

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) = 2×10^5 , $R_i = 2 \text{ M}\Omega$, $R_o = 75 \Omega$, $f_o \approx 5 \text{ Hz}$, Supply voltages = $\pm 15 \text{ V}$, output voltage swing = $\pm 13 \text{ V}$.

- Q.1 (a)** Design a Biquad band-pass filter circuit with a center frequency (ω_0) at 1000 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. **07**
- (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 differential amplifier constructed using 741 with V_{in1} applied at non-inverting terminal and V_{in2} at inverting terminal. **07**
- a. $V_{in1} = 5 \mu\text{V dc}$, $V_{in2} = -7 \mu\text{V dc}$
 - 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. **07**

OR

- (b)** An inverting amplifier is nulled when supply voltage is $\pm 10 \text{ V}$. 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_F) to be 100 k Ω . 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 $V_{in} = 10 \text{ mV}$. **07**
- Q.3 (a)** What are the different factors which contribute to output offset voltage in op-amp? Explain in detail the approach used to compensate one of these factors. **07**
- (b)** Sketch op-amp based basic integrator circuit. Derive expression for output voltage to justify its operation of integration. What are the problems associated with this circuit? Suggest possible solution. **07**

OR

- Q.3 (a)** Draw op-amp based peaking amplifier circuit along with its frequency response. Explain its working. Write expressions for the frequency at which gain peaks as well as maximum (peak) gain. **07**
- (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. **07**
- Q.4 (a)** Discuss op-amp based triangular wave generator circuit. Obtain expression for frequency of oscillation for the same. **07**
- (b)** Describe operation of op-amp based peak detector circuit with essential diagrams. **07**

OR

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

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