



# MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)  
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.



**MUST KNOW CONCEPTS**

**MKC**

**ECE**

**2021-22**

**Course Code & Course Name : 19ECC01& ELECTRIC NETWORK ANALYSIS AND MACHINES**  
**Year/Sem/Sec : II/III/A,B,C**

S.No.	Term	Notation (Symbol)	Concept / Definition / Meaning / Units / Equation / Expression	Units
<b>Unit-I : THEOREMS AND DC TRANSIENT ANALYSIS</b>				
1.	Kirchhoff's current law	-	Kirchhoff's current law says the currents flowing into a node must add up to zero.	-
2.	Kirchhoff's voltage law	-	The algebraic sum of all voltages within the loop must be equal to zero.	-
3.	Ohm's law	$R=V/I$	The current through conductor between two points is directly proportional to the voltage across the two points.	Ohms
4.	Nodal analysis	-	It is using the nodal equations of Kirchhoff's first law to find the voltage potentials around the circuit.	-
5.	Mesh analysis	-	It is used to find the currents circulating around a loop or mesh with in any closed path of a circuit.	-
6.	Superposition theorem	-	In any linear, active, bilateral network having more than one source, the response across any element is the sum of the responses obtained from each source considered separately and all other sources are replaced by their internal resistance.	-
7.	Thevenin's Theorem	-	Any linear circuit containing several voltages and resistances can be replaced by just one single voltage in series with a single resistance connected across the load.	-
8.	Norton's Theorem	-	Any linear circuit containing several energy sources and resistances can be replaced by a	-

			single Constant Current generator in parallel with a Single Resistor.	
9.	Maximum power transfer theorem	-	The maximum amount of power will be dissipated in the load resistance if it is equal in value to the Thevenin or Norton source resistance of the network supplying the power.	-
10.	Reciprocity theorem	-	The deflection at point 1 in a given direction due to a unit load at point 2 in a second direction is equal to the deflection at point 2 in the second direction due to a unit load at point 1 in the first direction.	-
11.	Tellegen's Theorem	-	Tellegen's Theorem states that, the summation of power delivered is zero for each branch of any electrical network at any instant of time.	-
12.	Compensation Theorem	-	Any resistance in a network may be replaced by a voltage source that has zero internal resistance and a voltage equal to the voltage drop across the replace resistance due to the current which was flowing through it.	-
13.	Millman's theorem	-	Millman's theorem is used to compute the voltage at the ends of a circuit made up of only branches in parallel.	-
14.	RC circuit	-	It is an electric circuit composed of resistors and capacitors driven by a voltage or current source.	-
15.	RL circuit	-	It is an electric circuit composed of resistors and inductors driven by a voltage or current source.	-
16.	source-free RC circuit	-	A source-free RC circuit occurs when its DC source is suddenly disconnected. The energy already stored in the capacitor is released to the resistor & dissipated. This is a first-order differential equation.	-
17.	source-free RL circuit	-	A source-free circuit is where all independent sources have been disconnected	-

			from the circuit after some switch action. The voltages and currents in the circuit typically will have some transient response due to initial conditions	
18.	Step function	-	A function on the real numbers is called a step function (or staircase function) if it can be written as a finite linear combination of indicator functions of intervals.	-
19.	Forced response	-	The forced response is what the circuit does with the sources turned on but with the initial conditions set to zero.	-
20.	Natural response	-	The natural response is what the circuit does including the initial conditions, but with the input suppressed.	-
21.	Damped circuit	-	An RLC circuit is an electrical circuit consisting of a resistor (R), an inductor (L), and a capacitor (C), connected in series or in parallel.	-
22.	Underdamped circuit	-	An underdamped response is one that oscillates within a decaying envelope.	-
23.	Open circuit	-	An open circuit implies that the two terminals are points are externally disconnected, which is equivalent to a resistance $R=\infty$ .	-
24.	Shot circuit	-	This means that zero current can flow between the two terminals, regardless of any voltage difference.	-
25.	RLC circuit	-	RLC circuit is an electrical circuit consisting of a resistor (R), an inductor (L), and a capacitor (C), connected in series or in parallel.	-
<b>Unit-II : SINUSOIDAL AND STEADY STATE POWER ANALYSIS</b>				
26.	Steady state	-	A steady-state is an unchanging condition, system or physical process that remains the same even after transformation or change.	-
27.	Active component	-	An active component is an electronic component which supplies energy to a circuit.	-

