

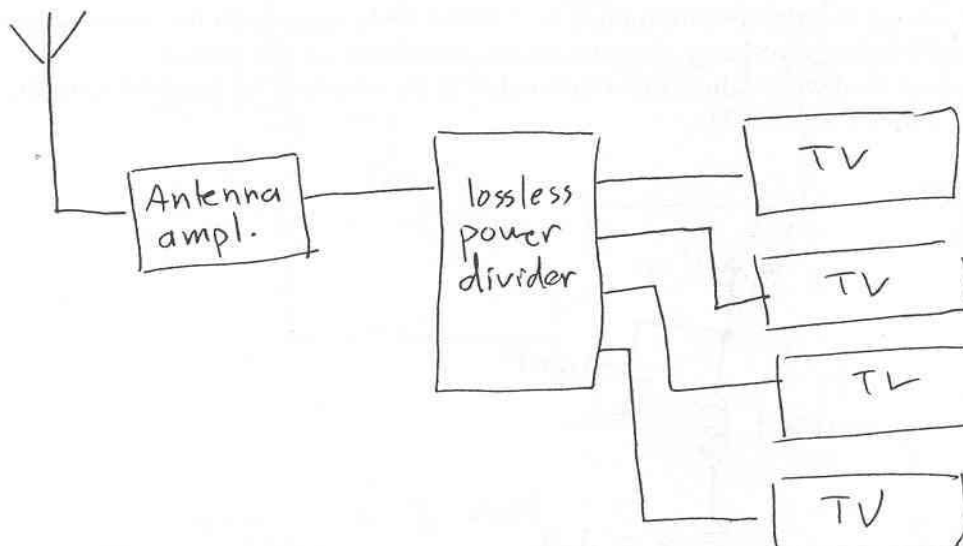
EE411/EEE511 FINAL EXAM

January 10, 2003 9.00 AM

Openbook Open notes

3 hours

Question 1:



A television signal distribution system is going to be constructed at an apartment building as shown above. There are 4 apartments in the building. The amplified signal is divided into 4 outputs by a lossless power divider and then carried to the apartments by cables which attenuates the signals by approximately 4 dB. The television receivers are assumed to have a noise figure of 6 dB. The antenna amplifier has the same noise figure. Find:

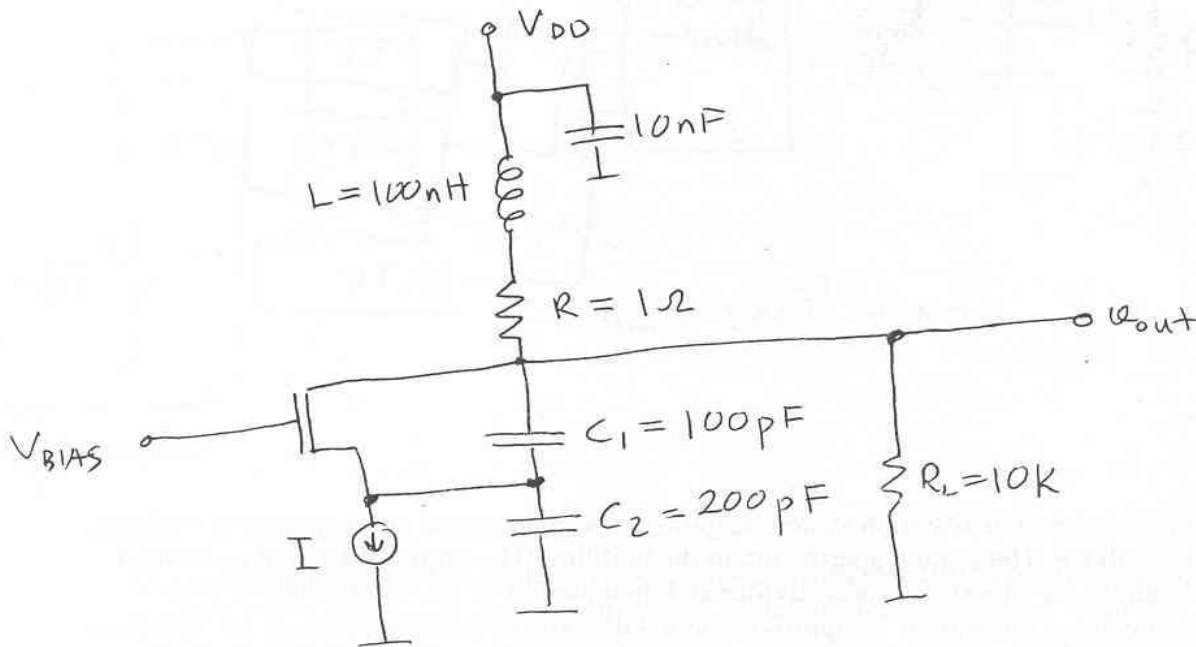
- (10 points) The minimum gain of the antenna amplifier so that the overall noise figure of the system does not exceed 8 dB.
- (10 points) The minimum signal strength at the antenna input of the antenna amplifier in dBm in order to have good reception (Good reception means 20 dB S/N at the input of the demodulator of the TV receiver).

