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Dept. of ECE, CEG Campus, Anna University
End Semester Examinations Apr-May 2012
B.E.(ECE) VIII Semester (FT, Regular)
EC525 – RF System Design
Answer All Questions

Part A (10x2=20 Marks)

Q1. .Consider a parallel tuned LCR circuit and write down the expression for its equivalent admittance at a frequency (ω_0 +$\Delta\omega$) where ω_0 is the resonant frequency of the circuit. Assuming $\Delta\omega$ to be small, show that the circuit behaves like an first order RC filter around its resonant frequency, and based on this, obtain a relation between the bandwidth and Q of the parallel tuned circuit.

Q2. It is required to transform a large impedance R_L to appear like a small impedance Rs. Sketch the diagrams of atleast four different possible impedance transformation circuits which can help you do this

Q3. Supposing you have an ideal mixer which does not generate any noise of its own. For some cases, this mixer can give 0dB Noise Figure, and for certain others, this same mixer will give 3dB Noise Figure. Explain how the same mixer can give two such different Noise Figures.

Q4. .It is preferable to mount the LNA as close as possible to the antenna. Justify this statement. By the same argument, is it essential to mount the mixer as close as possible to the LNA.

Q5. At what temperature is the Noise Figure -174dBm/Hz obtained, and what temperature will the Noise Figure become -180dBm/Hz

Q6. Explain the problem of blocker signals and state very briefly what you can do reduce this problem.

Q7. You are given a receiver which requires 20 dB S/N , has 70 dB gain, 14dB Noise Figure, 30 dBm output third order intercept, and 1 KHz IF bandwidth. What is the sensitivity of the receiver.(No additional information is needed for this problem)

Q8. In Fig.1, , both the preselect filters show have the same attenuation characteristics shown (pass band attenuation is -6dB and stop band attenuation is -26dB for each). Compute, in dB, the possible image rejection of this receiver

Q9. Distinguish between Spurious components and Phase Noise components in a PLL

Q10..A strictly linear amplifier can never oscillate. With justification, state whether this statement is true or false.

Part B (16x5 = 80Marks)

Q11. **(a)** For the tapped capacitor impedance matching circuit shown in Fig.2, obtain the expressions for the values of the capacitors and inductor in terms of R_L, Z_{in}, f_0 and Q of the overall circuit. (Assume Z_{in} is real) (8)

(b) Consider an ordinary source follower loaded with an arbitrary impedance *ZL*. Ignoring all device parasitic capacitors except C_{gs}, provide an expression for the impedance Z_x seen between the gate and ground. If Z_L is R_L + $1/jwC_L$, provide an expression for the frequency at which the real part of Z_x crosses over from positive to negative. (8)

Q12a. **(i)** With the help of suitable diagrams, explain the meaning of Spurious Free Dynamic Range of an amplifier.(6)

(ii) Even though the IIP3 and OIP3 are related only 'hypothetical' intercept point, how does it help in practical designs. (6)

(iii) Explain the possible reason why IIP4, IIP5 are not normally specified. (4)

OR

Q12b. Two nonlinear systems with input intercept point amplitudes defined by $A_{IIP3,1}$ and $A_{IIP3,2}$ are connected in cascade. Obtain the expression for the cascaded A_{IIP3} of the total system. (you can assume the individual nonlinearity coefficients of the two amplifiers to be represented by α_1 , α_2 and α_3 and β_1 , β_2 and β_3 respectively)

Q13a. (i) Derive the Friis formula for the cascaded Noise Figure of amplifiers.(4)

(ii) Starting from the definition of Noise Factor (F) of an amplifier, obtain the expression for the minimum Noise Factor F_{min} of an amplifier. (6)

(iii) One can achieve F_{min} in three possible ways. One is by altering the source resistance and keeping the amplifier fixed. The other is by keeping R_s fixed and choosing an amplifier with appropriate V_n and I_n. The third one is two alter both R_s and the also amplifier V_n and I_n. Are all methods equivalent. Justify (6)

OR

Q13b. (i) Show that at low frequencies, the Noise Figure of a CG amplifier with its input impedance matched to the source impedance R_s is given by $F = 1+\gamma/\alpha$. (8)

(ii) Give the possible definition of the IIP3 Gilbert cell mixer. (4)

(iii) Give the circuit diagram of any one circuit that can improve the nonlinearity performance of a mixer. (4)

Q14a. (i) Give the circuit diagram of any one RF oscillator. Explain how you could convert this into a VCO. (10)

(ii) Explain the procedure by which the amplitude of oscillation of an oscillator can be estimated (6)

OR

Q14 b. Draw the circuit diagrams of single balanced and double balanced (Gilbert cell) mixers and obtain expressions for their conversion gains.

Q15.a For the PLL block diagram shown in Fig.3, write down the expressions for the transfer functions for both phase ($\Phi_{out}(s)/\Phi_{in}(s)$) as well as for frequency ($f_{out}(s)/f_{in}(s)$). Next consider three possible cases (i) $Z(s) = 1$ and (ii) $Z(s) = 1/s$, and $Z(s) = s/(1+s/a)$. For each of these cases, comment on the stability of the loop. What will

OR

Q15b Give the block diagrams for two different realizations for the phase detector in a PLL and derive the expressions for K_{PD} for each case.

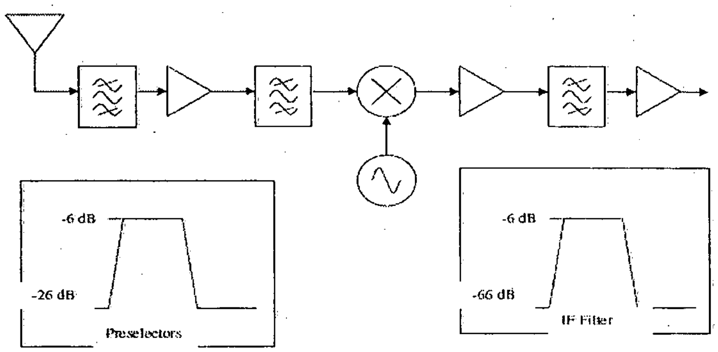

Fig.1 (Q8)

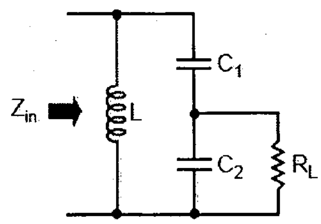

Fig.2 (Q11a)

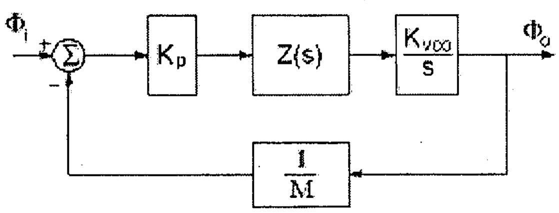

Fig.3 (Q15a)