28.	Passive component	-	A passive element is an electrical component that does not generate power, but instead dissipates, stores, and/or releases it.	-
29.	Impedance	Z	The measure of the opposition of an electric current to the energy flow when voltage is applied.	-
30.	Admittance	Y	Admittance is the reciprocal of impedance, Z and is given the symbol Y.	-
31.	Network theorem	-	The current through, or voltage across, any element of a network is equal to the algebraic sum of the currents or voltages produced independently by each source.	-
32.	RMS value	-	The RMS value is the effective value of a varying voltage or current. It is the equivalent steady DC (constant) value which gives the same effect.	-
33.	Power	-	The source of energy used to operate a machine or other system.	-
34.	Power factor	-	Power factor is defined as the ratio of real power (P) to apparent power (S),	-
35.	Magnetically coupled circuit	-	Magnetically coupled circuit means that two loops, with or without contacts between them, affect each other through the magnetic field generated by one of them.	-
36.	Self inductance	-	Self-inductance of the coil is defined as the property of the coil due to which it opposes the change of current flowing through it.	-
37.	Mutual Inductance	-	Mutual Inductance is the interaction of one coil magnetic field on another coil as it induces a voltage in the adjacent coil.	-
38.	Minimum function	-	If degrees of numerator and denominator were unequal, a pole or zero can be removed. Such a function cannot be a minimum function.	-
39.	Phasor	-	Phasors are vector representation of sinusoidal signals. Phasors suppress the element of time.	-

			The length of the phasor or its magnitude is the amplitude or maximum value of the cosine function.	
40.	Coupled circuits	-	Coupled circuits is the form of multi-turn coils sharing a magnetic circuit, where the magnetic flux produced by the current in one coil not only links with its own winding, but also with those of the other coils.	-
41.	Forced response	-	Forced response is the system's response to an external stimulus with zero initial conditions.	-
42.	sinusoidal function	-	A sinusoidal function is a function that is like a sine function in the sense that the function can be produced by shifting, stretching or compressing the sine function.	-
43.	Steady state analysis	-	In the steady state, the charge (or current) flowing into any point in the circuit has to equal the charge (or current) flowing out.	-
44.	Parallel resonance	-	In a parallel resonant circuit, the circuit current at resonance is maximum.	-
45.	Response	-	The current flowing through or voltage across branches in the circuit is called response.	-
46.	Transient response	-	The voltage or current are changed from one transient state to another transient state is called transient response.	-
47.	Natural response	-	The response determined by the internal energy stored in the network is called natural response.	-
48.	Transient	-	The state (or condition) of the circuit from the transient of switching to attainment of steady state is called transient state or simply transient.	-
49.	Critical resistance	-	The critical resistance is the value of the resistance of the circuit to achieve critical damping.	-
50.	Time constant of RL circuit	-	The time constant of RL circuit is defined as the ratio of inductance and resistance of the circuit.	-

**Unit-III : APPLICATION OF LAPLACE TRANSFORM TO CIRCUIT ANALYSIS**

51.	Complex frequency.	-	A type of frequency that depends on two parameters, one is the $\sigma$ which controls the magnitude of the signal and the other is $w$ , which controls the rotation of the signal is known as "complex frequency".	-
52.	Laplace transform	-	Laplace transform is the integral transform of the given derivative function with real variable $t$ to convert into complex function with variable $s$ .	-
53.	Significant of Laplace transform		The Laplace transform is used for solving linear differential and integral equations.	
54.	Uses of Laplace transform	-	It is used for analysis of linear time-invariant systems such as electrical circuits, harmonic oscillators, optical devices, and mechanical systems.	-
55.	Inverse Laplace transform	-	A Laplace transform which is a constant multiplied by a function has an inverse of the constant multiplied by the inverse of the function.	-
56.	Properties of Laplace transform	-	1. Linearity Property. 2. Time Shifting Property 3. Frequency Shifting Property 4. Time Reversal Property. 5. Time Scaling Property.	-
57.	Damped sinusoid	-	Damped sinusoid is a sinusoidal function whose amplitude approaches zero as time increases.	-
58.	Frequency domain	-	Frequency-domain analysis is widely used in such areas as communications, geology, remote sensing, and image processing.	-
59.	Time-domain	-	A time-domain graph shows how a signal changes over time	-
60.	Frequency	-	Frequency is the number of occurrences of a repeating event per unit of time.	-
61.	the time-domain relation between the current in inductance	-	$v_L(t) = L \frac{di_L(t)}{dt}$	-

