

GUJARAT TECHNOLOGICAL UNIVERSITY**B.E. Sem-Vth Examination December 2010****Subject code: 151003****Subject Name: Integrated Circuits and Applications****Date: 16 /12 /2010****Time: 03.00 pm - 05.30 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Take $V_{CC} = +10\text{ V}$ and $V_{EE} = -10\text{ V}$ as supply voltage for op-amp.

- Q.1** (a) Which type of feedback is used in inverting op-amp? Derive exact expressions for voltage gain, input resistance, output resistance and bandwidth for inverting op-amp. **07**
- (b) Explain following terms related to op-amp: **07**
1. CMRR, 2. PSRR, 3. Slew Rate, 4. Channel separation in multiple op-amps IC, 5. Equivalent input noise voltage and current, 6. Input offset current, 7. Input offset voltage

- Q.2** (a) Draw circuit diagram of differential amplifier with two op-amps and derive expression for its output signal as a function of input signals. Also derive expressions of input resistance faced by each input signal. **07**
- (b) Design input offset voltage-compensating network for non-inverting op-amp which has a gain 11 and feedback resistance of $10\text{ K}\Omega$. The op-amp used in non-inverting op-amp has an input offset voltage of 10 mV . **07**

OR

- (b) For the inverting amplifier which has a gain of 100 and feedback resistance of $47\text{ K}\Omega$, determine the maximum possible output offset voltage due to: 1. Input offset voltage, and 2. Input bias current. Determine the value of R_{OM} (offset minimizing resistance) to reduce the effect of input bias current. The required op-amp parameters are: maximum value of input offset voltage = 6 mV dc and maximum value of input bias current = 500 nA . **07**

- Q.3** (a) Explain with necessary diagrams the working of AC amplifiers (inverting and non-inverting) with single supply voltage. **07**
- (b) Design an op-amp based practical differentiator circuit to differentiate an input signal that varies in frequency from 10 Hz to 1 kHz . Draw output waveform of the designed differentiator circuit for an input signal with 2 V peak-to-peak amplitude with 1 kHz frequency. **07**

OR

- Q.3** (a) Draw and explain working op-amp based full-wave rectifier circuit. How is it better in performance compared to full-wave rectifier circuit without op-amp? **07**
- (b) In a differential instrumentation amplifier with transducer bridge to measure change in temperature, show that the output voltage of entire system (circuit) is proportional to change in resistance of temperature sensor. **07**

- Q.4** (a) Explain working of 555 timer based monostable multivibrator. Design the same for the output pulse width of 10 ms . **07**
- (b) Describe working principle of phase-locked loop electronic system and discuss its application as a frequency multiplier. **07**

OR

- Q.4** (a) What are the different types of voltage regulators? Discuss LM317 based adjustable voltage regulator. Indicate bypass capacitors to improve transient response and protective diodes in the connection diagram. **07**

- (b) Which type of feedback is used in Schmitt trigger circuit? Discuss its operation and derive expressions for lower and upper threshold voltage. Design the Schmitt trigger circuit for upper and lower threshold voltage equal to 25 mV and -25 mV. Op-amp maximum output voltages are ± 14 V. Take ± 15 V as op-amp supply voltage. **07**
- Q.5** (a) Discuss importance of magnitude and frequency scaling in filter design. Design Biquad lowpass filter whose poles in normalized s-plane are located at $-0.577 \pm j0.8165$. The dc gain is 2. The frequency is to be scaled by 20,000 rad/sec. Find the values of pole frequency and pole quality factor and design a circuit to realize the specifications. **07**
- (b) Derive transfer function of Sallen-key lowpass filter. **07**
- OR**
- Q.5** (a) Design a Delyiannis-Friend circuit with $f_0 = 12.5$ kHz, $Q_0 = 10$, and midband gain $H = 26$ dB. **07**
- (b) Draw simple internal diagram of operational transconductance amplifier and show that its output current is proportional to difference of input voltages. **07**
