GEREKLİ OLABİLECEK FORMÜLLER:

Bu formül kağıdı temel formülleri içerir. Sınav sırasında tüm formülleri kullanmanız gerekmeyebilir.

$dA = r^2 \sin\theta \, d\theta \, d\phi$	$d\Omega = \sin\theta \, d\theta \, d\phi$	$G = \frac{4\pi U(\theta,\phi)}{P_{in}} = e_{cd}\left[\frac{4\pi U(\theta,\phi)}{P_{rad}}\right] = e_{cd} D(\theta,\phi)$
$U = r^2 W_{rad}$	$D = \frac{U}{U_0} = \frac{4\pi U}{P_{rad}} = \frac{4\pi}{\Omega_A}$	$Z_A = R_A + jX_A = (R_r + R_L) + jX_A$
$D_0 = \frac{4\pi}{\Omega_A} \simeq \frac{4\pi}{\Theta_{1r}\Theta_{2r}}$	$D_0 \simeq \frac{4\pi(180/\pi)^2}{\Theta_{1d}\Theta_{2d}} = \frac{41{,}253}{\Theta_{1d}\Theta_{2d}}$	
$P_{\text{rad}} = \oiint_{\Omega} U(\theta,\phi)\, d\Omega$	$P_{\text{rad}} = P_{\text{av}} = \oiint_S \mathbf{W}_{\text{rad}} \cdot d\mathbf{s} = \oiint_S \mathbf{W}_{\text{av}} \cdot \hat{\mathbf{n}}\, da$	
$\text{PLF} = \lvert \hat{\boldsymbol{\rho}}_w \cdot \hat{\boldsymbol{\rho}}_a \rvert^2$	$R_r = \frac{2P_{\text{rad}}}{\lvert I_0 \rvert^2}$	$A_{em} = \left(\frac{\lambda^2}{4\pi}\right) D_0$
$\mathbf{E}_a = \hat{\mathbf{a}}_\theta E_\theta + \hat{\mathbf{a}}_\phi E_\phi = -j\eta \frac{kI_{in}}{4\pi r} \ell_e e^{-jkr}$	$V_{oc} = \mathbf{E}^i \cdot \boldsymbol{\ell}_e$	$W_t = \frac{P_t G_t(\theta_t,\phi_t)}{4\pi R^2} = e_t \frac{P_t D_t(\theta_t,\phi_t)}{4\pi R^2}$
$\frac{P_r}{P_t} = \left(\frac{\lambda}{4\pi R}\right)^2 G_{0t} G_{0r} \lvert \hat{\boldsymbol{\rho}}_t \cdot \hat{\boldsymbol{\rho}}_r \rvert^2$	$\frac{P_r}{P_t} = e_{cdt} e_{cdr} (1 - \lvert\Gamma_t\rvert^2)(1 - \lvert\Gamma_r\rvert^2) \left(\frac{\lambda}{4\pi R}\right)^2 D_t(\theta_t,\phi_t) D_r(\theta_r,\phi_r) \lvert \hat{\boldsymbol{\rho}}_t \cdot \hat{\boldsymbol{\rho}}_r \rvert^2$	
$\frac{P_r}{P_t} = \sigma \frac{G_{0t} G_{0r}}{4\pi} \left[\frac{\lambda}{4\pi R_1 R_2}\right]^2 \lvert \hat{\boldsymbol{\rho}}_w \cdot \hat{\boldsymbol{\rho}}_r \rvert^2$	$\frac{P_r}{P_t} = e_{cdt} e_{cdr} (1 - \lvert\Gamma_t\rvert^2)(1 - \lvert\Gamma_r\rvert^2) \sigma \frac{D_t(\theta_t,\phi_t) D_r(\theta_r,\phi_r)}{4\pi} \times \left(\frac{\lambda}{4\pi R_1 R_2}\right)^2 \lvert \hat{\boldsymbol{\rho}}_w \cdot \hat{\boldsymbol{\rho}}_r \rvert^2$	
$\mathbf{A}(x,y,z) = \frac{\mu}{4\pi} \int_C \mathbf{I}_e(x',y',z') \frac{e^{-jkR}}{R} dl'$	$\mathbf{A} = \frac{\mu}{4\pi} \iiint_V \mathbf{J} \frac{e^{-jkR}}{R} dv'$	$\mathbf{F} = \frac{\epsilon}{4\pi} \int_C \mathbf{I}_m(x',y',z') \frac{e^{-jkR}}{R} dl'$
$\mathbf{F} = \frac{\epsilon}{4\pi} \iiint_V \mathbf{M} \frac{e^{-jkR}}{R} dv'$	$\mathbf{E}_A = -\nabla\phi_e - j\omega\mathbf{A} = -j\omega\mathbf{A} - j\frac{1}{\omega\mu\epsilon}\nabla(\nabla\cdot\mathbf{A})$	
$\mathbf{H}_F = -j\omega\mathbf{F} - \frac{j}{\omega\mu\epsilon}\nabla(\nabla\cdot\mathbf{F})$	$\int e^{\alpha x}\sin(\beta x + \gamma)\, dx = \frac{e^{\alpha x}}{\alpha^2 + \beta^2}[\alpha\sin(\beta x + \gamma) - \beta\cos(\beta x + \gamma)]$	
$\frac{W}{h} > 1 \ \text{için} \quad \epsilon_{eff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-1/2}$		$\frac{\Delta L}{h} = 0{,}412 \frac{(\epsilon_{eff} + 0{,}3)\left(\frac{W}{h} + 0{,}264\right)}{(\epsilon_{eff} - 0{,}258)\left(\frac{W}{h} + 0{,}8\right)}$
$W = \frac{1}{2f_r\sqrt{\mu_0\epsilon_0}}\sqrt{\frac{2}{\epsilon_r + 1}}$	$L = \frac{1}{2f_r\sqrt{\mu_0\epsilon_0}\sqrt{\epsilon_{eff}}} - 2\Delta L$	$L_{eff} = L + 2\Delta L$
$(f_{rc})_{010} = \frac{1}{2L_{eff}\sqrt{\epsilon_{eff}}\sqrt{\mu_0\epsilon_0}}$		
$\nabla \cdot \nabla \times \mathbf{A} = 0$	$\nabla \times \nabla \times \mathbf{A} = \nabla(\nabla\cdot\mathbf{A}) - \nabla^2\mathbf{A}$	$\nabla \times \nabla\psi = 0$
$\begin{bmatrix} A_r \\ A_\theta \\ A_\phi \end{bmatrix} = \begin{bmatrix} \sin\theta\cos\phi & \sin\theta\sin\phi & \cos\theta \\ \cos\theta\cos\phi & \cos\theta\sin\phi & -\sin\theta \\ -\sin\phi & \cos\phi & 0 \end{bmatrix} \begin{bmatrix} A_x \\ A_y \\ A_z \end{bmatrix}$		$\begin{bmatrix} A_x \\ A_y \\ A_z \end{bmatrix} = \begin{bmatrix} \sin\theta\cos\phi & \cos\theta\cos\phi & -\sin\phi \\ \sin\theta\sin\phi & \cos\theta\sin\phi & \cos\phi \\ \cos\theta & -\sin\theta & 0 \end{bmatrix} \begin{bmatrix} A_r \\ A_\theta \\ A_\phi \end{bmatrix}$

