal link of string to line capacitance, when guard ring is used for the string of insulators.	10	CO2	L2
38	What is string efficiency in the context of suspension insulators?	10	CO2	L2
39	Explain the methods of improving the sting efficiency.	10	CO2	L2
40	Explain the terms self GMD and mutual GMD and prove that the inductance of a group of parallel wires carrying current can be represented in terms of their geometric distances.	10	CO3	L3
41	Derive an expression for the capacitance of a unsymmetrically spaced but regularly transposed line.	10	CO4	L3
42	Derive the expression for the inductance of a 3 phase transmission line with unsymmetrical spacing without transposition. Use the Flux linkage concept	10	CO3	L3
43	Write short notes on transposition of transmission Lines	10	CO3	L3
44	Derive the expression for the inductance of a 3 phase unsymmetrically spaced but transmission line/km.	10	CO3	L3
45	Derive the expression for the capacitance of a 3 phase single circuit. Line with equilateral spacing	10	CO4	L3
46	Show how the inductance of 3 phase transmission. Line with equilateral and symmetrical spacing between conductors can be calculated.	10	CO3	L3
47	Derive the expression for the capacitance of a 3 phase line with unsymmetrical spacing.	10	CO4	L3
48	Derive from first principles, an expression for the inductance per phase per km of a 3 phase regularly transposed transmitting. Line. The conductors are of diameter d mt and placed at the corner of a triangle of sides a, b, c.	10	CO3	L3
49	Calculate the inductance of single phase two wire line starting from fundamentals	10	CO3	L3
50	Find the capacitance between the conductors of a single-phase 10 km long line. The diameter of each conductor is 1.213cm. The spacing between conductors is 1.25m. Also find the capacitance of each conductor to neutral.	10	CO4	L3
51	A 3 Φ overhead transmission line has its conductors arranged at the corners of an equilateral triangle of 2m side. Calculate the capacitance of each line conductor per km. Given the diameter of each conductor is 1.25cm	10	CO4	L3
52	Find the capacitance per km per phase of a 3Φ line arrangement in a Horizontal plane spaced 8 meters apart. The height of all conductors above the earth is 13 meters. The diameter of each conductor is 2.6 cm. the line is completely transposed and takes the effect of ground into account.	10	CO4	L3
53	A single phase transmission line has a resistance of 0.22 ohm and inductive reactance of 0.36ohm. Find the voltage at the sending end to give 500KVA at 2000V at the receiving end at a load power factor of 0.707 lagging. Also, find the efficiency of transmission at this load	10	CO3	L3
54	A two conductor single phase line operates at 50 Hz. The diameter of each conductor is 20mm and the spacing between the conductors is 3m. Calculate inductance of each conductor per km. also find the inductive reactance per km.	10	CO3	L3
55	A three phase line 100km long has its conductors of 0.5cm diameter spaced at the corners of the equilateral triangle of 120cm side. Find the inductance per phase of the system.	10	CO3	L3
56	The three conductors of a three phase, 3 wire lines are arranged at the corners of a triangle, the sides of which are 1m, 1.3m, and 2m. Calculate the inductance per km of the line, when the conductors are transposed.	10	CO3	L3

57	A two conductor single phase line operates at 50 Hz. The diameter of each conductor is 20mm and the Spacing between the conductors is 3m. Calculate inductance of each conductor per km. also find the inductive reactance per km.	10	CO3	L3
58	The three conductors of a 3 phase line are arranged at the corners of a triangle of side 2, 2.5 and 4.5m respectively as shown in fig. Calculate the inductance per km of the line if the conductors are regularly transposed. Diameter of each conductor is 1024mm	10	CO3	L3
59	A two conductor on single phase line operated at 50 Hz. The diameter of each conductor is 20mm and the spacing between the conductors is 3m calculate (i) the inductance of each conductor/km (ii) the loop inductance of the line /km (iii) the inductive reactance/km	10	CO3	L3
60	A 3 phase transmission line 100km long has its conductor of 0.6cmdiameter speed at the corners of an equilateral triangle of 10cm at each side. Find the inductance / phase/km of the system	10	CO3	L3
61	Determine the capacitance and charging current per unit length of the line when the arrangement of conductors are shown in the figure The conductor radius is 20mm 	10	CO4	L3

D2. TEACHING PLAN - 2

Module – 3

Title:	Performance of transmission lines	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
3	Analyze the performance of overhead lines	CO3	L3
b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**
25	Performance of transmission lines- classification of lines	CO3	L2
26	Short transmission line-Current and voltage relations, line regulation and Ferranti effect	CO3	L3
27	Problems	CO3	L3
28	Medium transmission line- nominal T	CO3	L3
29	Medium transmission line- nominal pi methods	CO3	L3
30	Problems on medium transmission line	CO3	L3
31	Generalised circuit constants of a transmission line	CO3	L4
32	ABCD constants in all cases	CO3	L4
33	Long transmission line-hyperbolic form equations	CO3	L2
34	Equivalent circuit of a long transmission line	CO3	L2
35	Numericals	CO3	L3
36	Numericals	CO3	L3
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-

