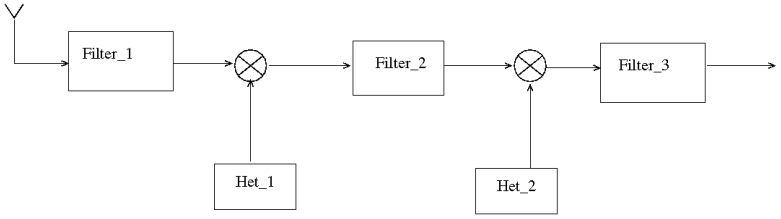
Name:_____

ESPTR 2010 – Final Exam, **version A** 22.06.2010

Try to write the answer in the provided space. If you need it, put your calculations on an additional sheet.
If there are multiple answers for a problem - give one to have full score, give all to have +1 bonus point.



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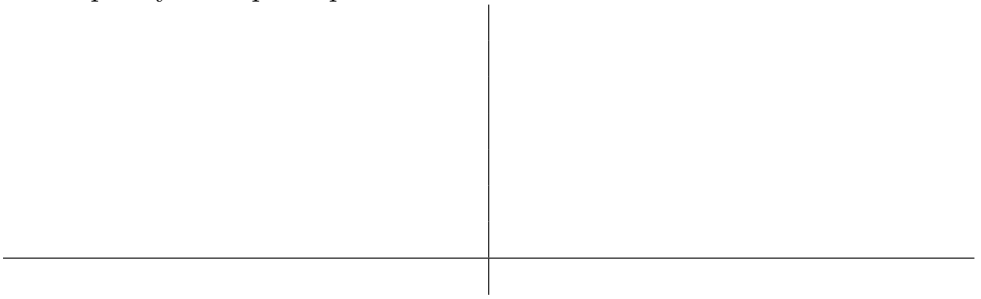
1. (4 p.) A dual conversion receiver idea is sketched above. $F_{RF} = 870\ MHz$, $F_{Filter2} = 170\ MHz$, $F_{Het2} = 190.7\ MHz$ Choose the missing frequencies (or middle frequencies of filter passband) properly. Answer: F_{het1} =[ ], $F_{Filter1}$ =[ ], $F_{Filter3}$ =[ ]
   .....

2. (3 p.) Where is the image band when $F_{RF} = 2\,GHz$ and $F_{het} = 1.950\,GHz$? Answer: [ ].
   Calculation: .....

3. (2 p.) The signal propagates from the transmitter (Tx) to the receiver (Rx) along two paths. One path is straight and has length of 3000 m, the other is a bounce off the ground. Both Tx and Rx are 30 m over the flat earth surface. (In case of any doubt, ask the teacher for a sketch on the blackboard). At which signal frequencies could there be a destructive interference?
   Answer:[ ]Calculations: .....

4. (8 p.) A 6 GHz transmitter is located on the earth surface. An airplane flies at 1 km altitude exactly over the transmitter, with linear velocity of 100 m/s, carrying a receiver. Calculate the received frequency at some (e.g. 5) chosen points of the aircraft path, to be able to sketch the Rx frequency vs airplane position.



5. (5 p.) For a given pulsed radar with 2 kW (peak) transmitter, the smallest detectable object at the distance of 10 km has 1 square meter of effective radar cross-section. If the object had 1/16 square meter, at what maximum distance could it be detected?[ ].....
   .....
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6. (4 p.) A signal expected at the digital receiver input is 10 periods of cosine with period of 10 samples.

- Calculate the impulse response of a filter required to detect this signal in the presence of white noise. Answer:.....
- Sketch the output signal of this filter when the above signal is present at the input (no noise). What is the response length? Answer:[ ]
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7. (6 p.) Describe the working principle of ISAR radar system. Hint: start from the idea of Doppler frequency, describe the radar or object movement. Answer: .....
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8. (5 p.) An OFDM system is designed to be used for communication with hi-speed trains ($v_{max} = 370\ km/h$). Carrier frequency is $F_c = 2.4\ GHz$

   - Calculate the possible number of subcarriers in 7 MHz band, so that the Doppler shift does not induce more than 3% error in location of the outermost subband. Answer:[ ].
     .....
     .....
   - Calculate the minimum possible length of symbol using the results of above calculations. Answer:[ ] .....
     .....
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9. (3 p.) Two users transmit 1 W each in a CDMA system. One is located at 100m from the receiver, second at 10 km. Calculate ratio of powers received from both users at the receiver Answer:[ ] .....
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10. (3 p.) The duration of 148 bits transmitted in a GSM time slot is equal to 0.546ms while the time slot lasts for 0.577ms (so some part of the slot is wasted). What is the reason of this duration difference? .....
    .....

11. (3 p.)Why do some modulation techniques require highly linear amplifiers? .....
    .....
    .....

12. (3 p.) What are the roles of two antennas in a passive (parasitic) radar? .....
    .....
    .....

13. (3 p.) How can all users in an ideal CDMA system use the same band at the same time? Answer:
    .....
    .....

version A , $\Sigma = 52p\ T = 90\ min$