INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

Electrical and Electronics Engineering

TUTORIAL QUESTION BANK

Course Title	**TRANSMISSION AND DISTRIBUTION SYSTEM**				
Course Code	**AEE011**				
Programme	**B. Tech**				
Semester	**V**	**EEE**			
Course Type	**Core**				
Regulation	**IARE – R16**				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	**1**	**4**	**-**	**-**
Course Coordinator	**Ms. T Saritha Kumari, Assistant professor, EEE**				
Course Faculty	**Ms. T Saritha Kumari, Assistant professor, EEE** **Mr. P Mabuhussain, Assistant professor, EEE**				

COURSE OBJECTIVES:

I	Determine the performance parameters of transmission lines.
II	Evaluate the voltage regulation and efficiency of short, medium and long transmissions lines.
III	Demonstrate the mechanical design of overhead line insulators and cables.
IV	Illustrate the importance of sag in the design of overhead transmission lines.
V	Discuss the operation of different distribution schemes and design of feeders.

COURSE OUTCOMES (COs):

CO 1	Determine the value of Resistance, inductance and capacitance of transmission lines and study the effect of corona.
CO 2	Model the short, medium and long transmission lines and study the Ferranti effect and surge impedance loading.
CO 3	Demonstrate the working of different types of insulators, calculate the string efficiency and also illustrate the importance of underground cables.
CO 4	Estimate the Sag and tension in overhead transmission lines in different conditions.
CO 5	Discuss the different types of distribution systems, its economic considerations along with the Indian electricity rules and present grid scenario.

COURSE LEARNING OUTCOMES:

CAEE011.01	Formulate the transmission line parameters (resistance, inductance and capacitance)
CAEE011.02	Estimate the value of inductance and capacitance of different.
CAEE011.03	Illustrate the effect of ground on the capacitance calculations
CAEE011.04	Explain the effect corona in overhead transmission lines.
CAEE011.05	Classify the transmission lines based on the length of the conductor and voltage levels.
CAEE011.06	Analyze the nominal T model, nominal-π and end capacitor models of medium transmission and long transmission lines
CAEE011.07	Evaluate the efficiency and regulation of short, medium and long length transmission lines.
CAEE011.08	Describe Ferranti effect in long transmission lines.
CAEE011.09	Differentiate different insulators used in overhead and underground transmission systems.
CAEE011.10	Determine the string efficiency of suspension type insulators and discuss the methods to improve string efficiency.
CAEE011.11	Construct single core and three core underground cables for transmission of power in highly populated areas.
CAEE011.12	Calculate the sag and tension with equal and unequal heights of towers
CAEE011.13	Illustrate the effect of wind and ice on weight of the conductors for the calculation of sag.
CAEE011.14	Compare different distribution systems (AC Vs DC distribution, Ring main Vs Radial).
CAEE011.15	Evaluate the voltage drops in AC distributors and DC distributors.
CAEE011.16	Discuss parameters to design a substation, Indian electricity rules, various voltage levels of transmission and distribution systems and present Indian grid scenario.

TUTORIAL QUESTION BANK

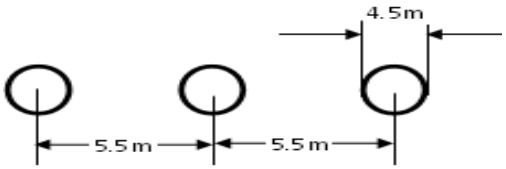
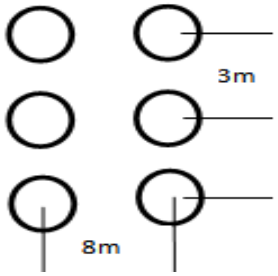
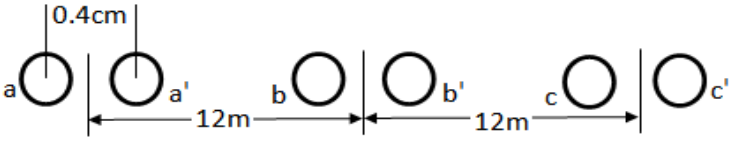
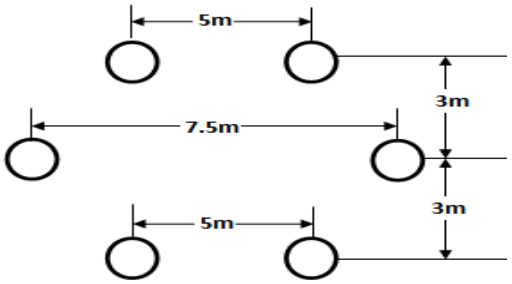
UNIT-I

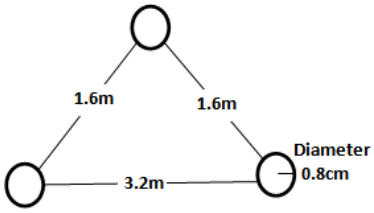
TRANSMISSION LINE PARAMETERS

Part – A (Short Answer Questions)

S No	QUESTIONS	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes (CLOs)
1	What is a transmission line?	Understand	CO 1	AEE011.1
2	Define a two –wire transmission system?	Understand	CO 1	AEE011.1
3	What do you mean by internal and external flux linkage?	Understand	CO 1	AEE011.1
4	Define permeability of a conductor.	Remember	CO 1	AEE011.1
5	What is a composite conductor?	Understand	CO 1	AEE011.2
6	Define inductive reactance spacing factor.	Understand	CO 1	AEE011.2
7	What is the difference between single and double circuit?	Understand	CO 1	AEE011.2
8	Give the expansion of GMR and GMD.	Understand	CO 1	AEE011.2
9	What is transposed line?	Understand	CO 1	AEE011.2
10	What is skin effect?	Understand	CO 1	AEE011.2