1	Performance of transmission lines includes the calculation of sending end voltage, sending end current, sending end power factor, power loss in the lines, efficiency of transmission, regulation and limits of power flows during steady state and transient conditions. Performance calculations are helpful in system planning.	CO3	L4
2	Performance of transmission lines includes the calculation of sending end voltage, sending end current, sending end power factor, power loss in the lines, efficiency of transmission, regulation and limits of power flows during steady state and transient conditions. Performance calculations are helpful in system planning.	CO3	L4
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
62	Derive expressions for generalized ABCD constants for a long transmission line using rigorous method of analysis	CO3	L4
63	Derive expressions for ABCD constants for a medium transmission line using nominal T model. Hence prove AD-BC = 1.	CO3	L4
64	Write short note on classification of transmission lines.	CO3	L4
65	Write short note on Ferranti effect	CO3	L4
66	What are ABCD constants of a trasmn. Line? Determine the same for a medium transmission line using nominal Π model. Hence prove AD-BC = 1.	CO3	L4
67	Derive the expressions for sending end voltage and current of a medium transmission. Line (nominal T method) interms of Y, Z, Vr and Ir	CO3	L4
68	Derive expressions for generalized ABCD constants for equivalent T representation of long transmission line.	CO3	L4
69	Discuss the terms voltage regulation and transmission efficiency as applied to transmission line.	CO3	L4
70	Write and explain the classification of overhead transmission. Lines	CO3	L4
71	Calculate the efficiency. And voltage regulation for medium transmitting. Line assuming nominal T method	CO3	L4
72	Derive an expression for the efficiency. And voltage regulation for short transmission. Line giving the vector diagram.	CO3	L4
73	A three phase 50 Hz transmission line has conductor of section 90 sq. mm. And Effecting dia. Of 1 cm and are placed at the vertices of an equilateral triangle of side 1 m. the line is 40 km long and delivers a load of 10MW at 33kV and pf = 0.9. Compute the efficiency and regulation of the line. Assume temperature of 200C.	CO3	L4
74	Determine ABCD constants of a 3 phase 50 Hz transmitting line 200 KM long having the following distributed parameters. L= 1.3 *10-3h/km C = 9*10-9 F/KM R = 0.20 ohm/km. A single phase overhead transmitting line delivers 1100 kw at 33kv at 0.8 pf lagging the load resistance and inductive reactance for short transmitting line are 10 ohm and 15 ohms respectively determine (1) Vs (2) cos φs (3) line efficiency with vector diagram	CO3	L4
75	A 3 phase, 50hz transmission lines has the following constants R = 28 ohm, inductive reactance = 63 ohms, capacitive susceptance = 4*10-4 . The load at the receiving end is 75MVA at 0.8 pf lag with 132 kv between lines. Calculate (1) voltage, (2) current (3) pf at sending end (4) reg and efficiency of the transmission for these loads using nominal t method?	CO3	L4
76	Write a short note on Ferrantic effect? What are ABCD constants of a transmitting line? Determine the same for a medium transmission line using nominal T model hence prove AD- BC = 1	CO3	L4
77	An overhead 3 phase transmitting line delivers 5000kw at 22kv at 0.8 pf lagging. The resistance and reactance of short transmitting line is 4 ohm and 6 ohms respectively. Determine (1) sending end voltage (ii) % reg (iii) transmitting efficiency.	CO3	L4
e	**Experiences**	-	-
1			

2			

Module – 4

Title:	Corona and underground cable	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
	Explain the types and features of underground cable and corona	CO4	L2
b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**
37	**Corona-** phenomenon of corona, disruptive voltages and visual critical voltages	CO4	L2
38	Corona loss, advantages & disadvantages of corona	CO4	L2
39	Methods of reducing corona	CO4	L2
40	**Underground cable**- types and features of cables	CO4	L2
41	Insulation resistance, thermal rating, charging current of cables	CO4	L2
42	Grading of cables	CO4	L2
43	Dielectric loss of underground cables	CO4	L2
44	Comparison between ac and dc cables	CO4	L3
45	Limitations of cables, Specifications of power cables	CO4	L2
46	Problems	CO4	L3
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Due to corona formation, the air surrounding the conductor becomes conducting and hence virtual diameter of the conductor is increased. The increased diameter reduces the electrostatic stresses between the conductors. Corona reduces the effects of transients produced by surges such as lightning.	CO4	L2
2	Underground cables are used for power transmission where overhead transmission is not possible. They are mostly used in urban areas, industries, and even to supply power from the overhead to the consumer premises.	CO4	L4
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
79	What is corona? Derive expression for the disruptive critical voltage and visual critical voltage	CO4	L2
80	What are the effects of corona?	CO4	L2
81	Write short note on disruptive critical voltage	CO4	L2
82	Discuss the advantages and disadvantages of corona	CO4	L2
83	Explain the terms with reference to corona. i)disruptive critical voltage ii) Power loss due to corona	CO4	L2
84	Write short note on corona in transmission lines.	CO4	L2
85	Write short note on factors affecting corona and methods of reducing corona effect	CO4	L2
86	Explain the terms with reference to corona. i)visual critical voltage ii) Power loss due to corona	CO4	L2
87	Find the corona characteristics f 110KV, 50Hz, 3 phase transmission line 175 Km long consisting of three 1 cm diameters stranded conductors arranged in the form of delta with spacing 3m. The barometric pressure is 74 cm of mercury and temperature 26°C.Surface factor is 0.85. For Local coron, surface is 0.72 and it is	CO4	L2

