ECS455 Formula Sheet

ID3	
035	Spread spectrum Properties : - Difficult to intercept - Resistant to jamming - Easily hidden
074	Key randomness Properties - Run length property - Balanced property - shift property
075	m-sequence : ℓ (run length) $\quad r \quad r-1 \quad r-2 \quad r-3 \quad r-4 \quad r-i \quad 1$ $\#\quad 1 \quad 1 \quad 2 \quad 2^2 \quad 2^3 \quad 2^{i-1} \quad 2^{r-2}$
118	Inner Product $\langle \bar{x}, \bar{y} \rangle = \sum_{k=1}^{n} x_k y_k^*$ (discrete) $= \int_{-\infty}^{\infty} x(t) y^*(t)\,dt$ (continuous) $= \int_{-\infty}^{\infty} X(f) Y^*(f)\,df$
126	Uplink $T_x = s_i c_i$, $\underline{r} = \sum_i s_i \underline{c}_i = \underline{s}C$, R_x, $\hat{\underline{s}} = \frac{1}{N} \underline{r} C^T$ $\quad N$ = code length
167	$H_1 = [+1] = [0]$ $\quad H_{2N} = \begin{bmatrix} H_N & H_N \\ H_N & \overline{H}_N \end{bmatrix}$ $\quad$ Kronecker Product $A \otimes B = \begin{bmatrix} a_{11}B & \cdots & a_{1n}B \\ \vdots & \ddots & \vdots \\ a_{m1}B & \cdots & a_{mn}B \end{bmatrix}$
170	Hadamard Properties - Orthogonality - Closure property ($\omega_i \oplus \omega_j = \omega_k$) - Symmetric ($H = H^T$) - sum along row & column $= 0$ - Traceless property ($tr(H) = 0$)
190	OFDM: $s(t) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} s_k \exp\left(j \frac{2\pi k t}{T_s}\right)$, $0 \le t \le T$
307	DFT $S[n] = \frac{1}{\sqrt{n}} \sum_{k=0}^{N-1} s_k \exp\left(j \frac{2\pi k n}{N}\right) = \sqrt{N}\,\mathrm{IDFT}\{s\}[n]$
356	DFT $\quad \Psi_N = e^{j\frac{2\pi}{N}}$ $\quad M = \Psi_N = \begin{bmatrix} 1 & 1 & 1 & \cdots & 1 \\ 1 & \Psi_N^{-1} & \Psi_N^{-2} & \cdots & \Psi_N^{-(N-1)} \\ \vdots & & & & \\ 1 & \Psi_N^{-(N-1)} & \Psi_N^{-2(N-1)} & \cdots & \Psi_N^{-(N-1)(N-1)} \end{bmatrix}$ $\quad \Psi_N^{-1} = \frac{1}{N} \Psi_N^*$
491	DFT oversampling $\quad$ zero padding $\tilde{s}_k = \begin{cases} s_k, & 0 \le k < N \\ 0, & N \le k < LN \end{cases}$ $\quad L$ is over-sampling factor
539	Convolution $\{x * h\}[n] = \sum_m x[m] h[n-m]$ $\quad$ ① Flip ② Shift ③ Multiply ④ Add Circular Convo. ① replicated zero-padding ② stop when output is N-pt
562	Cyclic Prefix (CP) $\hat{x}[n] = \begin{cases} x[n], & 0 \le n \le N-1 \\ x[n+N], & -\nu \le n \le -1 \end{cases}$ Property ①: $\{h \circledast x\}[n] = (h * \hat{x})[n]$ for $0 \le n \le N-1$ Property ②: $\{h \circledast x\}[n] \xrightarrow{DFT} H_k X_k$
604	^_^ $\quad$ T ∧ T
702	CDMA: $\underline{x}_1 = a_1 \underline{c}_1$, $a_2 \underline{c}_1$ $\underline{x}_2 = b_1 \underline{c}_2$, $b_2 \underline{c}_2$ Receiver gets $\underline{r} = \underline{x}_1 + \underline{x}_2$ To recover a_1: $\frac{1}{4} \langle \underline{r}(1{:}4), \underline{c}_1 \rangle$
737	
740	
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