11	Differentiate the stranded conductor and bundled conductor.	Understand	CO 1	AEE011.2
12	List out the advantages of double circuit lines.	Understand	CO 1	AEE011.2
13	Illustrate the importance of transposition of conductors in three phase transmission?	Understand	CO 1	AEE011.2
14	Describe about fictitious conductor radius?	Understand	CO 1	AEE0112
15	Define unsymmetrical and symmetrical spacing.	Understand	CO 1	AEE011.2
16	List out the disadvantages of corona?	Understand	CO 1	AEE011.4
18	Define disruptive and visual critical voltages?	Understand	CO 1	AEE011.4
19	Define corona?	Understand	CO 1	AEE011.4
20	State the factors that are affecting corona?	Understand	CO 1	AEE011.4
Part - B (Long Answer Questions)				
1	Derive an expression for inductance of a conductor due to external flux.	Understand	CO 1	AEE011.2
2	With a diagram explain equilateral and unsymmetrical spacing of conductors.	Understand	CO 1	AEE011.2
3	A Single phase line of 230V has conductor spacing of 135cm.The radius of conductor is 0.8cm.Calculate the loop inductance in mH of the line per km.	Understand	CO 1	AEE011.2
4	Compare the capacitance of a three phase double circuit line with symmetrical spacing with the capacitance of a three phase double circuit line with unsymmetrical spacing.	Understand	CO 1	AEE011.2
5	Discuss effect of earth on the capacitance of the line.	Understand	CO 1	AEE011.3
6	A wire 4mm in diameter is suspended at constant height 10meters above sea level which constitutes the return conductor. Calculate the inductance of the system per km.	Understand	CO 1	AEE011.2
7	A 3-phase overhead transmission line has its conductors arranged at the corners of an equilateral triangle of 2mside.Calculate the capacitance of each line conductor per km. Given that diameter of each conductor is 1.25cm	Understand	CO 1	AEE011.2
8	Explain the concept of self and mutual GMDs.	Understand	CO 1	AEE011.2
9	Calculate the inductance of each conductor of 3-phase.3 wire system when the conductors are arranged in a horizontal plane with spacing such that D_{31}=4mt,D_{12}=D_{23}=2mt.The conductors are transposed and have a diameter of 3cm.	Understand	CO 1	AEE011.2
10	Explain the concept of transposed and untransposed line with unsymmetrical spacing.	Understand	CO 1	AEE011.2
11	Derive an expression for capacitances of a single phase transmission system and discuss the effect of earth on capacitance with suitable equation	Understand	CO 1	AEE011.3
12	Derive an expression for inductance Of a single-phase overhead line.	Understand	CO 1	AEE011.2
13	Derive the expression for inductance of a two wire 1Φ transmission line	Understand	CO 1	AEE011.2
14	What are the advantages of bundled conductors?	Understand	CO 1	AEE011.2
15	Derive the expression for the capacitance per phase of the 3 Φ double circuit line flat vertical spacing with transposition.	Understand	CO 1	AEE011.2
16	Derive an expression for disruptive and visual critical voltages.	Understand	CO 1	AEE011.4
17	Discuss power loss due to corona	Understand	CO 1	AEE011.4
18	Describe the phenomenon of corona? How can the corona loss are minimized in transmission lines.	Understand	CO 1	AEE011.4
Part - C (Analytical Questions)				

1	A 3-phase , 50hz, 66kv over head transmission line has conductors arranged at the corners of an equivalent triangular of 3m sides and the diameter of each conductor is 1.5cm determine 'L' and 'C' per phase, if l=100km. also calculate charging current.	Understand	CO 1	AEE011.2
2	Calculate L of a single phase two wire system if D=2m and r=1.2cm?	Understand	CO 1	AEE011.2
3	Two conductor of a single phase line each diameter 2cm, arranged in a vertical plane with are conductor mounted 2m above the other. A second identical line is mounted at the same height as the first and space horizontally 0.5m apart from it and connected in parallel. Determine L/km.	Understand	CO 1	AEE011.2
4	Determine L/km/phase of a single circuit 3-phase,20kv line given. 	Understand	CO 1	AEE011.2
5	A 3-phase transmission line100km long diameter =0.5cm spaced at the corner of an equivalent triangular of 120cm sides find inductance km/ph. Derive the formula used.	Understand	CO 1	AEE011.2
6	Calculate the inductance/ph if diameter=1.5cm 	Understand	CO 1	AEE011.2
7	Determine the inductance per km of a three phase transmission line having conductors per phase and arranged as shown. 	Understand	CO 1	AEE011.2
8	Determine the inductance per Km of a double circuit 3-phase line is transposed with in each circuit and each circuit remains at its outside. The diameters of each conductor in 15mm. 	Understand	CO 1	AEE011.2

