Registration No. :

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B. Tech
PCEC 4201

Third Semester Examination – 2012-13

ANALOGUE ELECTRONICS CIRCUIT

Full Marks – 70

Time : 3 Hours

*Answer Question No. 1 which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

    (a) Cite two operational differences between a MOSFET and an FET.

    (b) State the input impedance of a CC stage in terms of the hybrid parameters. What is its significance ?

    (c) What is a current buffer ? Where is it used ?

    (d) What happens to the overall bandwidth when 10 identical amplifiers are cascaded. Why ?

    (e) Explain how dc load line is different from ac load line. Write two viewpoints.

    (f) Which switch is faster ? A BJT or a MOSFET ? Justify.

    (g) Write the use(s) of CMOS. Draw one such circuit.

    (h) Explain how do you determine the hybrid input parameters of a BJT graphically.

    (i) Why bias stabilization is important ? State at least two reasons.

    (j) How does an emitter resistance affect the frequency response of a CE amplifier ? Illustrate.

P.T.O.

2. (a) Under what conditions does a MOSFET behave as a linear resistor ? Hence, derive an expression for the resistance offered by the device under this condition. Show your steps clearly along with the underlying assumption(s).

5

(b) An E-type NMOS transistor with a threshold voltage of 0.7 V has its source grounded and the gate is connected to 1.5 V. In what region does the device operate for

(a) $V_D = 0.6$ V,

(b) $V_D = 0.8$ V and

(c) $V_D = 3.3$ V ?

Hence find the current in each case for $\mu_n C_{ox} = 100 \; \mu A/V^2$, and $W = 10 \, \mu m$ and $L = 1 \, \mu m$.

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3. (a) Derive an expression for the upper 3-dB cut off frequency for a CE amplifier. State your assumptions clearly.

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(b) An NPN Si transistor with grounded emitter with $V_{BE} = 0.7$ V is operated with a collector current of 1 mA. A 10 KΩ resistor connects the collector to a 12 V supply. What is V_{CE} ? Now, if a signal is applied to the base raises v_{BE} to 705 mV, find the resulting total collector current i_C and the total collector voltage v_C. For this situation, what are v_{be} and v_c ?

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4. (a) In a certain MOSFET amplifier using voltage divider biasing, we need to have a dc drain current of 0.5 mA. The MOSFET has a threshold voltage of 1 V and $k'_n W/L$ of $1 \; mA/V^2$. Use a power supply of 12 V. Design a suitable circuit. Draw your final circuit along with the components.

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(b) Derive an expression for the voltage gain of a CS amplifier having a drain resistance R_D and a source resistance R_S. Draw the small signal equivalent circuit.

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5. (a) Derive the frequency of oscillation in a phase shift oscillator. Draw the small-signal equivalent circuit. 5

(b) Derive suitable expressions for the input resistance and the voltage gain of a transconductance amplifier that uses negative feedback. 5

6. (a) Derive the expressions for the differential gain and the common-mode gain of a differential amplifier with the help of the respective small signal equivalent circuits. 5

(b) Discuss an instrumentation amplifier. Where is it used ? 5

7. (a) Derive the conversion efficiency of a class-B power amplifier. 5

(b) Discuss the circuit operation of a class-A power amplifier. 5

8. (a) Design a suitable circuit for furnishing a reference bias current of 0.43 mA to μA 741. Use power supplies of $\pm$ 12 V. You may assume other parameters in a suitable manner. 5

(b) To what feedback topology, the non-inverting amplifier does belong ? Hence derive an expression for its voltage gain and output impedance ? 5

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