## **GUJARAT TECHNOLOGICAL UNIVERSITY** BE - SEMESTER-V • EXAMINATION – WINTER • 2014

Subject Code: 151003

## Date: 28-11-2014

# Subject Name: Integrated Circuits and Applications

Time: 10.30 am - 01.00 pm

## **Total Marks: 70**

Instructions:

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- **3.** Figures to the right indicate full marks.
- 4. Parameters of 741(op-amp) IC are: A (open loop gain) =  $2 \times 10^5$ ,  $R_i = 2 M\Omega$ ,  $R_o = 75 \Omega$ ,  $f_o \approx 5$  Hz, Supply voltages =  $\pm 15$  V, output voltage swing =  $\pm 13$  V.
- **Q.1** (a) Design a Biquad band-pass filter circuit with a center frequency  $(\omega_0)$  at 1000 **07** rad/s, a bandwidth of 200 rad/s, and maximum gain of 1. Use magnitude scaling factor  $(k_m)$  of 10,000 to get practical values for the components.
  - (b) Draw Sallen and Key low-pass filter circuit and obtain its transfer function. 07
- Q.2 (a) Determine the output voltage in each of the following case for the open-loop 07 differential amplifier constructed using 741 with  $V_{in1}$  applied at non-inverting terminal and  $V_{in2}$  at inverting terminal.
  - a.  $V_{in1} = 5 \ \mu V \ dc, \ V_{in2} = -7 \ \mu V \ dc$
  - b.  $V_{in1} = 10 \text{ mV rms}$ ,  $V_{in2} = 20 \text{ mV rms}$
  - (b) What are the drawbacks of single op-amp based differential amplifier? Draw two op-amp based differential amplifier circuit and obtain expression for its differential gain.

#### OR

- (b) An inverting amplifier is nulled when supply voltage is  $\pm 10$  V. Assume that negative supply voltage remains constant and positive supply voltage varies between +8 to +12 V. SVRR of op-amp IC is 96 dB. Gain of inverting amplifier is -100 when nulled. Assume feedback resistance (R<sub>F</sub>) to be 100 k $\Omega$ . Determine (a) the change in the output offset voltage caused by the change in the supply voltage mentioned above, and (b) the total output voltage if V<sub>in</sub> = 10 mV.
- Q.3 (a) What are the different factors which contribute to output offset voltage in opamp? Explain in detail the approach used to compensate one of these factors.
  - (b) Sketch op-amp based basic integrator circuit. Derive expression for output 07 voltage to justify its operation of integration. What are the problems associated with this circuit? Suggest possible solution.

#### OR

- Q.3 (a) Draw op-amp based peaking amplifier circuit along with its frequency response. 07 Explain its working. Write expressions for the frequency at which gain peaks as well as maximum (peak) gain.
  - (b) Sketch op-amp based basic differentiator circuit. Derive expression for output voltage to justify its operation of differentiation. What are the problems associated with this circuit? Suggest possible solution.
- Q.4 (a) Discuss op-amp based triangular wave generator circuit. Obtain expression for 07 frequency of oscillation for the same.
  - (b) Describe operation of op-amp based peak detector circuit with essential 07 diagrams.

#### OR

Q.4 (a) What are the different important parameters of comparator circuit? Describe 07 operation of op-amp based voltage limiter circuit with suitable diagrams.

- (b) What do you understand by precision rectifier circuit? Illustrate op-amp based 07 full-wave rectifier circuit with its complete functionality.
- Q.5 (a) Describe application of 555 timer as an astable multivibrator circuit. Obtain 07 expressions for frequency of operation and duty cycle.
  - (b) List the different types of voltage regulators. Describe the operation of basic 07 switching regulator.

### OR

- Q.5 (a) Draw block diagram of basic PLL and explain operation of each of the blocks. 07
  - (b) Enumerate characteristics of ideal op-amp, and describe following parameters of op-amp: 1. CMRR, 2. SVRR, 3. Slew rate, and 4. Output voltage swing.

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