9	Determine the capacitance and the charging inductance per Km. when the transmission line of figure operating at 132kv.  	Understand	CO 1	AEE011.2
10	Derive an expression for the capacitance per km of a single phase line taking into account the effect of ground.	Understand	CO 1	AEE011.3
11	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 neutral.	Understand	CO 1	AEE011.2
12	Derive the expression for capacitance of a double circuit line for hexagonal spacing.	Understand	CO 1	AEE011.2
13	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.	Understand	CO 1	AEE011.2
14	Find the capacitance per km per phase of a 3Φ line arrangement in a horizontal plane spaced 8 metres apart. The height of all conductors above the earth is 13 metres. The diameter of each conductor is 2.6 cm. the line is completely transposed and takes the effect of ground into account.	Understand	CO 1	AEE011.2
15	A 3-phase, 220 kV, 50 Hz transmission line consists of 1·5 cm radius conductor spaced 2 metres apart in equilateral triangular formation. If the temperature is 40ºC and atmospheric pressure is 76 cm, calculate the corona loss per km of the line. Take mo = 0·85.	Understand	CO 1	AEE011.4
16	A certain 3-phase equilateral transmission line has a total corona loss of 53 kW at 106 kV and a loss of 98 kW at 110·9 kV. What is the disruptive critical voltage? What is the corona loss at 113 kV?	Understand	CO 1	AEE011.4
17	Estimate the corona loss for a three-phase, 110 kV, 50 Hz, 150 km long transmission line consisting of three conductors each of 10 mm diameter and spaced 2·5 m apart in an equilateral triangle formation. The temperature of air is 30ºC and the atmospheric pressure is 750 mm of mercury. Take irregularity factor as 0·85. Ionisation of air may be assumed to take place at a maximum voltage gradient of 30 kV/ cm.	Understand	CO 1	AEE011.4
18	A single phase overhead line has two conductors of diameter 1 cm with a spacing of 1 meter between centres. If the disruptive critical voltage for air is 21 kV/cm, for what value of the line voltage will corona commence?	Understand	CO 1	AEE011.4
UNIT-II				
MODELING AND PERFORMANCE OF TRANSMISSION LINES				
Part – A (Short Answer Questions)				
1	Give classification of overhead transmission line.	Remember	CO 2	AEE011.05
2	Draw equivalent T and π network.	Remember	CO 2	AEE011.06
3	What is surge impedance loading?	Understand	CO 2	AEE011.06
4	What are ABCD constants in a transmission line?	Remember	CO 2	AEE011.06
5	What is reflected and refracted wave?	Understand	CO 2	AEE011..06

6	What are the limitations of T and π methods?	Understand	CO 2	AEE011.06
7	Define characteristic impedance of a transmission line.	Remember	CO 2	AEE011.06
8	What is the purpose of using series reactors on a transmission line?	Understand	CO 2	AEE011.06
9	Why do we analyze a three phase transmission line on single phase basis?	Remember	CO 2	AEE011.06
10	What is the length of short, long and medium transmission line?	Understand	CO 2	AEE011.06
11	Define transmission efficiency.	Remember	CO 2	AEE011.07
12	List out the common methods of representation of medium transmission lines.	Understand	CO 2	AEE011.06
13	Define voltage regulation.	Remember	CO 2	AEE011.07
14	What are the voltages regulating equipments used in transmission systems?	Remember	CO 2	AEE011.07
15	Classify overhead transmission lines.	Remember	CO 2	AEE011.05
	Part - B (Long Answer Questions)			
1	What do you mean by medium transmission line? How capacitance effect is taken to account.	Understand	CO 2	AEE011.06
2	Show how regulation and efficiency are determined in nominal T and nominal π method.	Understand	CO 2	AEE011.06
3	A I-phase transmission line has a resistance of 0.2Ω and an inductance of 0.4Ω.Find the voltage at the sending end to give 500KVA at 2KV at the receiving end at load power factor of i)unity ii) 0.707 lagging	Understand	CO 2	AEE011.07
4	Using rigorous method, derive expression for sending end voltage for a long transmission line.	Understand	CO 2	AEE011.06
5	Determine A,B,C,D constants for a 3-phase 50Hz transmission line 200km long having the following parameters $l=1.2*10^{-3}$H/km $c=8*10^{-9}$F/km r=0.15Ω/km. Use nominal T-Method	Understand	CO 2	AEE011.06
6	Determine A,B,C,D constants for a 3-phase 50Hz transmission line 200km long having the following parameters $l=1.2*10^{-3}$H/km $c=8*10^{-9}$F/km r=0.15Ω/km . Use nominal-Pie method	Understand	CO 2	AEE011.06
7	Explain how voltages and currents are evaluated in long transmission lines.	Understand	CO 2	AEE011.06
8	Derive expression for surge impedance.	Understand	CO 2	AEE011.06
9	Determine A,B,C,D constants for a 3-phase 50Hz transmission line 200km long having the following distributed parameters $l=1.2*10^{-3}$H/km, $c=8*10^{-9}$F/km, r=0.15Ω/km, g=0	Understand	CO 2	AEE011.06
10	compare A,B,C,D parameters of short ,Nominal T ,Pie and long lines	Understand	CO 2	AEE011.06
11	Enumerate the important methods in use for improving the power factor at the receiving end of a transmission line	Understand	CO 2	AEE011.07
12	Discuss the action of a synchronous phase modifiers for voltage regulation of a line and explain carefully how its use increases the current carrying capacity of a transmission line.	Understand	CO 2	AEE011.07
13	Show that the following relationships hold for a transmission line $V_s=DV_r + BI_r$, $I_s = CV_r + DI_r$ Where V_s,I_s and V_r ,I_r denotes sending end and receiving voltages and currents respectively and A,B,C,D are auxiliary constants	Understand	CO 2	AEE011.07
14	Expain the feranti effect in long transmission lines	Understand	CO 2	AEE011.08
15	Derive the expression for ABCD parameters of medium transmission lines by π-method draw the vector diagram.	Understand	CO 2	AEE011.07