Küresel Koordinatlarda

$$\vec{\nabla} f = \frac{\partial f}{\partial r}\hat{a}_r + \frac{1}{r}\frac{\partial f}{\partial\theta}\hat{a}_\theta + \frac{1}{r\sin\theta}\frac{\partial f}{\partial\phi}\hat{a}_\phi$$

$$\vec{\nabla}\cdot\vec{A} = \frac{1}{r^2}\frac{\partial}{\partial r}(r^2 A_r) + \frac{1}{r\sin\theta}\frac{\partial}{\partial\theta}(\sin\theta A_\theta) + \frac{1}{r\sin\theta}\frac{\partial A_\phi}{\partial\phi}$$

$$\vec{\nabla}\times\vec{A} = \frac{1}{r\sin\theta}\left[\frac{\partial}{\partial\theta}(A_\phi\sin\theta) - \frac{\partial A_\theta}{\partial\phi}\right]\hat{a}_r + \frac{1}{r}\left[\frac{1}{\sin\theta}\frac{\partial A_r}{\partial\phi} - \frac{\partial}{\partial r}(rA_\phi)\right]\hat{a}_\theta + \frac{1}{r}\left[\frac{\partial}{\partial r}(rA_\theta) - \frac{\partial A_r}{\partial\theta}\right]\hat{a}_\phi$$

$$\nabla^2 f = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial f}{\partial r}\right) + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial f}{\partial\theta}\right) + \frac{1}{r^2\sin^2\theta}\frac{\partial^2 f}{\partial\phi^2} = \left(\frac{\partial^2}{\partial r^2} + \frac{2}{r}\frac{\partial}{\partial r}\right)f + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial}{\partial\theta}\right)f + \frac{1}{r^2\sin^2\theta}\frac{\partial^2}{\partial\phi^2}f$$