a) Simplex transmission channel

b) All the above

c) $i^2+ij+j^2 \quad \begin{matrix} i=0 \\ j=2 \end{matrix} \Rightarrow 4$

d) $\left(\frac{G}{T}\right)^{\uparrow} = 5dB/K \qquad \left(\frac{G}{T}\right)^{\uparrow} = G_A^{\uparrow} - 10\log_{10}(T_{eq}) \Leftrightarrow T_{eq} = 10^{2.2} = 158.5K$

$G_A^{\uparrow} = 27\,dB \qquad T_{eq} = T_R + T_A \Rightarrow T_R = T_{eq} - T_A = 116.5K$

$T_A = 42\,K$

e) $P_E = 3W \qquad LB = 36\,MHz \qquad EIRP = P_E + G_E \Leftrightarrow G_E = EIRP - P_E =$

$EIRP = 70dBm \qquad 4\text{-}PSK \qquad = 70dBm - 5dB = 65dBm = 35dB$

$f_c = 12\,GHz$

f) $LB_{ch} = \frac{R_B(1+\alpha)}{\log_2(M)} = 2.4\,Mbit/s$

$\frac{LB}{LB_{ch}} = 15$

g) The Earth curvature

h) $\frac{[720\times 576 + 2\times 360\times 288]\times 8}{50\times 10^3 \times 8} = 12.4$

i) DCT - Spatial Redundancy

entropy coding - Statistical Redundancy

quantizing - Irrelevancy

j) the decoder and the bitstream syntax

Grupo II

$\frac{C}{i} \geq 12dB$

$m=3$

$i_0=6$

a) $Q = \frac{D}{R}$

$\frac{C}{i} = \frac{R^{-3}}{6\,D^{-3}} = \frac{Q^3}{6} \Rightarrow Q \geq \sqrt[3]{10^{1.2}\cdot 6} = 4.56$

$Q = \sqrt{3N} \Leftrightarrow N = \frac{Q^2}{3} = \lceil 6.9 \rceil = 7 \qquad \text{com } N=7 \Rightarrow \frac{C}{i} = 16 \approx 12.05\,dB$

b) $A_u = 0.02\,E$

$N_{ch} = 100$, $GoS \ll 2\%$ $\Rightarrow A = 88\,E \qquad \frac{A}{A_u} = U = 4400$

c) $d_0 = 1m$

$P_R = 0.1\,mW \qquad P_{min} = P_R\left(\frac{d}{d_0}\right)^{-3}$

$P_{min} = -110dBm =$

$= 10\times 10^{-12}\,mW \qquad \sqrt[-3]{\frac{P_{min}}{P_R}\cdot d_0^{-3}} = d = 2154m$

Grupo III

$L = 60\,km$ $\quad m = 15$

$A_S = 0.06\,dB$ $\quad A_c = 0.3\,dB$ $\quad A_f = 0.25\,dB/Km$

$\lambda_0 = 1540\,mm$ $\quad D_\lambda = 17\,ps/mm/Km$ $\quad \Delta\lambda_s = 2\,mm$

$r = -7\,dB$ $\quad P_{0:0} = 0.5\,mW$ $\quad \eta = 0.8$ $\quad \sqrt{S_c} = 4\,pA/\sqrt{Hz}$

$R_B = 2.5\,Gbit/s$ $\quad B_{RF} = 0.65\,R_B$

a) $A_T = 2A_c + 14A_S + L A_f = 16.44\,dB$

b) $\overline{P_0} = \frac{P_{0:0} + P_{0:1}}{2} = 1.5\,mW$

$r = 0.2 \Rightarrow P_{0:1} = \frac{P_{0:0}}{r} = 2.5\,mW$

c) $Q = 6$ $\quad M_G = 6\,dB$

$R_\lambda = \eta \cdot \frac{\lambda}{1.24} \approx 1$ $\quad \Delta\overline{P_i} = 2\,dB$

$\overline{P_i} = \frac{1+r}{1-r} Q \frac{\sqrt{S_c} \cdot \sqrt{B_{eff}}}{R_\lambda} = 1.45 \times 10^{-6}\,W = -58.38\,dB \Rightarrow P_{min} = \overline{P_i} + M_S + \Delta\overline{P_i} = -50.38\,dB = -20\,dBm$

d) $\overline{P_\pi} = \overline{P_0} - A_t = 10\log_{10}(1.5\,mW) - 16.44\,dB = 1.76\,dBm - 16.44\,dB = -14.68\,dBm$

$M = \overline{P_\pi} - \overline{P_i} - \Delta\overline{P_i} = 11.72\,dB$