Part - C (Analytical Questions)				
1	A 1-phase transmission line has a resistance of 0.20 ohm and an inductance of 0.40 ohm. Find the voltage at the sending end to give 500KVA at 2KV at the receiving end at power factor of (i) Unity (ii) 0.707 lagging. Illustrate with suitable phasor diagrams.	Understand	CO 2	AEE011.06
2	A 60 Hz short line has resistance of 0.62 ohm/ph and inductance of 93.24 mh/ph. The line supplies a load(Y connected) of 100μW at 0.9 p.f.(lag) and at 215KV(L-L). Calculate sending-end voltage per phase	Understand	CO 2	AEE011.06
3	Define A, B, C & D constants of a transmission line? What are their values in short lines?	Understand	CO 2	AEE011.06
4	A 3-Ph, 3km long line delivers 300 kW at a PF of 0.8 lag to a load if the voltage at the supply end is 11kV, determine the voltage at the load end, % regulation, sending end PF and the efficiency of transmission line. The resistance and reactance of each conductor per km are 0.4 Ohm and 0.3 Ohm respectively.	Understand	CO 2	AEE011.07
5	Find the values of A, B, C & D in the nominal - Π method in terms of Z & Y.	Understand	CO 2	AEE011.06
6	A 3-Ph overhead line has a resistance of 2 Ohm/Ph and reactance of 6 Ohm/Ph. It supplies a load of 10 MVA at a PF of 0.8 leading at 33kV between lines at far end. Find i).Sending End Voltage ii). % Regulation iii).Sending End PF iv).Transmission Efficiency.	Understand	CO 2	AEE011.07
7	Derive equation which represents the performance of a long transmission line with its electrical parameters uniformly distributed along its length?	Understand	CO 2	AEE011.07
8	Calculate the distance over which a load of 15MW at 0.85 p.f. can be delivered by a 3 phase transmission line having conductors each of resistance 0.905 ohm/km. The receiving end voltage is 132kv and the loss is to be 7.5% of the load.	Understand	CO 2	AEE011.07
9	Determine the sending end voltage current, power and power factor for a 160km section of 3-phase line delivering 50MVA at 132kv and p.f. 0.8 lagging. Also find the efficiency and regulation of the line. Resistance per line 0.1557 ohm per km, spacing 3.7 m, 6.475 m, 7.4 m transposed. Also evaluate the A,B,C,D parameters. Given diameter is 1.956cm.	Understand	CO 2	AEE011.07
10	Show that for a transmission line receiving end voltage and current (V_r and I_r) in terms of sending end voltage and current(V_s and I_s) and auxiliary constants are given by $V_r = DV_s - B_s$ and $I_r = -CV_s + AI_s$.	Understand	CO 2	AEE011.07
11	Determine the efficiency and regulation of a 3-phase, 100 Km, 50 Hz transmission line delivering 20 MW at a power factor of 0.8 lagging and 66 kV to a balanced load. The conductors are of copper, each having resistance 0.1 Ω / Km, 1.5 cm outside dia, spaced equilaterally 2 metres between centres. Use nominal T method.	Understand	CO 2	AEE011.07

12	A three phase 5 km long transmission line, having resistance of 0.5 Ω / km and inductance of 1.76mH/km is delivering power at 0.8 pf lagging. The receiving end voltage is 32kV. If the supply end voltage is 33 kV, 50 Hz, find line current, regulation and efficiency of the transmission line.	Understand	CO 2	AEE011.07
13	A 50Hz transmission line 300 km long total series impedance of 40+j25 Ω and total shunt admittance of 10-3 mho. The 220 KV with 0.8 lagging power factor. Find the sending end voltage, current, power and power factor using nominal-pi method.	Understand	CO 2	AEE011.07
UNIT-III				
OVERHEAD INSULATORS AND UNDERGROUND CABLES				
Part - A (Short Answer Questions)				
1	Classify different of overhead and underground insulators	Remember	CO 3	AEE011.09
2	What are the various types of insulators?	Remember	CO 3	AEE011.09
3	Define string efficiency	Understand	CO 3	AEE011.10
4	What are the various methods to improve string efficiency?	Remember	CO 3	AEE011.10
5	What are the various tests conducted on insulators?	Remember	CO 3	AEE011.09
6	What is insulation failure?	Remember	CO 3	AEE011.09
7	Define impulse ratio.	Understand	CO 3	AEE011.09
8	Write short notes on puncture test.	Understand	CO 3	AEE011.09
9	What is the purpose of insulator?	Understand	CO 3	AEE011.09
10	What are the practical difficulties in grading?	Understand	CO 3	AEE011.11
11	What is the need of guard ring?	Understand	CO 3	AEE011.11
12	What is the purpose of using inter sheath in a cable?	Understand	CO 3	AEE011.11
13	A 3- core cable gives on test a capacitance measurement of 2μF between two cores find the line charging current of the cable when it is connected to 11kv,50Hz supply system.	Understand	CO 3	AEE011.11
14	A single-core cable has a conductor diameter of 1cm and insulation thickness of 0·4 cm. If the specific resistance of insulation is 5×10^{14} Ω-cm, calculate the insulation resistance for a 2 km length of the cable.	Understand	CO 3	AEE011.11
15	What is meant by serving of a cable?	Understand	CO 3	AEE011.11
16	In what way AI sheaths are superior to lead sheaths?	Understand	CO 3	AEE011.11
17	Mention the advantages of PVC over paper insulated cables.	Understand	CO 3	AEE011.11
18	Where CSA sheath is used in cables? Why is it used?	Understand	CO 3	AEE011.11
19	Compare the merits and demerits of underground system versus overhead system.	Understand	CO 3	AEE011.11
20	What is the main purpose of Armouring?	Understand	CO 3	AEE011.11
21	What is the function of sheath in a cable?	Understand	CO 3	AEE011.11
22	State the properties of insulating materials.	Understand	CO 3	AEE011.11
23	Mention the commonly used power cables.	Understand	CO 3	AEE011.11
24	Why protective covering is done in cables?	Understand	CO 3	AEE011.11
Part – B (Long Answer Questions)				
1	A string of 6 insulator units has a self-capacitance equal to 10 times the pin to earth capacitance. Find voltage distribution across various units as a percentage of total voltage across the string.	Understand	CO 3	AEE011.10