62.	the time-domain relation between the voltage $v_L(t)$ in inductance	-	$i_L(t) = \frac{1}{L} \int_{-\infty}^t v_L(t) dt$	-
63.	For capacitance, the time-domain relation between voltage	-	$i_c(t) = c \frac{dv_c(t)}{dt}$	-
64.	For capacitance, the time-domain relation between current	-	$v_c(t) = \frac{1}{C} \int_{-\infty}^t i_c(t) dt$	-
65.	root of the characteristic equation	-	$S_n = \sigma_n + j\omega_n$	-
66.	A Resistor in the s-Domain	-	$V = RI$	-
67.	An Inductor in the s-Domain	-	$V = L [SI - i(0)] = SLI - LI_0$	-
68.	A Capacitor in the s-domain	-	$I = SCV - CV_0$	-
69.	Transfer Admittance	-	It is defined as the ratio of current transform at one port to the voltage transform at the other port, and is denoted by $Y(s)$ .	-
70.	Transfer Impedance	-	It is defined as the ratio of voltage transform at one port to the current transform at the other port, and is denoted by $Z(s)$ .	-
71.	Current-Transfer Ratio	-	This is the ratio of current transform at one port to current transform at other port, and is denoted by $a(s)$ .	-

72.	Voltage transfer Ratio	-	$G_{21}(S) = \frac{V_2(S)}{V_1(S)}$ $V_2(S) = G_{21}(S) V_1(S)$	-
73.	Driving Point Admittance	-	$Y(S) = \frac{I(S)}{V(S)}$	-
74.	Driving Point Impedance	-	$Z(S) = \frac{V(S)}{I(S)}$	-
75.	Significance of poles and zeros	-	Poles and zeros are critical frequencies. At poles, the network function become infinite, while at zeros, the network function becomes zero	-

**Unit-IV : NETWORK TOPOLOGY AND TWO PORT NETWORK**

76.	Branch	-	A branch is represented by a line segment connecting a pair of nodes in the graph of a network.	-
77.	Node	-	A node is a terminal of a branch, which is represented by a point. Nodes are the end points of branches.	-
78.	Directed graph	-	If every branch of a graph has a direction	-
79.	Planar graph	-	A graph is said to be planar if it can be drawn on a plane surface such that no two branches cross each other	-
80.	Non-planar graph	-	There will be branches which are not in the same plane as others, i.e. a non-planar graph cannot be drawn on a plane surface without a crossover	-
81.	Tree	-	A tree is a connected subgraph of a network which consists of all the nodes of the original graph but no closed paths.	-
82.	Co-Tree	-	The set of all links of a given tree is called	-



			the co-tree of the graph.	
83.	Links	-	In forming a tree for a given graph, certain branches are removed or opened.  The branches thus opened are called links	-
84.	Twigs	-	The branches of a tree are called its twigs	-
85.	Rank of the tree	-	The number of twigs ( $n - 1$ ) is known as the tree value of the graph. It is also called the rank of the tree	-
86.	Loop	-	If a link is added to the tree, the resulting graph contains one closed path, called a loop.	-
87.	Incidence matrix	-	The incidence of elements to nodes in a connected graph is shown  by the element node incidence matrix	-
88.	Tie-set	-	The fundamental loop formed by one link has a unique path in the tree joining the two nodes of the link. This loop is also called f-loop or a tie-set	-
89.	A cut-set	-	A cut-set is a minimal set of branches of a connected graph such that the removal of these branches causes the graph to be cut into exactly two parts	-
90.	Port	-	A pair of terminals at which a signal may enter or leave a network is called a port.	-
91.	Two-port network	-	A two-port network is simply a network inside a black box, and the network has only two pairs of accessible terminals; usually one pair represents input and the other represents the output.	-
92.	Z-Parameters	-	Z-parameters of a two-port for the positive directions of voltages and currents may be defined by expressing the port voltages $V_1$ and $V_2$ in terms of  the currents $I_1$ and $I_2$	-

