BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: PRE-PHD **SEMESTER : NA**
BRANCH: ECE **SESSION : MO/18**

SUBJECT: EC509 RF MICROELECTRONICS CIRCUIT DESIGN

TIME: 3 HRS. **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a) Write down the expressions of MOS capacitances in cutoff, linear and saturation regions. [5]

Q.1(b) Consider a MOS device with a 0.1-μm gate length, $R_{ge,eff}$ = 40 Ω, g_{sd}= 2 mA/V, and C_{gd}= 3 fF. Assuming a saturation velocity of 10^7 cm/s, estimate the transition frequency f_T and maximum oscillation frequency, f_{max} of the MOS device. All the parameters have their usual meaning. [5]

Q.2(a) Define noise figure and noise factor. Write the value of noise factor of a noiseless circuit or system. [5]

Q.2(b) If the compressed gain is given by $\alpha 1 + \frac{3}{4}\alpha 3 A_{in,\,1dB}^2$ and ideal gain is given by $\alpha 1$, then calculate the 1-dB compression point. [5]

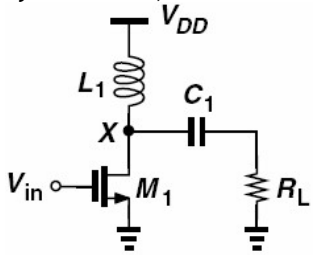
Q.3(a) Write the names for digital counterparts of analog modulation scheme such as AM, PM, and FM. Sketch the ASK, PSK and FSK waveforms to illustrate binary baseband signals. [5]

Q.3(b) Criticize multipath propagation. Explain how wireless communication handles intersymbol interference. [5]

Q.4(a) List the various topologies of LNA. Write down the typical RX noise figure and the contributions of the antenna switch (or duplexer), LNA and the remainder of the chain. [5]

Q.4(b) Schematize CMOS based LNA (CS stage) *with resistive feedback* and formulate its voltage gain and noise figure. [5]

Q.5(a) Consider a power amplifier (shown in Fig. below) delivering 1W (+30 dBm) of power to a 50-Ω antenna. The peak-to-peak voltage swing, V_{PP}, at the antenna reaches 20 V and the peak current through the load, 200 mA. Write the peak current carried by M_1. Assume L_1 is large enough to act as an ac open circuit at the frequency of interest, in which case it is called an "RF choke" (RFC). [5]



Q.5(b) Design a CMOS based class B power amplifier and formulate its maximum "drain efficiency", η. [5]

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