3B1 – Radio Frequency Electronics 2006

(some numerical answers etc.)

1(b)

R1	R2	R3	R4	
1M2	150k	3k3	33k	stage 1
390k	47k	1k	10k	stage 2 100nF coupling caps, 15nF shunt cap.

1(c) Use diode demodulator and comparator to monitor signal level and MOSFET analogue switch to mute the signal when at low levels.

2(b) With L = 10 nH @ 1 GHz = j63 Ω, so Q factor = 30 gives shunt resistance of ~2 k Ω, hence choose transistor bias to give –R of LESS than this eg. -50 Ω to guarantee oscillation. C = 2.53 pF for LC resonance at 1 GHz.

3(a) Choose Chebyshev for sharp frequency cut-off. Low pass up to 7 MHz, high pass from 5 MHz gives cascaded bandpass 5-7 MHz.
C1 = 38 pF, C2 = 22 pF (low pass stages), (A-1)R = 580 or 1660 Ω
C3 = 19 pF, C4 = 33 pF (high pass stages), ditto

3(b) w = 3.85 mm microstrip, 0.46 mm stripline for 33 Ω.

3(c) 37 mm track length difference = 90 degrees.
For 66 Ω track, use microstrip 0.92 mm wide; not possible in stripline (-0.26 mm).

4(a) P = 2.5 mW/m^2, H = 3.6 x 10^{-3} A/m, E = 1.37 V/m.

4(b) P rec. = 33 pW, Vrec. = 58 μV into R = 50 Ω.

4(c) Normalise to 1.74 + j1.16. Voltage refl. coeff. = 0.46
Match with C = 2.3 pF and L = 9.4 nH.