2	Explain various methods for equalizing the potential across the various units in an insulator string.	Understand	CO 3	AEE011.10
3	Discuss various methods for improving the string efficiency in a string of insulators.	Understand	CO 3	AEE011.10
4	Show that in a string of suspension insulators, the disc nearest to the conductor has the highest voltage across it.	Understand	CO 3	AEE011.10
5	Give the reasons : (i) It is necessary to use high voltage for transmission systems (ii) At 400 kV and above the transmission lines have bundled conductors (iii) Corona loss is more in stormy weather than during fair weather	Understand	CO 3	AEE011.12
6	Derive an expression for stress at the sheath in insulator.	Understand	CO 3	AEE011.11
7	Derive an expression for capacitance grading in cable.	Understand	CO 3	AEE011.11
8	Comment on power factor in cables.	Understand	CO 3	AEE011.11
9	Discuss various problems in laying cable.	Understand	CO 3	AEE011.11
10	State the classification of cables and discuss their general construction.	Understand	CO 3	AEE011.11
11	Write a short note on pressure cables.	Understand	CO 3	AEE011.11
12	Explain why the potential distribution is not in general uniform over the string of suspension type insulators?	Understand	CO 3	AEE011.11
13	State the classification of cables (according to voltage) and discuss their general construction.	Understand	CO 3	AEE011.11
14	Calculate the capacitance of the cable of 100KM long with internal and external radii 0.5 & 1.0cm. Given relative permittivity of the material is 3.	Understand	CO 3	AEE011.11
15	What is meant by capacitance grading of a cable? Derive expression for capacitance and maximum potential gradients in two (or more) dielectrics of a graded cable in terms of dielectric constants and radius of core and overall radius etc.	Understand	CO 3	AEE011.11
16	Derive the expression for insulator resistance, capacitance and electric stress in a single core cable. Where is the stress maximum and minimum?	Understand	CO 3	AEE011.11
17	Describe with the neat sketch, the construction of a 3 core belted type cable.	Understand	CO 3	AEE011.11
18	Briefly explain about various types of cables used in underground system.	Understand	CO 3	AEE011.11
19	Explain the constructional features of one LT and HT cable.	Understand	CO 3	AEE011.11
20	Compare and contrast overhead lines and underground cables.	Understand	CO 3	AEE011.11
	Part - C (Analytical Questions)			
1	In a 33 kV overhead line, there are three units in the string of insulators. If the capacitance between each insulator pin and earth is 11% of self-capacitance of each insulator, find (i) the distribution of voltage over 3 insulators and (ii) string efficiency.	Understand	CO 3	AEE011.10
2	Each line of a 3-phase system is suspended by a string of 3 similar insulators. If the voltage across the line unit is 17·5 kV, calculate the line to neutral voltage. Assume that the shunt capacitance between each insulator and earth is 1/8th of the capacitance of the insulator itself. Also find the string efficiency.	Understand	CO 3	AEE011.10

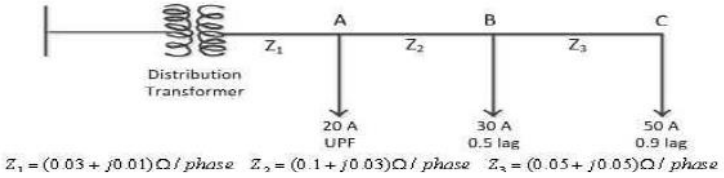
3	The three bus-bar conductors in an outdoor substation are supported by units of post type insulators. Each unit consists of a stack of 3 pin type insulators fixed one on the top of the other. The voltage across the lowest insulator is 13·1 kV and that across the next unit is 11 kV. Find the bus-bar voltage of the station.	Understand	CO 3	AEE011.10
4	A string of 5 insulators is connected across a 100 kV line. If the capacitance of each disc to earth is 0·1 of the capacitance of the insulator, calculate (i) the distribution of voltage on the insulator discs and (ii) the string efficiency.	Understand	CO 3	AEE011.10
5	Each line of a 3-phase system is suspended by a string of 3 identical insulators of self-capacitance C farad. The shunt capacitance of connecting metal work of each insulator is 0·2 C to earth and 0·1 C to line. Calculate the string efficiency of the system if a guard ring increases the capacitance to the line of metal work of the lowest insulator to 0·3 C.	Understand	CO 3	AEE011.10
6	A string of 6 suspension type insulators is to be graded to obtain uniform distribution of voltage across the string. If the pin- to earth capacitances are all equal to C and the mutual capacitance of the top insulator is 10 C find the mutual capacitance of each unit in terms of C.	Understand	CO 3	AEE011.10
7	In a 5 insulator disc string capacitance between each unit and earth is 1/6 of the mutual capacitance. Find the voltage distribution across each insulator in the string as %age of the voltage of the conductor to earth. Find the string efficiency. How is this efficiency affected by rain.	Understand	CO 3	AEE011.10
8	An overhead transmission line at a river crossing is supported from two towers at heights of 25 meters and 75 meters above water level. His horizontal distance between the towers is 250 meters. If the requires clearance between the conductors and the water midway between the towers is 45 meters and if both the towers are on the same side of the point of maximum sag of the parabola configuration find, the stringing tension in the conductor. The weight of the conductor is 0.70 kg/metre Also find the span allowable for the same sag if the supports were level.	Understand	CO 3	AEE011.10
9	A transmission conductor is suspended by a string of 3 similar units; the self capacitance of each unit is C farad and the mutual capacitance is 0.1C farad. Determine the voltage distribution across the string if the maximum voltage per unit is 20KV hence determine the string efficiency?	Understand	CO 3	AEE011.11
10	Write a short note on different types of insulators used for overhead lines and their applications.	Understand	CO 3	AEE011.11
11	Find the voltage across each unit of an overhead line suspension insulator string consisting of similar units if the voltage between the line conductor and earth is 60 kV and the ratio of the capacitance of each insulator unit to the capacitance relative to earth of each intermediate section of the connecting network is 10:1. Assume no leakage takes place. Also calculate the string efficiency.	Understand	CO 3	AEE011.11
12	A string of 5 suspension insulators is to be graded for obtaining uniform voltage distribution across the string. If the pin to earth capacitances are all equal to “C” and the mutual capacitance of the top insulator is 10C, find the mutual capacitance of each unit in terms of C.	Understand	CO 3	AEE011.11

