Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V • EXAMINATION – SUMMER • 2014

Subject Code: 151003 **Date: 13-06-2014**

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 IC are:** A (open loop gain) = 2 x 10^5, R_i = 2 MΩ, R_o = 75 Ω, $f_o \approx 5$ Hz, Supply voltages = ± 15 V, output voltage swing = ± 13 V.

Q.1 **(a)** (1) Op-amp (741) IC with an open loop gain equal to 2 x 10^5 is used in open loop mode. Supply voltage is ± 15 V. Find out output voltage if (a) V_{id} = -20 mV, and (b) V_{id} = 50 µV. V_{id} is input differential voltage across positive and negative input terminals of op-amp. **07**

(2) Define following terms for op-amp: (a) CMRR, (b) SVRR, (c) Slew Rate, and (d) Output voltage swing.

(b) Design non-inverting op-amp (741) based amplifier which has feedback resistance (R_F) equal to 10 kΩ and closed loop gain of 11. For this circuit, calculate R_{iF}, R_{oF}, f_F, and V_{ooT} (total output offset voltage with feedback). **07**

Q.2 **(a)** Draw two op-amp based differential amplifier and derive expression for its gain, input and output resistances, and bandwidth. **07**

(b) Discuss design steps for input offset voltage compensating network. **07**

OR

(b) For an inverting amplifier with a gain equal to -100 and feedback resistance of 47 kΩ, determine maximum possible output offset voltage due to (1) input offset voltage of 6 mV, and (2) Input bias current of 500 nA. What value of R_{OM} is needed to reduce offset voltage effect due to the effect of input bias current? **07**

Q.3 **(a)** Draw schematic of single supply based op-amp AC inverting amplifier. Explain its working along with necessary input and output waveforms. **07**

(b) Design a practical op-amp based integrator such that peak gain is 20 dB and the gain is 3 dB down from its peak value at *w* equal to 10,000 rad/s. Use capacitance of 0.01 µF. **07**

OR

Q.3 **(a)** Describe the operation of differential instrumentation amplifier which uses resistive transducer in a bridge circuit. Show that the output voltage is directly proportional to the change in resistance value of a transducer. **07**

(b) Draw and explain working of basic differentiator circuit. What are the limitations of this circuit? How it can be corrected? **07**

Q.4 **(a)** Explain working of op-amp based Schmitt trigger circuit along with schematic and input/output waveforms. **07**

(b) Illustrate operation of op-amp based triangular wave generator circuit with necessary waveforms as well as mathematical steps. **07**

OR

Q.4 **(a)** Draw op-amp based full wave rectifier (absolute-value) circuit. Explain its working with necessary input/output waveforms. **07**

(b) Discuss operation of op-amp based saw-tooth wave generator circuit with relevant diagram and waveforms. **07**

Q.5	**(a)**	Describe operation of each block of phase locked loop. List out PLL applications.	**07**
	(b)	Draw Sallen-key low-pass filter circuit and obtain its transfer function.	**07**

OR

Q.5	**(a)**	Draw 555 timer block diagram. Explain its working and its use as a monostable multivibrator.	**07**
	(b)	Sketch Delyiannis-Friend circuit and obtain its transfer function.	**07**

****