Question 2:

A PLL frequency synthesizer is needed for bluetooth application. The operational frequency band is 2.4-2.5 GHz. Channel spacing is 100 kHz. The first frequency starts at 2.4 GHz. The frequency is so high that counters can not function without a prescaler. A dual modulus prescaler dividing to 16/16+1 must be used. Reference frequency must be 100 kHz.

- (5 points) Draw the block diagram of the frequency synthesizer, name all the blocks to show their functions and label the frequencies.
- (5 points) Find what values must be loaded to the counters for synthesizing the frequency of 2.455 GHz.
- (5 points) A new requirement comes up which specifies that everything is the same, except that the first frequency is 2.40005 GHz again with the same channel spacing. Modify your block diagram to accommodate for the change.
- (5 points) Find what values must be loaded to the counters for synthesizing the frequency of 2.45505 GHz.

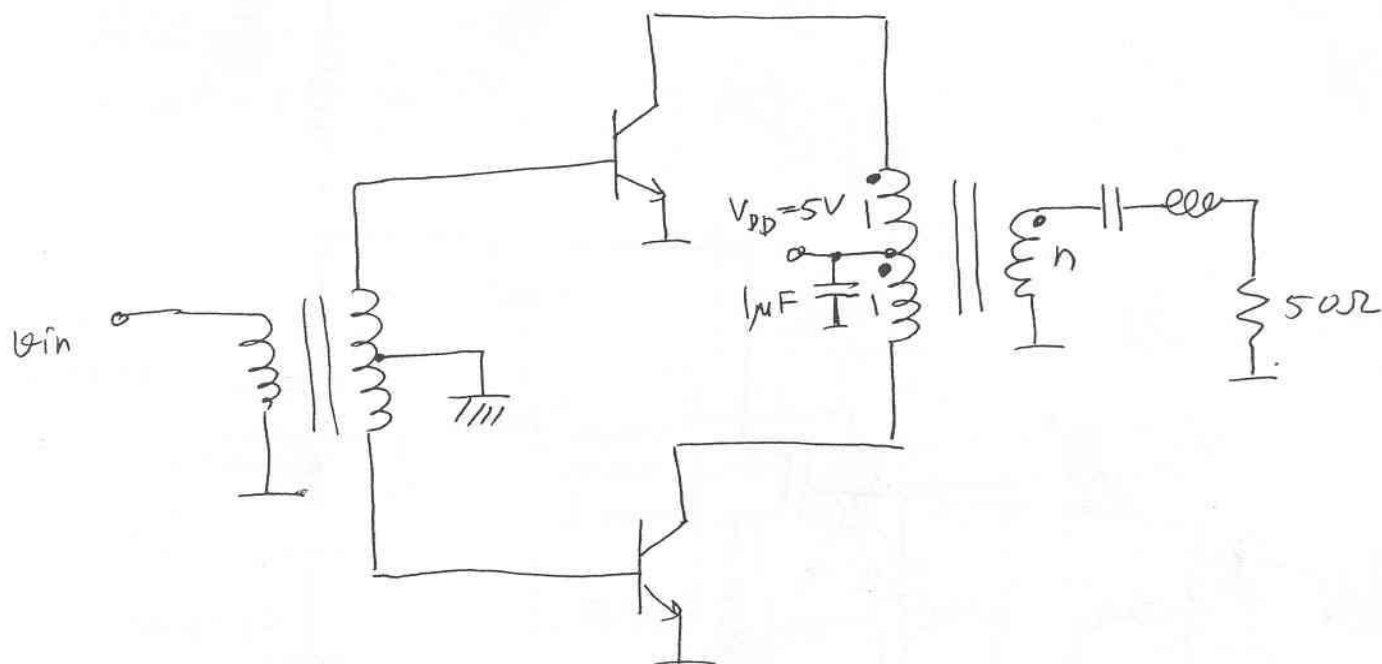
Question 3:



An oscillator as shown above was constructed.

- (10 points) Find the minimum value of g_m such that oscillation starts.
- (10 points) Assuming that oscillation starts, find the current I to make the output voltage V_{rms} .

