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Dept. of ECE, CEG Campus, Anna University
End Semester Examinations Apr-May 2013
B.E.(ECE) VIII Semester (FT, Regular)
EC9044 RF Microelectronics
Answer All Questions

Part A (10x2=20 Marks)

Q1. For N=5, Determine the frequency of oscillation of the circuit shown in Fig.1

Q2. What is the main difference advantage of a double balanced mixer over a single balanced mixer.

Q3. Fig.2. shown below is known as Weaver image reject mixer. Express Vout(t) in terms of Vin(t). Why would this be called an image reject mixer

Q4. For a simple parallel RLC network, determine the relation between Q and bandwidth of the circuit.

Q5. Justify as to why IP2 and IP3 are not considered real intercept points and only as hypothetical extrapolated intercept points.

Q6. Define clearly what is meant by the conversion gain of a VCO.

Q7. State in dB, the ideal (best possible) values for NF, IIP3, input P1dB point and SFDR.

Q8. State the conditions under which one can obtain minimum Noise Factor Fmin.

Q9. State the problems that can arise if port to port isolations in a mixer are poor.

Q10. In an integer N frequency synthesizer using an input reference frequency f_{ref}, what is the minimum frequency resolution that one can get at the output.

Part B (16x5=80 marks)

Q11. a. Study carefully the diagram given in Fig.2 along with its title. Explain and justify clearly, the problem being addressed in this Figure. [5]

Q11. b Read the title given in Fig.4 and study the figure carefully. Why is the blocker amplitude so large at the output of Fig.4b. Also, if you compare the amplitudes of the wanted signals at the outputs of the LNA, it is smaller in Fig.4b and this is to be expected. Justify this.[5]

Q11.c. Explain the problem being described in Fig.5. Explain what the expression in Fig.5 represents and define all the terms in it. [6]

Q12. a Study Fig.6 carefully and all the captions associated with it. The circuit diagram represents a proposed double balanced mixer. Answer the following

(i) Name the LNA topology used in this scheme. [2]

(ii) With minor modifications, show how this circuit can be made to operate as a single balanced mixer. [4]

(iii) Explain the principle of operation of this double balanced mixer. State your answer in the form of brief points. [8]

(iv) For the waveforms shown, sketch the desirable spectrum of differential output. [8]

OR

Q12b . Study the figure and captions carefully in Fig.7 . Answer the following questions. Note that both the transmitter and received signals are supposed to have been narrowband and hence their spectra should have like almost delta functions.

(i) What would be improvement the in SNR if there is no transmitter leakage at all. Which part of the spectrum of the transmitter signal is leaking and causing this SNR degradation [8].

(ii) Apart from SNR degradation, what other problems do you expect due to this leakage. Suggest possible solutions to reduce these problems.[8]

Q13.a Consider the circuit in Fig.8.

(i) Wrtite down the fitler transfer function Z(S) for this circuit. [4]

(ii) Give the expression for the phase detector gain K_{PD} for this circuit and state the possible units for it. [2]

(iii) Assume the VCO gain to be represented by K_{VCO} and write down the expression for the transfer function f_{out}/f_{in}. [10]

OR

Q13. b (i) What would be possible difference in the definitions of IP3 of an LNAs and mixers [4].

(ii) Discuss any one scheme to improve the linearity performance of a mixer [4].

(iii) For a Gilbert cell mixer, explain the possible source that influence its Noise Figure [4].

(iv) Draw the circuit diagram of a passive mixer using MOS switches. [4]

Q14.a Consider the oscillator and its equivalent circuit shown in Fig.9a and 9b.

(i) Determine the expressions for Z(s) and the loop gain of the system. [4]

(ii) Determine the transfer function relating of the V to I converter block. [4]

(iii) Hence establish the condition to be satisfied by the device transconductance for sustaining oscillations.[8]

OR.

Q14.b (i) Determine the condition for obtaining input impedance match for the circuit shown in Fig.10. [8]

(ii) Ignoring Cgd of the MOS transistor, draw the noise equivalent circuit for Fig.8 and obtain an expression for output short circuit noise current.[8]

Q15.a (i) Using a T network comprising of two inductors and one capacitor, it is required to provide impedance match between two impedances Z_s and Z_L. Derive the equations required to determine values inductors and capacitor. [12]

(ii) Draw the circuit diagram of a tapped capacitor impedance matching network [4].

OR

Q15 b (i) Consider the two expressions given below for the input and signal and the transfer characteristics of an amplifier. Deetermine expressions for IIP2, IIP3 and input 1dB compression point. [5+5+6]

$$v_i = V_1 \cos\omega_1 t + V_2 \cos\omega_2 t$$

$$v_o = f(v_{in}) \approx c_0 + c_1 v_i + c_2 v_i^2 + c_3 v_i^3$$

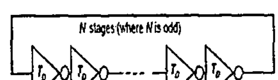

Fig.1

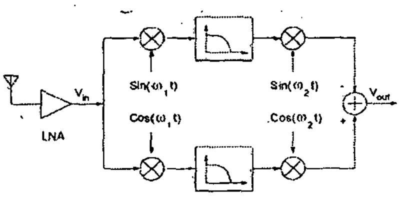

Fig.2

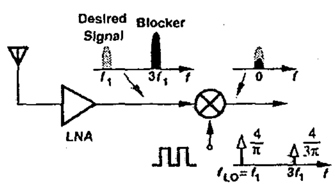

Fig.3. Problem of LO Harmonics in Direct Conversion Receiver

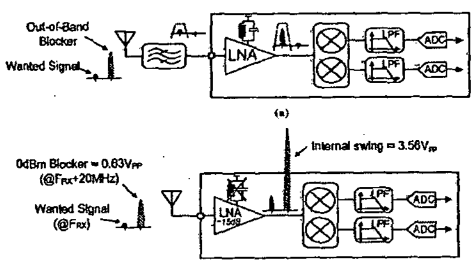

Fig. 1. Effect of an out-of-band blocker on narrowband and wideband receivers.(a) A narrowband direct-conversion narrowband receiver typically employs both off-chip and on-chip passive RF filtering to attenuate any unwanted signals, (b) A wideband receiver cannot employ passive RF filtering and, therefore, a large blocker will saturate a conventional front-end design.

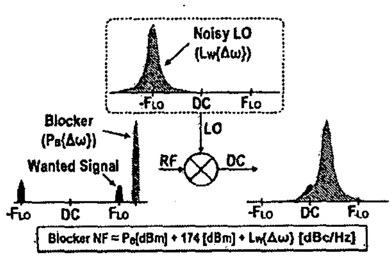

Fig.5. Noise degradation due to reciprocal mixing in a perfectly linear wide-band receiver.