	0.82 for general corona.		
88	A single core 66kv cable working on 3-phase system has a conductor diameter of 2cm and sheath of inside diameter 5.3cm. If two inner sheaths are introduced in such a way that the stress varies between the same maximum and minimum in the three layers find: a) position of inner sheaths b) voltage on the linear sheaths c) maximum and minimum stress	CO4	L4
89	A cable is graded with three dielectrics of permittivity 4, 3 and 2. The maximum permissible potential gradient for all dielectrics is same and equal to 30 kV/cm. The core diameter is 1.5cm and sheath diameter is 5.5cm.	CO4	L4
90	Calculate the most economical diameter of a single core cable to be used on 132kV, 3 phase system. Find also the overall diameter of the insulation, if the peak permissible stress does not exceed 60kV/cm. also derive the formula used here	CO4	L4
91	A single core cable has a conductor of diameter 1.8cm and its insulation thickness is 1cm.The specific resistance of material is 7.5*108 MΩ cm. Calculate the insulation resistance per kilometer of a cable. If this resistance is increased by 30%, calculate the thickness of the additional layer required.	CO4	L4
92	Calculate the most economical diameter of a single core cable to be used on 132kV, 3 phase system. Also, find the overall diameter of the insulation; if the peak permissible stress does not exceed 60kV/cm. Also derive the formula used.	CO4	L4
93	A cable is graded with three dielectrics of permittivity"s 4, 3 and 2. The maximum permissible potential gradient for all dielectrics is same and equal to 30 kV/cm. The core diameter is 1.5cm and sheath diameter is 5.5cm. Determine the inner radii of dielectrics.	CO4	L4
94	A single core 33kv cable working on 3-phase system has a conductor diameter of 1.2 cm and sheath of inside diameter 5cm. If two inner sheaths are introduced in such a way that the stress varies between the same maximum and minimum in the three layers find: a) Position of inner sheaths b) Voltage on the sheaths c) Maximum and minimum stress	CO4	L4
95	The three conductors of a three phase, 3 wire line are arranged at the corners of a triangle, the sides of which are 1m, 1.3m, and 2m. Calculate the inductance and capacitance per km of the line, when the conductors are transposed	CO4	L4
96	A cable is graded with three dielectrics of permittivity"s 4, 3 and 2. The maximum permissible potential gradient for all dielectrics is same and equal to 30 kV/cm. The core diameter is 1.5cm and sheath diameter is 5.5cm. Determine the inner radii of dielectrics.	CO4	L4
97	A single core cable is graded by using three dielectrics of relative permittivity of 5, 4 and 3 respectively. The conductor diameter is 2 cm and overall diameter is 8 cm. If the three dielectrics are worked at the same maximum stress of 40KV/cm, find the safe working voltage of the cable.	CO4	L4
98	Draw the cross sectional view of a single core cable and explain the construction.	CO4	L4
99	Write short notes on testing of cables	CO4	L4
100	Derive an expression for insulation resistance of a cable	CO4	L4
101	Explain capacitance grading of cables with appropriate derivation	CO4	L4
102	What is meant by grading of cables? Briefly explain the various methods of grading.	CO4	L4
103	Write short note on thermal rating of cables	CO4	L4
104	Derive expressions for the maximum and minimum dielectric stress in a single core cable and obtain the criteria for keeping the dielectric stress to a minimum value.	CO4	L4
105	Compare the merits and demerits of underground system overhead system	CO4	L4
106	State five advantages of using underground cables for power distribution	CO4	L4

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs Code:	17EE43	Sem:	IV	Marks:	30	Time:	75 minutes		
Course:	Transmission and Distribution								
-	**-**	**Note: Answer all questions, each carry equal marks. Module : 3, 4**					**Marks**	**CO**	**Level**
1	a	Calculate the efficiency. And voltage regulation for medium transmitting. Line assuming nominal T method					8	CO3	L4
	b	A 3 phase, 50hz transmission lines has the following constants R = 28 ohm, inductive reactance = 63 ohms, capacitive susceptance = $4^{*}10^{-4}$. The load at the receiving end is 75MVA at 0.8 pf lag with 132 kv between lines. Calculate (1) voltage, (2) current (3) pf at sending end (4) reg and efficiency of the transmission for these loads using nominal t method?					7	CO3	L4
		OR							
1	a	Explain the terms with reference to corona. i)disruptive critical voltage ii) Power loss due to corona					8	CO4	L2
	b	Write short note on factors affecting corona and methods of reducing corona effect					7	CO4	L2
2	a	Find the corona characteristics f 110KV, 50Hz, 3 phase transmission line 175 Km long consisting of three 1 cm diameters stranded conductors arranged in the form of delta with spacing 3m. The barometric pressure is 74 cm of mercury and temperature 26°C.Surface factor is 0.85. For Local coron, surface is 0.72 and it is 0.82 for general corona.					10	CO3	L2
	b	Discuss the advantages and disadvantages of corona					5	CO4	L2
		OR							
2	a	A single core cable is graded by using three dielectrics of relative permittivity of 5, 4 and 3 respectively. The conductor diameter is 2 cm and overall diameter is 8 cm. If the three dielectrics are worked at the same maximum stress of 40KV/cm, find the safe working voltage of the cable.					8	CO4	L4
	b	Draw the cross sectional view of a single core cable and explain the construction.					7	CO4	L4

b. Assignment -2

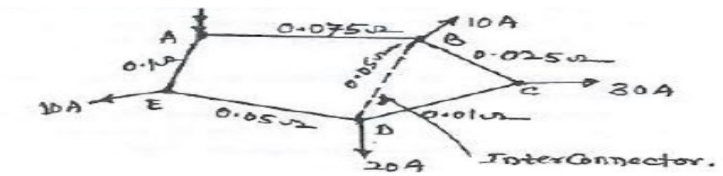
Model Assignment Questions									
Crs Code:	17EE43	Sem:	IV	Marks:	10	Time:	90 – 120 minutes		
Course:	Transmission and Distribution				Module : 3,4				
SNo	**Assignment Description**						**Marks**	**CO**	**Level**
1	Derive expressions for generalized ABCD constants for a long transmission line using rigorous method of analysis						10	CO3	L4
2	Derive expressions for ABCD constants for a medium transmission line using nominal T model. Hence prove AD-BC = 1.						10	CO3	L4
3	Write short note on classification of transmission lines.						10	CO3	L4
4	Write short note on Ferranti effect						10	CO3	L4
5	What are ABCD constants of a trasmn. Line? Determine the same for a medium transmission line using nominal Π model. Hence prove AD-BC = 1.						10	CO3	L4