13	Calculate the insulation resistance for 5km length of a 1-core cable. Resistance of insulation(impregnated paper) is 5×10^{14} ohm-cm, insulation thickness is 1 cm and radius of conductor is 1.25 cm.	Understand	CO 3	AEE011.11
14	The capacitances of a 3-phase belted cable are 12·6 μF between the three cores bunched together and the lead sheath and 7·4 μF between one core and the other two connected to sheath. Find the charging current drawn by the cable when connected to 66 kV, 50 Hz supply.	Understand	CO 3	AEE011.11
15	Calculate the capacitance and charging current of a single core cable used on a 3-phase, 66 kV system. The cable is 1 km long having a core diameter of 10 cm and an impregnated paper insulation of thickness 7 cm. The relative permittivity of the insulation may be taken as 4 and the supply at 50 Hz.	Understand	CO 3	AEE011.11
16	A single core lead sheathed cable has a conductor diameter of 3 cm; the diameter of the cable being 9 cm. The cable is graded by using two dielectrics of relative permittivity 5 and 4 respectively with corresponding safe working stresses of 30 kV/cm and 20 kV/cm. Calculate the radial thickness of each insulation and the safe working voltage of the cable.	Understand	CO 3	AEE011.11
17	A single core cable has a conductor diameter of 1 cm and internal sheath diameter of 1·8 cm. If impregnated paper of relative permittivity 4 is used as the insulation, calculate the capacitance for 1 7km length of the cable.	Understand	CO 3	AEE011.11
18	A 33 kV single core cable has a conductor diameter of 1 cm and a sheath of inside diameter 4 cm. Find the maximum and minimum stress in the insulation.	Understand	CO 3	AEE011.11
19	Find the most economical value of diameter of a single-core cable to be used on 50 kV, single-phase system. The maximum permissible stress in the dielectric is not to exceed 40 kV/cm.	Understand	CO 3	AEE011.11
20	A single core cable has a conductor diameter of 2.5 cm and a sheath of inside diameter of 6 cm. calculates the maximum stress. It is desired to reduce the maximum stress by using two inter sheaths. Determine their best position, the maximum stress and the voltage on each; system voltage is 3 phase 66kv.	Understand	CO 3	AEE011.11
UNIT-IV				
MECHANICAL DESIGN OF TRANSMISSION LINES				
Part – A (Short Answer Questions)				
1	Define sag of a line.	Understand	CO 4	AEE011.12
2	Mention the factors that affect sag in the transmission line.	Remember	CO 4	AEE011.13
3	What is the reason for the sag in the transmission line?	Remember	CO 4	AEE011.12
4	What is sag template.	Remember	CO 4	AEE011.13
5	What is deviation tower.	Remember	CO 4	AEE011.12
6	Name two factors effecting sag.	Remember	CO 4	AEE011.13
7	What is meant by tower spotting?	Understand	CO 4	AEE011.12
8	What is meant by stringing chart?	Understand	CO 4	AEE011.13
9	Give the significance of stringing chart.	Understand	CO 4	AEE011.13
10	Define conductor tension.	Remember	CO 4	AEE011.12
11	Define safety factor.	Remember	CO 4	AEE011.13
12	Describe the effect of wind and ice loading in overhead line.	Understand	CO 4	AEE011.13
13	Define length of span in over head lines.	Remember	CO 4	AEE011.12
14	Describe about Tower height.	Understand	CO 4	AEE011.12

