

# Module 4F5: Engineering Tripos 2013/14 – Numerical Answers

1. a)  $f_Z(z) = 1/4$  for  $z \in [-1, 1]$ , and  $1/8$  for  $z \in [-3, -1) \cup (1, 3]$
2. a)  $\beta = 3, \alpha = 2$    b)  $\mathbf{H} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 4 \end{bmatrix}$    c)  $\mathbf{G}_{\text{sys}} = [1 \ 2 \ 4]$ , 7 codewords  
d) ii) Linear complexity=1   iv)  $[0, 3, 0]$    v)  $[2, 4, 1]$
3. a)  $p^* = [a(1 + 2^{H_2(a)/a})]^{-1}$ ,  $\mathcal{C} = \log_2(1 + 2^{H_2(a)/a}) - \frac{H_2(a)}{a}$    b) ii)  $[1, 0, 1, 1, 0, 0, 1, 0]$
4. a) i)  $2A^2/3$    iii)  $\frac{4}{3}\mathcal{Q}(\sqrt{3E_s/4N_0})$   
b) i)  $\frac{4}{3}\mathcal{Q}(\sqrt{3|h|^2E_s/4N_0})$    ii)  $\frac{2}{3} \left(1 + \frac{3E_s}{8N_0}\right)^{-1}$