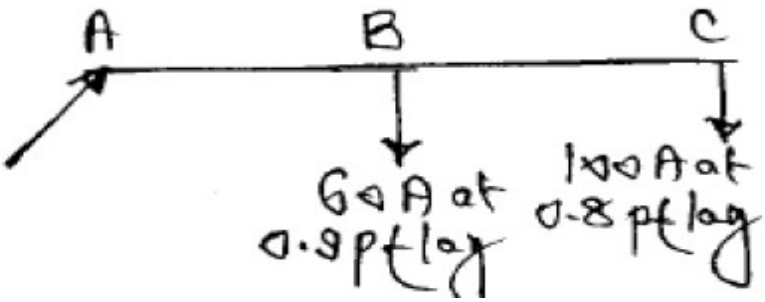
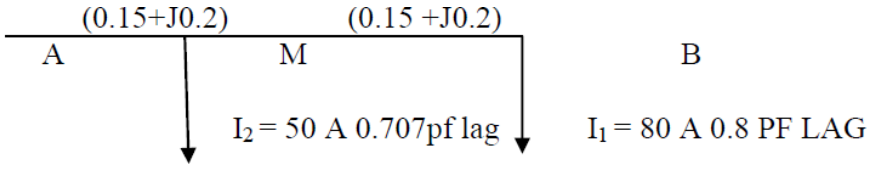
6	Derive the expressions for sending end voltage and current of a medium transmission. Line (nominal T method) interms of Y, Z, Vr and Ir	10	CO3	L4
7	Derive expressions for generalized ABCD constants for equivalent T representation of long transmission line.	10	CO3	L4
8	Discuss the terms voltage regulation and transmission efficiency as applied to transmission line.	10	CO3	L4
9	Write and explain the classification of overhead transmission. Lines	10	CO3	L4
10	Calculate the efficiency. And voltage regulation for medium transmitting. Line assuming nominal T method	10	CO3	L4
11	Derive an expression for the efficiency. And voltage regulation for short transmission. Line giving the vector diagram.	10	CO3	L4
12	A three phase 50 Hz transmission line has conductor of section 90 sq. mm. And Effecting dia. Of 1 cm and are placed at the vertices of an equilateral triangle of side 1 m. the line is 40 km long and delivers a load of 10MW at 33kV and pf = 0.9. Compute the efficiency and regulation of the line. Assume temperature of 200C.	10	CO3	L4
13	Determine ABCD constants of a 3 phase 50 Hz transmitting line 200 KM long having the following distributed parameters. L= 1.3 *10-3h/km C = 9*10-9 F/KM R = 0.20 ohm/km. A single phase overhead transmitting line delivers 1100 kw at 33kv at 0.8 pf lagging the load resistance and inductive reactance for short transmitting line are 10 ohm and 15 ohms respectively determine (1) Vs (2) cos φs (3) line efficiency with vector diagram	10	CO3	L4
14	A 3 phase, 50hz transmission lines has the following constants R = 28 ohm, inductive reactance = 63 ohms, capacitive susceptance = 4*10-4 . The load at the receiving end is 75MVA at 0.8 pf lag with 132 kv between lines. Calculate (1) voltage, (2) current (3) pf at sending end (4) reg and efficiency of the transmission for these loads using nominal t method?	10	CO3	L4
15	Write a short note on Ferrantic effect? What are ABCD constants of a transmitting line? Determine the same for a medium transmission line using nominal T model hence prove AD- BC = 1	10	CO3	L4
16	An overhead 3 phase transmitting line delivers 5000kw at 22kv at 0.8 pf lagging. The resistance and reactance of short transmitting line is 4 ohm and 6 ohms respectively. Determine (1) sending end voltage (ii) % reg (iii) transmitting efficiency.	10	CO3	L4
17	What is corona? Derive expression for the disruptive critical voltage and visual critical voltage	10	CO4	L2
18	What are the effects of corona?	10	CO4	L2
19	Write short note on disruptive critical voltage	10	CO4	L2
20	Discuss the advantages and disadvantages of corona	10	CO4	L2
21	Explain the terms with reference to corona. i)disruptive critical voltage ii) Power loss due to corona	10	CO4	L2
22	Write short note on corona in transmission lines.	10	CO4	L2
23	Write short note on factors affecting corona and methods of reducing corona effect	10	CO4	L2
24	Explain the terms with reference to corona. i)visual critical voltage ii) Power loss due to corona	10	CO4	L2
25	Find the corona characteristics f 110KV, 50Hz, 3 phase transmission line 175 Km long consisting of three 1 cm diameters stranded conductors arranged in the form of delta with spacing 3m. The barometric pressure is 74 cm of mercury and temperature 26°C.Surface factor is 0.85. For Local coron, surface is 0.72 and it is 0.82 for general corona.	10	CO4	L2
26	A single core 66kv cable working on 3-phase system has a conductor diameter of 2cm and sheath of inside diameter 5.3cm. If two inner sheaths are introduced in such a way that the stress varies between the same maximum and minimum in the three layers find: a) position of inner sheaths b) voltage on the linear sheaths	10	CO4	L4