15	State the shape of sag for river crossing over head lines.	Remember	CO 4	AEE011.12
Part – B (Long Answer Questions)				
1	Show how the sag of an overhead line can be calculated in case of supports at different levels.	Understand	CO 4	AEE011.12
2	Show how the sag of an overhead line can be calculated in case of supports at same level	Understand	CO 4	AEE011.12
3	An overhead transmission line has a span of 220meters,the conductor weighing 604kg/km. Calculate the maximum sag if the ultimate tensile strength of conductor is 5758kg.Assume a factor of safety=2.	Understand	CO 4	AEE011.12
4	Show how the effect of wind and ice loading are taken into account while determining the sag of an overhead line conductor.	Understand	CO 4	AEE011.13
5	Write a note on stringing charts and sag template.	Understand	CO 4	AEE011.13
6	Derive expressions for sag and tension in a power conductor strung between to supports at equal heights taking into account the wind and ice loading also.	Understand	CO 4	AEE011.13
7	Derive the expressions for sag and conductor length under bad weather conditions. Assume Shape of overhead line is a parabola.	Understand	CO 4	AEE011.13
8	Show how the sag of an overhead line can be calculated in case of supports at different level.	Understand	CO 4	AEE011.12
9	Explain the necessity of stinging chart for a transmission line and show how chart can be constructed.	Understand	CO 4	AEE011.13
10	Describe about the use of stringing chart in the case of overhead lines.	Understand	CO 4	AEE011.12
11	Describe about the conductor vibration in the case of transmission lines.	Understand	CO 4	AEE011.13
12	Describe in detail about the Tower height for transmission lines.	Remember	CO 4	AEE011.12
13	Explain about the slant sag and vertical sag in overhead lines.	Understand	CO 4	AEE011.12
Part - C (Analytical Questions)				
1	A 132 kV transmission line has the following data : Wt. of conductor = 680 kg/km ; Length of span = 260 m Ultimate strength = 3100 kg ; Safety factor = 2. Calculate the height above ground at which the conductor should be supported. Ground clearance required is 10 metres.	Understand	CO 4	AEE011.12
2	A transmission line has a span of 200 metres between level supports. The conductor has a cross-sectional area of 1·29 cm^2, weighs 1170 kg/km and has a breaking stress of 4218 kg/cm^2. Calculate the sag for a safety factor of 5, allowing a wind pressure of 122 kg per square metre of projected area. What is the vertical sag?	Understand	CO 4	AEE011.13
3	A transmission line has a span of 275 m between level supports. The conductor has an effective diameter of 1·96 cm and weighs 0·865 kg/m. Its ultimate strength is 8060 kg. If the conductor has ice coating of radial thickness 1·27 cm and is subjected to a wind pressure of 3·9 gm/ cm^2 of projected area, calculate sag for a safety factor of 2. Weight of 1 c.c. of ice is 0·91 gm.	Understand	CO 4	AEE011.13
4	A transmission line has a span of 275 m between level supports. The conductor has an effective diameter of 1·96 cm and weighs 0·865 kg/m. Its ultimate strength is 8060 kg. If the conductor has ice coating of radial thickness 1·27 cm and is subjected to a wind pressure of 3·9 gm/ cm2 of projected area, calculate sag for a safety factor of 2. Weight of 1 c.c. of ice is 0·91 gm.	Understand	CO 4	AEE011.13

5	An overhead line has a span of 150 m between level supports. The conductor has a cross-sectional area of 2 cm^2. The ultimate strength is 5000 kg/cm^2 and safety factor is 5. The specific gravity of the material is 8·9 gm/cc. The wind pressure is 1·5 kg/m. Calculate the height of the conductor above the ground level at which it should be supported if a minimum clearance of 7 m is to be left between the ground and the conductor.	Understand	CO 4	AEE011.13
6	A 132-Kv transmission line uses A.C.S.R conductors whose data are: Nominal copper area 110 mm^2, size 30+7/2.79 mm, weight 844 kg/Km: ultimate strength 7950 Kg.Calculate the height above ground at which the conductors with a span of 300 meters should be supported the factor of safety being 2. Wind pressure 75 Kg/m^2 of projected area. Ground clearance required is 7 meters	Understand	CO 4	AEE011.13
7	Calculate maximum sag(total and vertical) of a line with the copper conductor 7/0.295 cm size, area 0.484 sq.cm . Overall dia.0.889 cm, weight 428 kg/km and breaking strength 1093 kg. Assume factor of safety 2,. Span 200 meters, level supports- (i) Due to weight of the conductor (ii) Due to additional weight of ice loading of 1 cm thickness (iii) Due to both (i) and (ii) plus wind acting horizontally at a pressure of 39 Kg per sq metre	Understand	CO 4	AEE011.12
8	An overhead transmission line at a river crossing is supported from two towers at heights of 25 meters and 75 meters above water level. His horizontal distance between the towers is 250 meters. If the requires clearance between the conductors and the water midway between the towers is 45 meters and if both the towers are on the same side of the point of maximum sag of the parabola configuration find, the stringing tension in the conductor. The weight of the conductor is 0.70 kg/metre Also find the span allowable for the same sag if the supports were level.	Understand	CO 4	AEE011.12
9	An overhead transmission line conductor having parabolic configuration weight 1.925 kg per meter length cross section of 2.2cm^2 and ultimate strength of 8000 Kg per cm^2 when erected between supports of 600 metres apart and having 5 meters distance in height determine the vertical sag from the taller of the two supports which must be allowed so that the factor safety shall be 5 with the wire loaded due to 1 Kg of ice per meter of no wind pressure	Understand	CO 4	AEE011.13
10	A transmission line conductor at river crossing is supported from two towers at heights of 50 metres and 80 meters above water levels. The horizontal distance between the towers is 300 meter. If the tension in the conductor is 2000 kg, find the clearance between the conductors and water level at a point between the towers. Weight of conductor per meter= 0.844 kg. Assume that the conductor takes the shape of parabola.	Understand	CO 4	AEE011.12
UNIT-V				
DISTRIBUTION SYSTEMS				
Part - A (Short Answer Questions)				
1	What is a distribution system?	Remember	CO 5	AEE011.14
2	Give classification of distribution system.	Remember	CO 5	AEE011.14
3	Draw the circuit of a dc 3wire system.	Understand	CO 5	AEE011.14

