ELEC2222 – Circuits and Transmission useful formulae to remember - Ricki Tura rst1g15

Section	***Formula***	***Information***
Milos	$Z = R + jX$	Impedance with real resistance R, and imaginary reactance X. All quantities measured in Ohms.
	$Y = G + jB$	Admittance with real conductance G, and imaginary susceptance B. All quantities measured in Siemens or mhos.
	$\boldsymbol{A}^{-1} = \frac{adj\ \boldsymbol{A}}{\det \boldsymbol{A}} = \frac{adj\ \boldsymbol{A}}{\lvert\boldsymbol{A}\rvert}$	Inverse of a matrix, useful in nodal and mesh analysis.
	$Z_{AB} = Z_{AS} + Z_{BS} + \frac{Z_{AS}Z_{BS}}{Z_{CS}}$	Star to a Delta, also useful in James' section.
	$Z_{AS} = \frac{Z_{AB}Z_{CA}}{Z_{AB} + Z_{CA} + Z_{BC}}$	Delta to a Star, also useful in James' section.
	$Z_{I1} = \sqrt{Z_{oc1}Z_{sc1}}$	Finding the image impedance by experimentation.
	$Z_{I2} = \sqrt{Z_{oc2}Z_{sc2}}$	
	$Loss\ (dB) = 20\log_{10}\left(\frac{V'_1}{V_2}\right)$	Insertion loss in dB
	$\gamma = \ln\frac{I_1}{I_2} = \ln\frac{V_1}{V_2} = ke^{j\beta} = \ln k + j\beta$	Propagation coefficient.
	$\gamma = \cosh^{-1}(A) = \ln\left(A + \sqrt{A^2 - 1}\right)$	Propagation coefficient from *ABCD* parameters. $\gamma = \cosh^{-1}(A)$ is provided on the formula sheet.
Sasan	$Z_0 = \sqrt{\frac{R + j\omega L}{G + j\omega C}} = \sqrt{\frac{L}{C}}$	Characteristic impedance of a lossy and lossless case.
	$v_p = \frac{1}{\sqrt{LC}}$	Phase velocity from *L* and *C*.
	$V(z) = V_0^+\left(e^{-j\beta z} + \Gamma e^{+j\beta z}\right)$	Voltage and current from the reflection coefficient and the imaginary value of the propagation coefficient. Useful in finding Z_0.
	$I(z) = \frac{V_0^+\left(e^{-j\beta z} - \Gamma e^{+j\beta z}\right)}{Z_0}$	
	$(r\angle\theta)^n = r^n\angle n\theta$	DeMoivre's Theorem for rooting complex numbers.
	$\ln(z) = ln\lvert z\rvert + j\angle z$	Natural log and normal log of a complex number.

James	$\mathrm{V} = \sqrt{a^2 + b^2}, \phi = \tan^{-1}\left(\frac{b}{a}\right)$	Finding the magnitude and angle.
	$A\angle B \times C\angle D = (A \times C)\angle(B + D)$	Multiplying phasors.
	$A\angle B \ \div \ C\angle D = (A \div C)\angle(B - D)$	Dividing phasors.
	$P = \ V_{RMS}I_{RMS}\cos(\phi)$	Real power.
	$Q = \ V_{RMS}I_{RMS}\sin(\phi)$	Reactive power.
	$S = V_{RMS}I_{RMS}$	Apparent power.
	$Power\ factor = \cos(\phi) = \frac{P}{S}$	The ratio of the real power that is used to do work and the apparent power that is supplied.
	$S^2 = P^2 + Q^2$	
	$P = \sqrt{3}V_L I_L \cos(\phi)$ $Q = \sqrt{3}V_L I_L \sin(\phi)$	The power in a balanced 3-phase system. This considers the 3 generators, and applies to both star-star and star-delta systems.
	$Z = A\angle B\ then\ Y = A^{-1}\angle - B$	Converting complex impedance to admittance.
	$a = \cos(120°) + j\sin(120°)$ $a = -\frac{1}{2} + j\frac{\sqrt{3}}{2}$	The '*a*' operator. Multiplying a vector by *a* corresponds to rotating the vector 120° counter clockwise.
	$\begin{pmatrix} V_{A0} \\ V_{A1} \\ V_{A2} \end{pmatrix} = \frac{1}{3}\begin{pmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{pmatrix}\begin{pmatrix} V_A \\ V_B \\ V_C \end{pmatrix}$	Very important for the sequence questions. The inverse can be found using the equation below.
	$\frac{1}{3}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix}^{-1} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix}$	Used to go from the sequence components to the actual voltages.
	$I_{A0}, I_{B0}, and\ I_{C0} = \frac{I_A + I_B + I_C}{3}$ $I_N = I_A + I_B + I_C$ $\therefore I_N = I_{A0} \times 3$	Easy way to find the neutral current.