	c) maximum and minimum stressCO4			
27	A cable is graded with three dielectrics of permittivity 4, 3 and 2. The maximum permissible potential gradient for all dielectrics is same and equal to 30 kV/cm. The core diameter is 1.5cm and sheath diameter is 5.5cm.	10	CO4	L4
28	Calculate the most economical diameter of a single core cable to be used on 132kV, 3 phase system. Find also the overall diameter of the insulation, if the peak permissible stress does not exceed 60kV/cm. also derive the formula used here	10	CO4	L4
29	A single core cable has a conductor of diameter 1.8cm and its insulation thickness is 1cm.The specific resistance of material is 7.5*108 MΩ cm. Calculate the insulation resistance per kilometer of a cable. If this resistance is increased by 30%, calculate the thickness of the additional layer required.	10	CO8	L4
30	Calculate the most economical diameter of a single core cable to be used on 132kV, 3 phase system. Also, find the overall diameter of the insulation; if the peak permissible stress does not exceed 60kV/cm. Also derive the formula used.	10	CO8	L4
31	A cable is graded with three dielectrics of permittivity"s 4, 3 and 2. The maximum permissible potential gradient for all dielectrics is same and equal to 30 kV/cm. The core diameter is 1.5cm and sheath diameter is 5.5cm. Determine the inner radii of dielectrics.	10	CO4	L4
32	A single core 33kv cable working on 3-phase system has a conductor diameter of 1.2 cm and sheath of inside diameter 5cm. If two inner sheaths are introduced in such a way that the stress varies between the same maximum and minimum in the three layers find: a) Position of inner sheaths b) Voltage on the sheaths c) Maximum and minimum stress	10	CO4	L4
33	The three conductors of a three phase, 3 wire line are arranged at the corners of a triangle, the sides of which are 1m, 1.3m, and 2m. Calculate the inductance and capacitance per km of the line, when the conductors are transposed	10	CO4	L4
34	A cable is graded with three dielectrics of permittivity"s 4, 3 and 2. The maximum permissible potential gradient for all dielectrics is same and equal to 30 kV/cm. The core diameter is 1.5cm and sheath diameter is 5.5cm. Determine the inner radii of dielectrics.	10	CO4	L4
35	A single core cable is graded by using three dielectrics of relative permittivity of 5, 4 and 3 respectively. The conductor diameter is 2 cm and overall diameter is 8 cm. If the three dielectrics are worked at the same maximum stress of 40KV/cm, find the safe working voltage of the cable.	10	CO4	L4
36	Draw the cross sectional view of a single core cable and explain the construction.	10	CO4	L4
37	Write short notes on testing of cables	10	CO4	L4
38	Derive an expression for insulation resistance of a cable	10	CO4	L4
39	Explain capacitance grading of cables with appropriate derivation	10	CO4	L4
40	What is meant by grading of cables? Briefly explain the various methods of grading.	10	CO4	L4
41	Write short note on thermal rating of cables	10	CO4	L4
42	Derive expressions for the maximum and minimum dielectric stress in a single core cable and obtain the criteria for keeping the dielectric stress to a minimum value.	10	CO4	L4
43	Compare the merits and demerits of underground system overhead system	10	CO4	L4
44	State five advantages of using underground cables for power distribution	10	CO4	L4

D3. TEACHING PLAN - 3

Module – 5

Title:	Loop and Horn Antenna and Antenna Types	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
5	Explain the primary and secondary AC distribution and to test their reliability and quality	10	L2
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
47	Distribution-Radial feeders, parallel feeders, loop feeders and interconnected network system	CO5	L2
48	Secondary AC distribution- 3phase 4 wire system	CO5	L3
49	1phase 2wire system, distributors connected with loads	CO5	L3
50	Effect of disconnection of neutral wire in a 3phase 4wire system	CO5	L3
51	Problems	CO5	L3
52	Reliability and quality of distribution system-Introduction to reliability and quality of distribution system	CO5	L2
53	Failure probability concepts	CO5	L2
54	Limitations of distribution system	CO5	L2
55	Power quality aids	CO5	L2
56	Reliability aids	CO5	L2
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Electric power distribution is the final stage in the delivery of electric power; it carries electricity from the transmission system to individual consumers.	CO5	L4
2	The distribution system reliability evaluation considers the ability of the distribution system to transfer energy from bulk supply points such as typical transmission system end -stations, and from local generation points, to customer loads.	CO5	L2
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
107	Write short note on radial and ring main distributors	C05	L4
108	What is meant by DC distribution? Explain with diagram different types of DC distribution and discuss their merits and demerits.	C05	L4
109	Write short note on radial distribution system	C05	L4
110	In a 2 core dc distributor cable 400m long supplies there are concentrated loads of 120, 80, 50 and 120A at 50, 150, 200 and 300m, respectively from the end A. Determine the position of the lowest voltage when the cable is fed at 250V from both the ends.	C05	L4
111	The points B and D of a d.c main ABCEDA are linked through a interconnector the supply is given at point "A". The resistances of both run and return conductors of various sections are shown in the figure. Calculate (i) current in interconnector (ii) voltage drop in interconnector. 	C05	L4