93.	Open-circuit output impedance	-	$Z_{22} = \frac{V_2}{I_2} \Big _{I_1=0}$	-
94.	Y-parameters	-	The Y-parameters of a two-port network for the positive directions of voltages and currents may be defined by expressing the port currents I1 and I2 in terms of the voltages V1 and V2.	-
95.	Short-circuit input admittance.	-	$Y_{21} = \frac{I_2}{V_1} \Big _{V_2=0}$	-
96.	Short-circuited forward transfer admittance	-	$Y_{12} = \frac{I_1}{V_2} \Big _{V_1=0}$	-
97.	Short-circuit reverse transfer admittance	-	$Y_{22} = \frac{I_2}{V_2} \Big _{V_1=0}$	-
98.	Transmission parameters	-	$V_1 = AV_2 - BI_2$ $I_1 = CV_2 - DI_2$	-
99.	Quality factor	-	$Q = 2\pi \times \frac{\text{maximum energy stored}}{\text{energy dissipated per cycle}}$	-
100.	Resonant frequency	-	The frequency at which the resonance occurs is called the resonant frequency	-
<b>Unit-V : ELECTRIC MACHINES</b>				
101.	Three basic rotating machines types	-	1.The dc machines 2.the poly phase synchronous machine (ac), and 3. Poly and single phase induction machine (ac)	-

102.	Leakage flux	-	The flux setup in the air paths around the magnetic material is known as leakage flux.	-
103.	Fringing	-	In the air gap the magnetic flux fringes out into neighboring air paths due to the reluctance of air gap which causes a non uniform flux density in the air gap of a machine. This effect is called fringing effect.	-
104.	Magnetic materials	-	Alnicos, chromium steels, copper-nickel alloy, nickel, cobalt, tungsten and aluminum.	-
105.	Statically induced emf	-	The coil remains stationary with respect to flux, but the flux through it changes with time. The emf induced is known as statically induced emf.	-
106.	Dynamically induced emf	-	Flux density distribution remains constant and stationary but the coil moves relative to it. The emf induced is known as dynamically induced emf	-
107.	Fleming's right hand rule.	-	If the thumb represents the direction of movement of conductor and the fore finger the direction of magnetic flux, then the middle finger represents the direction of emf	-
108.	Fleming's Left hand rule	-	If the forefinger represents the direction of flux and the middle finger the direction of current, then the middle finger represents the direction of movement of conductor.	-
109.	Type of losses	-	Hysteresis loss, core loss and eddy current loss.	-
110.	Applications of DC series motor	-	Electric traction, Mixes Hoists, Drilling machines	-
111.	Different types of starters	-	1. Three-point starter 2. Four-point starter.	-
112.	Protective devices in a starter	-	1, No volt release 2. Overload Release.	-

113.	Various torque operations	-	1. DC series motor 2. DC cumulatively compound motor	-
114.	Speed regulation.	-	% Speed regulation= (NL speed- FL speed) X100/ FL speed	-
115.	Performance curves	-	Output Vs torque, Output Vs current, Output Vs speed, Output Vs efficiency.	-
116.	Applications of speed.	-	Used where regulated speed control is required in applications such as metering pumps and industrial process equipment.	-
117.	Alternators classified	-	According to type of field system <ul style="list-style-type: none"> <li>• Stationary field system type</li> <li>• Rotating field system type According to shape of field system</li> <li>• Salient pole type</li> <li>• Smooth cylindrical type</li> </ul>	-
118.	Types of Alternator	-	<ul style="list-style-type: none"> <li>• Smooth cylindrical type alternator</li> <li>• Salient pole alternator</li> </ul>	-
119.	Formula for distribution factor	-	$m$ =number of slots/ pole/ phase $n$ = order of harmonic	-
120.	Winding factor	-	The winding factor $K_d$ is defined as the ratio of phasor addition of emf induced in all the coils belonging to each phase winding to their arithmetic addition.	-
121.	Armature reaction in Alternators	-	The interaction between flux set up by the current carrying armature and the main is defined as the armature reaction	-
122.	Voltage regulation of an Alternator by MMF method	-	<ul style="list-style-type: none"> <li>• Effective resistance per phase of the 3-phase winding <math>R</math></li> <li>• Open circuit characteristic (OCC) at rated</li> </ul>	-