Question 4:

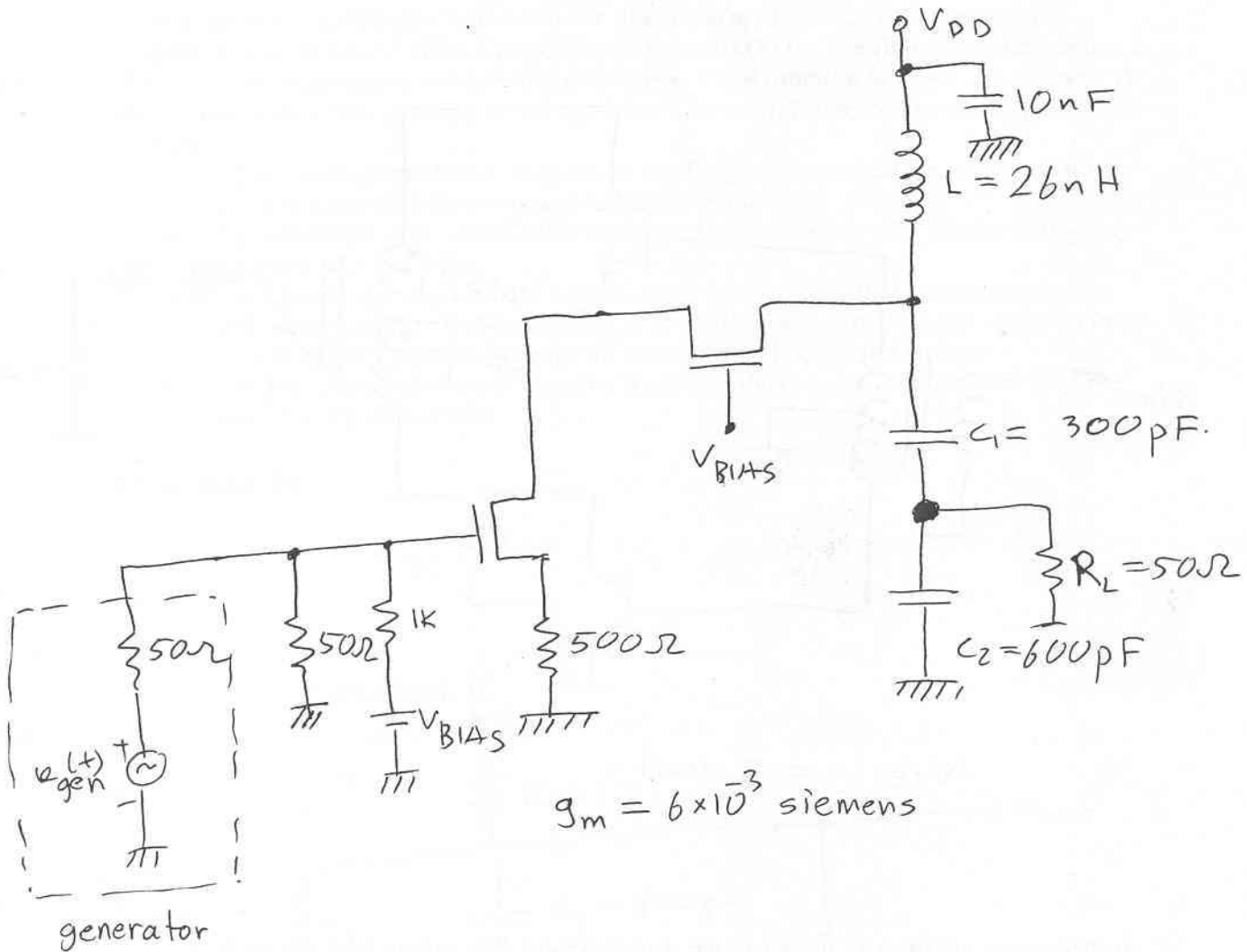


$$V_{CE_{SAT}} = 1 \text{ volt}$$

An RF power amplifier as shown above was designed. The output tank circuit is at resonance at the drive frequency. The collector-emitter saturation voltages of the transistors are 1 Volt. The output power required is 10 Watts.

- (10 points) Find the minimum value of n in order to obtain 10 Watts power output from the amplifier.
- (10 points) Find the power supply current.

Question 5:



(20 points) An RF amplifier as shown above was constructed. But, a requirement for a frequency tripler popped up from a new tender. So it was decided that the amplifier was to be driven by a square wave with the frequency 23.26 MHz and the amplitude 6.28 Volts. Find the output power in dBm.

Hint: A square wave can be represented as:

$$S(t) = \frac{4A}{\pi} \cos 2\pi ft + \frac{4A}{3\pi} \cos 6\pi ft + \frac{4A}{5\pi} \cos 10\pi ft$$

where A is the amplitude of a 0 average square-wave