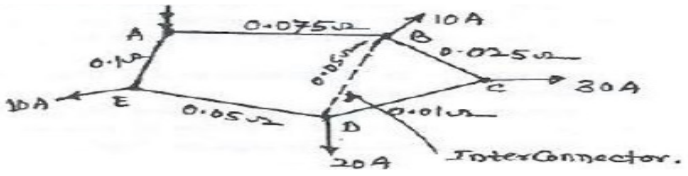
112	A two wire d.c distributor 1200m long is loaded as shown in the figure, B being the midpoint.The power factor at the two load points refer to voltage C . the impedance of each line is (0.15+j0.2) ohms . Calculate the sending end voltage, current and power factor . the voltage at point C is 220V 	C05	L4
113	A two wire d.c. distributor AB 600 m long is loaded as under. Distance from a 150,300,350,450. Loads in amperes 100,200,250,300. The feeding point A is maintained at 440 V and that of B at 430V. if each conductor has a resistance of 0.001 ohms / 100m calculate (1) the current supplied from A to B (2) the power dissipated in the distributor? List down the necessary power requirements of a power distribution systems	C05	L4
114	A single phase distributor is shown in the fig. The far end of the distributor has load current of 80 a and power factor 0.8 lagging at 220v. The midpoint M of the distributor has a load current of 50 A at pf of 0.707 lag with reference to a voltage M. Calculate the sending end voltage and power factor 	C05	L4
115	A 2-wire d.c. distributor cable AB is 2 km long and supplies loads of 100A, 150A, 200A and 50A situated 500 m, 1000 m, 1600 m and 2000 m from the feeding point A. Each conductor has a resistance of 0·01 Ω per 1000 m. Calculate the p.d. at each load point if a p.d. of 300 V is maintained at point A	C05	L4
116	A 2-wire d.c. ring distributor is 300 m long and is fed at 240 V at point A. At point B, 150 m from A, a load of 120 A is taken and at C, 100 m in the opposite direction, a load of 80 A is taken. If the resistance per 100 m of single conductor is 0·03 Ω, find : (i) current in each section of distributor (ii) voltage at points B and C	C05	L4
117	A single phase distributor one km long has resistance and reactance per conductor Of 0·1 Ω and 0·15 Ω respectively. At the far end, the voltage VB = 200 V and the current is 100 A at a p.f. of 0·8 lagging. At the mid-point M of the distributor, a current of 100 A is tapped at a p.f. of 0·6 lagging with reference to the voltage VM at the mid-point. Calculate : (i) voltage at mid-point (ii) sending end voltage VA (iii) phase angle between VA and VB	C05	L4
118	A 3-phase ring main ABCD fed at A at 11 kV supplies balanced loads of 50 A at 0.8 p.f. lagging at B, 120 A at unity p.f. at C and 70 A at 0·866 lagging at D, the load currents being Referred to the supply voltage at A. The impedances of the various sections are : Section AB = (1 + j 0·6) Ω ; Section BC = (1·2 + j 0·9) Ω Section CD = (0·8 + j 0·5) Ω ; Section DA = (3 + j 2) Ω. Calculate the currents in various sections and station bus-bar voltages at B, C and D.	C05	L4

119	Distinguish between reliability, availability, adequacy and security.	C05	L2
120	Discuss the commonly used distributors for failure	C05	L2
121	What are life failure rate curves?	C05	L2
122	Why is PQ important?	C05	L2
123	Define failure rate.	C05	L2
124	Define under voltage, over voltage sag and swell.	C05	L2
125	Distinguish between sag and interruption.	C05	L2
126	What are transients?	C05	L2
127	What are harmonics?	C05	L2
128	Define THD.	C05	L2
e	**Experiences**	-	-
1			
2			

E3. CIA EXAM – 3

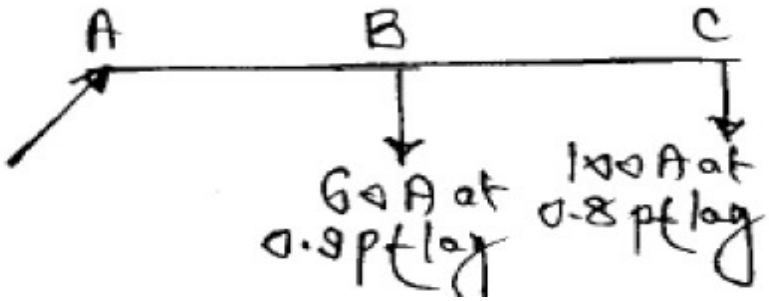
a. Model Question Paper - 3

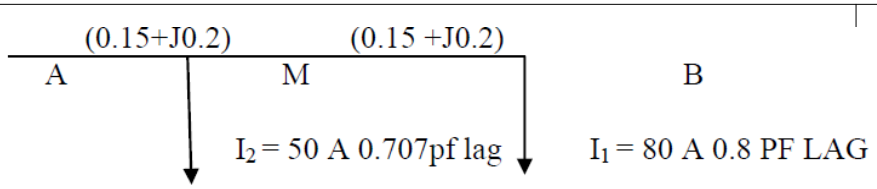
Crs Code:	17EE43	Sem:	IV	Marks:	30	Time:	75 minutes
Course:	Transmission and Distribution						

-	-	**Note: Answer all questions, each carry equal marks. Module : 5**	**Marks**	**CO**	**Level**
1	a	Write short note on radial and ring main distributors	7	C05	L4
	b	A 2-wire d.c. ring distributor is 300 m long and is fed at 240 V at point A. At point B, 150 m from A, a load of 120 A is taken and at C, 100 m in the opposite direction, a load of 80 A is taken. If the resistance per 100 m of single conductor is 0·03 Ω, find : (i) current in each section of distributor (ii) voltage at points B and C	8	C05	L4
		OR			
1	a	In a 2 core dc distributor cable 400m long supplies there are concentrated loads of 120, 80, 50 and 120A at 50, 150, 200 and 300m, respectively from the end A. Determine the position of the lowest voltage when the cable is fed at 250V from both the ends.	8	C05	L4
	b	The points B and D of a d.c main ABCEDA are linked through a interconnector the supply is given at point "A". The resistances of both run and return conductors of various sections are shown in the figure. Calculate (i) current in interconnector (ii) voltage drop in interconnector. 	7	C05	L4
2	a	Define under voltage, over voltage sag and swell.	5	CO5	L2
	b	Distinguish between sag and interruption.	5	CO5	L2
	c	Define THD.	5	CO5	L2
		OR			
2	a	Distinguish between reliability, availability, adequacy and security.	8	CO5	L2
	b	What are life failure rate curves and Define failure rate.	7	CO5	L2

b. Assignment 3

Model Assignment Questions									
Crs Code:	17EE43	Sem:	IV	Marks:	10	Time:	90 – 120 minutes		
Course:	Transmission and Distribution				Module : 5				

