

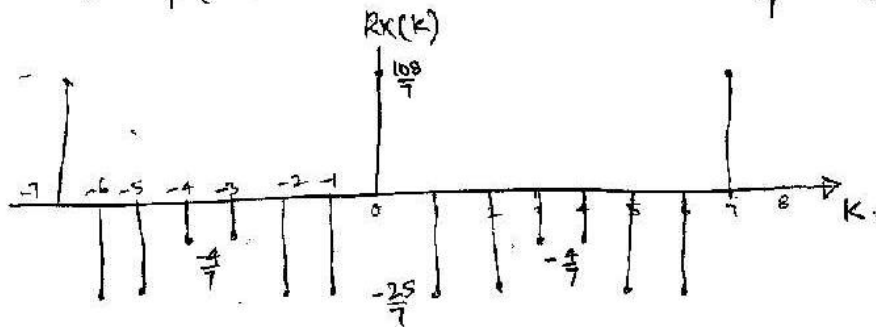
TEST 3 SOLUTIONS

Prob 1 $R_x(0) = \frac{1}{7} (4+1+16-25+9+4+49) = \frac{108}{7}$

$R_x(1) = \frac{1}{7} (-2+4-20+15+6-14-14) = -\frac{25}{7} = R_x(6)$

$R_x(2) = \frac{1}{7} (-8-5-12+10-21+4+7) = -\frac{46+21}{7} = -\frac{67}{7} = R_x(5)$

$R_x(3) = \frac{1}{7} (+10-3-8-35+6-2+28) = -\frac{4}{7} = R_x(4)$



Prob 2

2	0.2	—	0.2	—	0.25	—	0.53	0
00	0.2	—	0.2	—	0.2	—	0.25	1
01	0.2	—	0.2	—	0.2	—	0.2	2
02	0.13	—	0.13	—	0.13	—	0.13	3
10	0.12	—	0.12	—	0.12	—	0.12	4
11	0.10	—	0.10	—	0.10	—	0.10	5
120	0.03	—	0.05	—	0.05	—	0.05	6
121	0.02	—	0.02	—	0.02	—	0.02	7
0	0	—	0	—	0	—	0	8

Average length = $1(0.2) + 2(0.2+0.2+0.13+0.12+0.10) + 3(0.03+0.02)$

$= 1.85 \text{ symbols/message}$

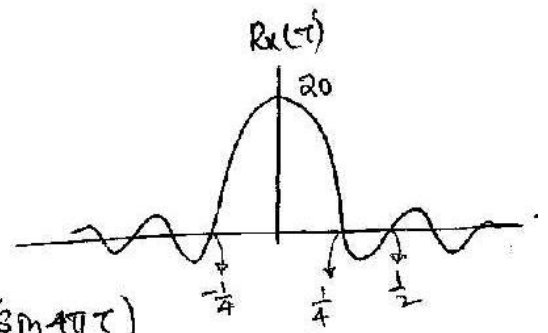
$= 1.85 \times \log_2 3 \text{ bits/message}$

Prob 3 $R_x(\tau) = F^{-1}[S_x(f)]$

$= \int_{-2}^2 5 e^{j2\pi f\tau} df$

$= \frac{5}{j2\pi\tau} [e^{j4\pi\tau} - e^{-j4\pi\tau}]$

$= \frac{5}{j2\pi\tau} [2j \sin 4\pi\tau] = 20 \left(\frac{\sin 4\pi\tau}{4\pi\tau} \right)$



Prob 4: # of audio channels: $\frac{6 \times 10^6 \log_2 [1 + 10^4]}{10 \times 10^3 \log_2 [1 + 10^9]} = 266.66$
266 Channels

Prob 5: $C = G^{-1} R$

$$\begin{bmatrix} C(0) \\ C(1) \end{bmatrix} = \begin{bmatrix} R_x(0) & R_x(1) \\ R_x(1) & R_x(0) \end{bmatrix}^{-1} \begin{bmatrix} R_x(0) \\ R_x(1) \end{bmatrix}$$