Answers to Exam Sample Paper

A1.

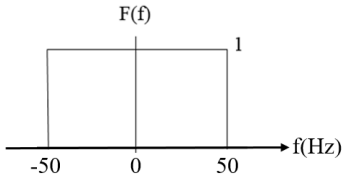
(a) $m_f = \Delta f / f_s = 30\text{ kHz}/15\text{ kHz} = 2$

(b) $k_f = \Delta f / V_s = 30/2 = 15\text{ kHz/V}$

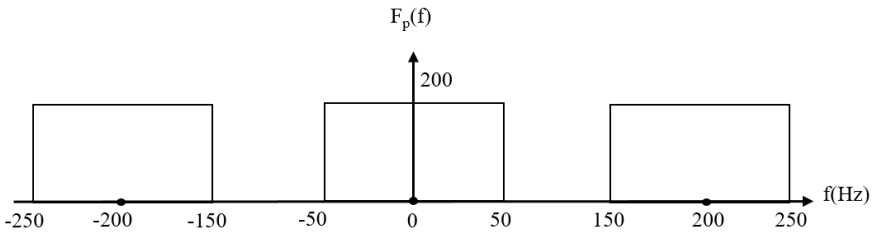
(c) $B/W = 2(m_f + 1)f_s = 6 \times f_s = 90\text{ kHz}$

A2.

(a)



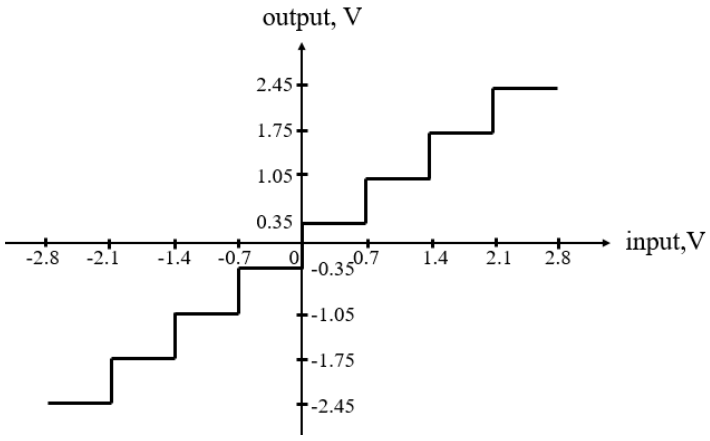
(b)



A3.

(a) step size, $q = 2 \times 2.8 / 8 = 0.7$ V

(b)



(c) $\left[\frac{S}{N_q}\right]_{dB} = 1.76 + 6B\text{ dB} = 19.76\text{ dB}$

(d) The quantised voltage for a dc input of -1.6 V is -1.75 V.

A4.

(a) $V_T = 0.5(V_1 + V_0) = 0.5(4\text{ mV} + (-3\text{ mV})) = 0.5\text{ mV}$

(b) $R = 0.5(V_1 - V_0) = 0.5(4\text{ mV} - (-3\text{ mV})) = 3.5\text{ mV}$

$R = 0.5(V_1 - V_0) = 0.5(4\text{ mV} - (-3\text{ mV}))$
$= 3.5\text{ mV}$

$$P_e = \frac{1}{2} erfc\left(\frac{R}{\sqrt{2}\sigma}\right) = \frac{1}{2} erfc\left(\frac{3.5}{\sqrt{2}\text{ x }1}\right)$$

$$= \frac{1}{2} erfc(2.47) = \frac{1}{2}\text{ x } 0.4774\text{ x } 10^{-3} = 0.2387\times10^{-3}$$

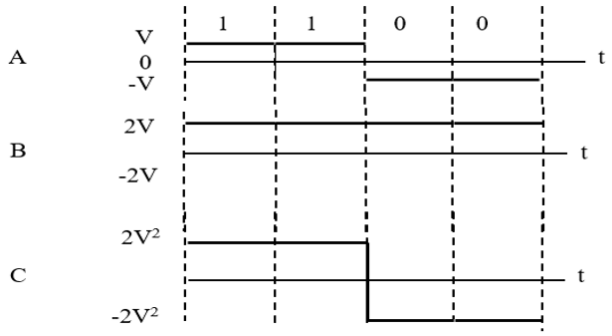
(c) Error bit per block = 10^5 x 0.2387 x 10^{-3} = 24 bits

(d) noise,

limited channel bandwidth

A5.

(a)



(b)

$\eta = 2\times10^{-9}$ watt/Hz

V = 12 mV

$1/T_b$ = 9000 bps

$$P_e = \frac{1}{2} erfc\left[\sqrt{\frac{V^2 T_b}{\eta}}\right]$$

$$= \frac{1}{2} erfc\left[\sqrt{\frac{(12\times10^{-3})^2}{9000\times2\times10^{-9}}}\right]$$

$$= \frac{1}{2} erfc[2.828]$$

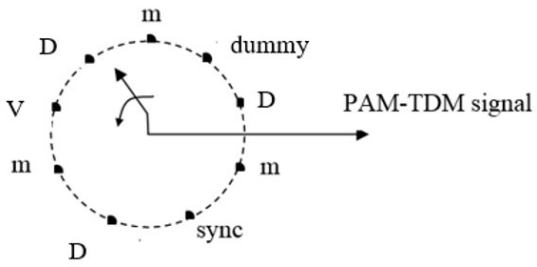
$$= 3.33\times10^{-5}$$

B1.

(a)

Signals	f_m(kHz)	f_s(kHz)	No. of i/ps = f_s/cs
V	4	8	8/8 =1
m	10	20	20/8=2.5 → 3
D	9	18	18/8=2.25 → 3
Syn	-	-	1

cs = min f_s in the f_s column = 8 kHz



(b) cs = 8 kHz

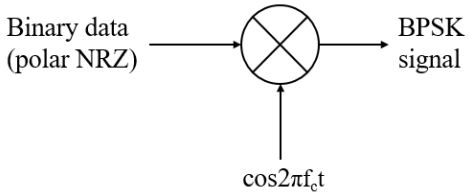
(c) Gross channel output bit rate, R = commutator speed x no. of inputs x no. of bits per sample

R = 8000 × 9 × 8 = 576 kbps

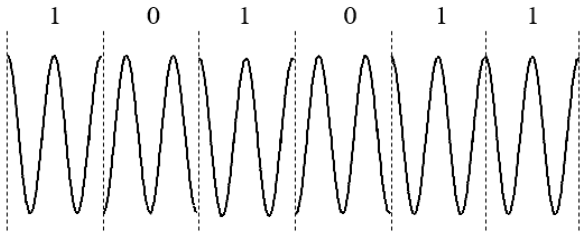
(d) BW = R/2 = 288 kHz

B2.

(a)



(b) As f_c = 8 kHz (T_c=0.125 ms), in 1 bit duration (0.25 ms), there are two cycles of the carrier.



(c) V = 10 mV; η = 2 × 10^{-9}; T_b = 1/(4 kHz) = 0.25 ms

$$P_e = \frac{1}{2} erfc\left[\sqrt{\frac{V^2 T_b}{2\eta}}\right]$$

$$= \frac{1}{2} erfc\left[\sqrt{\frac{(10\times10^{-3})^2\times0.25\times10^{-3}}{2\times2\times10^{-9}}}\right]$$

$$= \frac{1}{2} erfc\left[\sqrt{6.25}\right]$$

$$= \frac{1}{2} erfc[2.5]$$

$$= 2.04\times10^{-4}$$