4	What is concentrated load?	Remember	CO 5	AEE011.14
5	Draw a radial distribution system.	Remember	CO 5	AEE011.14
6	List various AC distribution systems	Remember	CO 5	AEE011.14
7	Distinguish a feeder and a service main in a distribution scheme.	Understand	CO 5	AEE011.14
8	What is dc distributor with distributed load fed at one end?	Understand	CO 5	AEE011.14
9	Draw a typical distribution system	Remember	CO 5	AEE011.14
10	Give two differences between ring and radial main systems.	Remember	CO 5	AEE011.14
11	Draw neat sketches radial type and loop type sub transmission systems.	Remember	CO 5	AEE011.14
12	Define the terms feeder and Distributor	Remember	CO 5	AEE011.14
13	Draw the neat sketch of ring main distribution system.	Remember	CO 5	AEE011.14
14	What are the advantages and disadvantages of ring bus scheme?	Remember	CO 5	AEE011.14
15	Define substation.	Understand	CO 5	AEE011.16
16	Define voltage drop.	Understand	CO 5	AEE011.15
17	Discuss voltage drop for loads of different power factor.	Remember	CO 5	AEE011.15
18	Discuss the voltage drop for uniformly distributed load.	Remember	CO 5	AEE011.15
Part - B (Long Answer Questions)				
1	Prove that the voltage drop diagram for a uniformly loaded distributor fed at one end is a parabola.	Understand	CO 5	AEE011.15
2	Explain briefly the various system of AC distribution.	Understand	CO 5	AEE011.14
3	Explain how a two wire dc distributor with concentrated load fed at one end can be represented by a single line diagram.	Understand	CO 5	AEE011.14
4	Explain briefly radial and ring main system.	Understand	CO 5	AEE011.14
5	What are the important rules involved in calculation of AC distribution.	Understand	CO 5	AEE011.14
6	Discuss how voltage drop is calculated in a distribution system.	Understand	CO 5	AEE011.15
7	Compare overhead and underground distribution system.	Understand	CO 5	AEE011.14
8	Discuss the design features of distribution system.	Understand	CO 5	AEE011.14
9	Explain briefly the various system of DC distribution.	Understand	CO 5	AEE011.14
10	Compare overhead and underground distribution system.	Understand	CO 5	AEE011.14
11	Explain briefly about different types of DC distributors.	Understand	CO 5	AEE011.14
Part - C (Analytical Questions)				
1	A 3 wire dc system with 400 V between outer supplies lighting loads of 1200A and 1040A on the positive and negative sides and motor load of 400KW across the outers. Calculate the load on the main generators and on each of the balancer machine assuming that at this load each balancer machine has a loss of 6KW.	Understand	CO 5	AEE011.15
2	A electric train taking a constant current of 600A moves on a section of line between two substations 8km apart and maintained at 575 and 590v respectively. The track resistance is 0.04Ω/km both go and return. Find the point of minimum potential along the track and current supplied by two substations at that instant.	Understand	CO 5	AEE011.15

3	Consider a three phase, 3 wire 240V secondary with balanced loads at A,B and C as shown in figure determine: i. The voltage drop in one phase of lateral ii. The real power per phase for each load iii. The reactive power per phase for each load. 	Understand	Apply	AEE011.15
4	Consider a single-phase, 2-wire secondary distributor of length 'I' meters from the distribution transformer .At a length of 'I_1" meters from source, a load of I_1 amps with a p.f of cos φ_1 (lag) is tapped. At a length of 'I_2' amps with a power factor cos φ_2 (lead) is tapped. At a length of I_3 meters from second load, a third load of I_3 amps with a UPF is tapped. If resistance and reactance of each wire are r and x ohms/meter respectively, derive approximate voltage drop equation in the distributor.	Understand	CO 5	AEE011.15
5	A single phase feeder circuit has total impedance (2+j6) ohms, receiving end voltage is 11 kv and current is $40\angle -45^0$A. Determine i) P.f of load ii) Load p.f for which the drop is maximum iii) Load p.f for which impedance angle is maximum and also , derive the formula used	Understand	CO 5	AEE011.15
6	Electrical energy is supplied to a consumer from a substation at a distance of 250 m. If the power required by the consumer is three phase 100kw at 415 V unity power factor and resistance of single conductor of the connecting cable is 0.1/1000Ω/m. calculate, i) The voltage at the bus bar of the substation ii) The power loss in the cable.	Understand	CO 5	AEE011.15
7	A 3 phase radial express feeder has a line to line voltage of 22.0 kV at the receiving end, a total impedance of 5.25+J10. 95 Ω/ phase, and a load of 5MW with a logging power factor of 0.90. determine the following i)Line to neutral and line to line voltage at the sending end ii) Load angle	Understand	CO 5	AEE011.15
8	Distinguish between a feeder, distributor and service main in a distribution scheme. Show that with an increase in working voltage to n times the cross sections of a feeder and distributor would be reduced to 1/n and $1/n^2$ of their respective values.	Understand	CO 5	AEE011.15
9	Four lines A,B,C and D are connected to a common point O. Resistances of AO,BO,CO and DO are respectively 1,2,3 and 4 ohms(both go and return) and feeding points A,B,C and D are maintained at 230,250,240 and 220 volts respectively. Find the potential of common point O assuming no load to be tapped from	Understand	CO 5	AEE011.15
10	A 3- wire distributor 100 metres long and fed from one has a uniformly distributed load of 0,5 amp per metre on the positive side and 0.45 amp per metre on the negative side. The resistance of each outer is 0.0004ohm per metre and middle wire 0.0008 ohm per metre. Calculate the voltage at distant end of the distributor if 220 volts is maintained between outers and middle wire at the feeding end.	Understand	CO 5	AEE011.15

11	A 2 wire D.C distributor XY fed at end X is 500 metres long and has a resistance of 0.1 ohm per km (go and return). At A,100 metres from X is load at 50A; at B,200 metres further from point A there is load of 0.5 amp/metre. Find the position of C so that maximum drop any consumer does not exceed 4 volts.	Understand	CO 5	AEE011.15

Prepared by:
Ms. T Saritha Kumari, Assistant Professor

HOD, EEE