			speed/frequency <ul style="list-style-type: none"> <li>• Short circuit characteristic (SCC) at rated speed/frequency</li> </ul>	
123.	Characteristic features of synchronous motor	-	<ol style="list-style-type: none"> <li>1. the motor is not inherently self-starting</li> <li>2. The speed of operation is always in synchronous with the supply frequency irrespective of load conditions</li> <li>3. The motor is capable of operating at any power factor.</li> </ol>	-
124.	Synchronous motor	-	Synchronous motor operates due to magnetic locking taking place between stator and rotor magnetic fields	-
125.	Starting of Synchronous motor	-	<ul style="list-style-type: none"> <li>• By an extra 3 phase cage induction motor</li> <li>• By providing damper winding in pole phases</li> <li>• By operating the pilot excitor as a dc motor</li> </ul>	-
<b>Placement Questions</b>				
126.	Current divider rule	-	Current divider rule provides a useful real relationship for determine the current through individual circuit elements that are connected in parallel	-
127.	Ideal voltage source	-	A device with zero internal resistance.	-
128.	Ideal current source	-	A device with infinite internal resistance.	-
129.	Practical voltage source	-	A device with small internal resistance.	-
130.	Practical current source	-	A device with large internal resistance.	-
131.	Voltage divider rule	-	Voltage divider rule provides a useful formula to determine the voltage across any resistor when two or more resistors are connected in series with a voltage source	-
132.	Circuit	-	The path between two points along which an	

			electrical current can be carried is called circuit	-
133.	Current	-	Current can be defined as the motion of charge through a conducting material.	Ampere
134.	Inductor	-	An inductor is a passive electrical device employed in electrical circuits for its property of inductance.	-
135.	Capacitor	-	A capacitor is an electrical device that can store energy in electric fields between a pair of conductors	-
136.	Super node	-	A super node exists when an ideal voltage source appears between any two nodes of an electric circuit.	-
137.	Corkscrew rule	-	A current flow a wire, the magnetic field rotates in the direction of a corkscrew	-
138.	Transient	-	The state (or condition) of the circuit from the transient of switching to attainment of steady state is called transient state or simply transient.	-
139.	Critical damping	-	The critical damping is the condition of the circuit at which the oscillations in the response are just eliminated. This is possible by increasing the value of resistance in the circuit.	-
140.	Damping ratio	-	The ratio of resistance of the circuit and resistance for critical damping is called damping ratio.	-
141.	Train problem	-	<p>A train running at the speed of 60 km/hr crosses a pole in 9 seconds. What is the length of the train?</p> <p>A)120 meters  B)180 meters  C)324 meters  D)150 meters</p> <p>Ans: D)150 meters</p>	-
142.	Time and work	-	A can do a work in 15 days and B in 20 days. If they work on it together for 4 days, then the	

			fraction of the work that is left is :	-
			Ans: 8/15	
143.	Probability	-	Tickets numbered 1 to 20 are mixed up and then a ticket is drawn at random. What is the probability that the ticket drawn has a number which is a multiple of 3 or 5?	-
			Ans: 9/20	
144.	Boat and stream	-	A boat can travel with a speed of 13 km/hr in still water. If the speed of the stream is 4 km/hr, find the time taken by the boat to go 68 km downstream.	-
			Ans: 4hours	
145.	Simple interest	-	A sum of money at simple interest amounts to Rs. 815 in 3 years and to Rs. 854 in 4 years. The sum is:	-
			Ans: Rs.698	
146.	Ratio and proportions	-	A and B together have Rs. 1210. If $\frac{4}{15}$ of A's amount is equal to $\frac{2}{5}$ of B's amount, how much amount does B have?	-
			Ans: Rs.484	
147.	Profit and loss	-	Alfred buys an old scooter for Rs. 4700 and spends Rs. 800 on its repairs. If he sells the scooter for Rs. 5800, his gain percent is:	-
			Ans: 5(5/11) %	
148.	Height and distance	-	Two ships are sailing in the sea on the two sides of a lighthouse. The angle of elevation of the top of the lighthouse is observed from the ships are 30° and 45° respectively. If the lighthouse is 100 m high, the distance between the two ships is:	-
			Ans: 273m	

149.	Average problem	-	In the first 10 overs of a cricket game, the run rate was only 3.2. What should be the run rate in the remaining 40 overs to reach the target of 282 runs?  Ans: 6.25	-
150.	Partnership	-	A and B invest in a business in the ratio 3 : 2. If 5% of the total profit goes to charity and A's share is Rs. 855, the total profit is:  Ans: Rs. 1500	-

**Faculty Team Prepared**

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**Signatures**

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