SNo	Assignment Description	Marks	CO	Level
1	Write short note on radial and ring main distributors	10	C05	L4
2	What is meant by DC distribution? Explain with diagram different types of DC distribution and discuss their merits and demerits.	10	C05	L4
3	Write short note on radial distribution system	10	C05	L4
4	In a 2 core dc distributor cable 400m long supplies there are concentrated loads of 120, 80, 50 and 120A at 50, 150, 200 and 300m, respectively from the end A. Determine the position of the lowest voltage when the cable is fed at 250V from both the ends.	10	C05	L4
5	The points B and D of a d.c main ABCEDA are linked through a interconnector the supply is given at point "A". The resistances of both run and return conductors of various sections are shown in the figure. Calculate (i) current in interconnector (ii) voltage drop in interconnector.	10	C05	L4
6	A two wire d.c distributor 1200m long is loaded as shown in the figure, B being the midpoint.The power factor at the two load points refer to voltage C . the impedance of each line is (0.15+j0.2) ohms . Calculate the sending end voltage, current and power factor . the voltage at point C is 220V 	10	C05	L4
7	A two wire d.c. distributor AB 600 m long is loaded as under. Distance from a 150,300,350,450. Loads in amperes 100,200,250,300. The feeding point A is maintained at 440 V and that of B at 430V. if each conductor has a resistance of 0.001 ohms / 100m calculate (1) the current supplied from A to B (2) the power dissipated in the distributor? List down the necessary power requirements of a power distribution systems	10	C05	L4
8	A single phase distributor is shown in the fig. The far end of the distributor has load current of 80 a and power factor 0.8 lagging at 220v. The midpoint M of the distributor has a load current of 50 A at pf of 0.707 lag with reference to a voltage M. Calculate the sending end voltage and power factor	10	C05	L4

				
9	A 2-wire d.c. distributor cable AB is 2 km long and supplies loads of 100A, 150A, 200A and 50A situated 500 m, 1000 m, 1600 m and 2000 m from the feeding point A. Each conductor has a resistance of 0·01 Ω per 1000 m. Calculate the p.d. at each load point if a p.d. of 300 V is maintained at point A	10	CO5	L4
10	A 2-wire d.c. ring distributor is 300 m long and is fed at 240 V at point A. At point B, 150 m from A, a load of 120 A is taken and at C, 100 m in the opposite direction, a load of 80 A is taken. If the resistance per 100 m of single conductor is 0·03 Ω, find : (i) current in each section of distributor (ii) voltage at points B and C	10	CO5	L4
11	A single phase distributor one km long has resistance and reactance per conductor Of 0·1 Ω and 0·15 Ω respectively. At the far end, the voltage VB = 200 V and the current is 100 A at a p.f. of 0·8 lagging. At the mid-point M of the distributor, a current of 100 A is tapped at a p.f. of 0·6 lagging with reference to the voltage VM at the mid-point. Calculate : (i) voltage at mid-point (ii) sending end voltage VA (iii) phase angle between VA and VB	10	CO5	L4
12	A 3-phase ring main ABCD fed at A at 11 kV supplies balanced loads of 50 A at 0.8 p.f. lagging at B, 120 A at unity p.f. at C and 70 A at 0·866 lagging at D, the load currents being Referred to the supply voltage at A. The impedances of the various sections are : Section AB = (1 + j 0·6) Ω ; Section BC = (1·2 + j 0·9) Ω Section CD = (0·8 + j 0·5) Ω ; Section DA = (3 + j 2) Ω. Calculate the currents in various sections and station bus-bar voltages at B, C and D.	10	CO5	L4
13	Distinguish between reliability, availability, adequacy and security.	10	CO5	L2
14	Discuss the commonly used distributors for failure	10	CO5	L2
15	What are life failure rate curves?	10	CO5	L2
16	Why is PQ important?	10	CO5	L2
17	Define failure rate.	10	CO5	L2
18	Define under voltage, over voltage sag and swell.	10	CO5	L2
19	Distinguish between sag and interruption.	10	CO5	L2
20	What are transients?	10	CO5	L2
21	What are harmonics?	10	CO5	L2
22	Define THD.	10	CO5	L2

F. EXAM PREPARATION

1. University Model Question Paper

Course:		Transmission and Distribution						Month / Year		May /2019	
Crs Code:		17EE43	Sem:	IV	Marks:	80		Time:		180 minutes	
Module	**Note**	Answer all FIVE full questions. All questions carry equal marks.							**Marks**	**CO**	**Level**
1	a	Explain about advantage of high voltage transmission?							5	CO1	L2
	b	Why are bundled conductors used? Lits out the advantages.							5	CO1	L2
		Write the comparison between. Overhead and underground transmission system							5	CO1	L2
		OR									

1	a	Obtain the expression for sag in a power conductor when the supports are at equal levels, taking into the effect of wind and ice loading	10	CO1	L2
	b	A transmission line conductor is supported by the towers of unequal height. The first has a height of 30m and the second tower has a height of 50m.The distance between the towers is 150m.Tension in the conductor is 2200Kg and cross section of the conductor is 2 cm2.The specific gravity of the conductor material is 9.5gm/cm3 and the wind pressure is 150kg/m2.Calculate the sag.	10	CO1	L2
2	a	Explain the terms self GMD and mutual GMD and prove that the inductance of a group of parallel wires carrying current can be represented in terms of their geometric distances.	10	CO2	L3
	b	Derive the expression for the capacitance of a 3 phase single circuit. Line with equilateral spacing	10	CO2	L3
		OR			
2	a	Find the capacitance between the conductors of a single-phase 10 km long line. The diameter of each conductor is 1.213cm. The spacing between conductors is 1.25m. Also find the capacitance of each conductor to neutral.	10	CO2	L3
	b	Calculate the inductance of single phase two wire line starting from fundamentals	10	CO2	L3
3	a	Derive expressions for generalized ABCD constants for a long transmission line using rigorous method of analysis	10	CO3	L4
	b	An overhead 3 phase transmitting line delivers 5000kw at 22kv at 0.8 pf lagging. The resistance and reactance of short transmitting line is 4 ohm and 6 ohms respectively. Determine (1) sending end voltage (ii) % reg (iii) transmitting efficiency.	10	CO3	L4
		OR			
3	a	Derive expressions for ABCD constants for a medium transmission line using nominal T model. Hence prove AD-BC = 1.	10	CO3	L4
	b	Discuss the terms voltage regulation and transmission efficiency as applied to transmission line.	5	CO3	L4
	c	Write and explain the classification of overhead transmission lines	5	CO3	L4
4	a	Discuss the advantages and disadvantages of corona	5	CO4	L2
	b	Explain the terms with reference to corona. i)disruptive critical voltage ii) Power loss due to corona	5	CO4	L2
	c	Write short note on factors affecting corona and methods of reducing corona effect	5	CO4	L2
		OR			
4	a	Draw the cross sectional view of a single core cable and explain the construction.	10	CO4	L4
	b	Calculate the most economical diameter of a single core cable to be used on 132kV, 3 phase system. Find also the overall diameter of the insulation, if the peak permissible stress does not exceed 60kV/cm. also derive the formula used here	10	CO4	L4
5	a	In a 2 core dc distributor cable 400m long supplies there are concentrated loads of 120, 80, 50 and 120A at 50, 150, 200 and 300m, respectively from the end A. Determine the position of the lowest voltage when the cable is fed at 250V from both the ends.	10	C05	L4
	b	Write short note on radial and ring main distributors	10	C05	L4
		OR			
5	a	Distinguish between reliability, availability, adequacy and security.	8	C05	L2
	b	Define failure rate and What are life failure rate curves?	6	C05	L2
	c	Define under voltage, over voltage sag and swell.	6	C05	L2

2. SEE Important Questions

Course:		Transmission and Distribution						Month / Year		May /2018	
Crs Code:		17EE43	Sem:	IV	Marks:	60		Time:		180 minutes	
	Note	Answer all FIVE full questions. All questions carry equal marks.							-	-	
Module	Qno.	Important Question							**Marks**	**CO**	**Year**
1	a	Write short note on feeders, distributors and service mains							05	CO1	2017
	b	Explain the different types of supporting structures used in transmission lines.							05	CO1	2018
	c	Draw the line diagram of a typical power supply scheme indicating the standard voltages.							05	CO1	2012
	d	Derive an expression for string efficiency of s 3 disc string							06	CO1	2014
	e	Explain pin type insulator							05	CO1	2016
2	a	Derive the expression for the inductance of a 3 phase unsymmetrically spaced but transmission line/km.							10	CO2	2017
	b	Derive the expression for the capacitance of a 3 phase single circuit. Line with equilateral spacing							10	CO2	2016
	c	Show how the inductance of 3 phase transmission. Line with equilateral and symmetrical spacing between conductors can be calculated.							10	CO2	2018
	d	Calculate the inductance of single phase two wire line starting from fundamentals							10	CO2	2017
	e	Find the capacitance between the conductors of a single-phase 10 km long line. The diameter of each conductor is 1.213cm. The spacing between conductors is 1.25m. Also find the capacitance of each conductor to neutral.							10	CO2	2016
3	a	Derive expressions for generalized ABCD constants for a long transmission line using rigorous method of analysis							10	CO3	2016
	b	Derive expressions for ABCD constants for a medium transmission line using nominal T model. Hence prove AD-BC = 1.							10	CO3	2017
	c	Write short note on classification of transmission lines.							5	CO3	2018
	d	A 3 phase, 50hz transmission lines has the following constants R = 28 ohm, inductive reactance = 63 ohms, capacitive susceptance = 4*10^-4 .The load at the receiving end is 75MVA at 0.8 pf lag with 132 kv between lines. Calculate (1) voltage, (2) current (3) pf at sending end (4) reg and efficiency of the transmission for these loads using nominal t method?							10	CO3	2015
	e	Write short note on Ferranti effect							5	CO3	2016
4	a	What is corona? Derive expression for the disruptive critical voltage and visual critical voltage							10	CO4	2018
	b	What are the effects of corona?							5	CO4	2017
	c	Explain the terms with reference to corona. i)visual critical voltage ii) Power loss due to corona							5	CO4	2016
	d	Derive expressions for the maximum and minimum dielectric stress in a single core cable and obtain the criteria for keeping the dielectric stress to a minimum value.							10	CO4	2015
	e	Compare the merits and demerits of underground system overhead system							5	CO4	2014

5	a	Write short note on radial distribution system	5	C05	2018
	b	In a 2 core dc distributor cable 400m long supplies there are concentrated loads of 120, 80, 50 and 120A at 50, 150, 200 and 300m, respectively from the end A. Determine the position of the lowest voltage when the cable is fed at 250V from both the ends.	10	C05	2017
	c	Distinguish between reliability, availability, adequacy and security.	10	C05	2017
	d	What are life failure rate curves?	5	C05	2018
	e	Why is PQ important?	5	C05	2017