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06EC46

Fourth Semester B.E. Degree Examination, December 2011

Linear ICs and Applications

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Justify any assumptions made.***

PART – A

1 a. Explain input offset current and state a typical input offset current level for an operational amplifier. Discuss offset nulling. **(07 Marks)**

b. Sketch the complete circuit of an op-amp non-inverting amplifier. Write equations for determining suitable values for each resistor :
i) using a bipolar op-amp and ii) using a BIFET op-amp. **(07 Marks)**

c. Design a differential amplifier for a gain of 100. If the input voltage, V_1 = 10V and V_2 = 10.01 to 10.1V. Calculate impedances at V_1, V_2, common mode and differential. Use 741 op-amp. **(06 Marks)**

2 a. Explain how to determine the capacitor values for a high input impedance capacitor coupled inverting amplifier. **(06 Marks)**

b. Explain how exactly the circuit of a non-inverting ac amplifier is modified to be used with single supply op-amps. **(06 Marks)**

c. Design a capacitor-coupled inverting amplifier to operate with a +20V supply. The minimum input signal level is 50 mV, the voltage gain is to be 68, the load resistance is 500Ω, and the lower cut-off frequency is to be 200 Hz, using 741 op-amp. **(08 Marks)**

3 a. With a neat sketch, explain Z_{in} MOD method of frequency compensation. Write the equation for the feedback factor. **(09 Marks)**

b. Define gain bandwidth product of an op-amp and explain its significance. **(05 Marks)**

c. i) Calculate the cut-off frequency limited rise time for a voltage follower circuit using 741 op-amp. Also determine the slew-rate limited rise time if the output amplitude is to be 5V, and cut-off frequency is equal to 800 KΩ.
ii) Determine the maximum undistorted pulse output amplitude for the 741 voltage follower if the output rise time is not to exceed 1 μs. **(06 Marks)**

4 a. Draw the circuit of a current source using an op-amp and a power MOSFET. Indicate typical voltage levels throughout the circuit and explain its operation. **(06 Marks)**

b. Sketch the circuit of a two output half wave precision rectifier. Draw the input and output waveforms and explain the circuit operation. **(06 Marks)**

c. Design a voltage source to provide a constant output voltage of 6V using Zener diode V_Z = 6.3V. The load resistance has a minimum value of 150Ω and the available supply voltage is ±12V. Assume I_z = 20 mA, $h_{fe(min)}$ = 20, $I_{c(max)}$ > 42 mA and $V_{cc(max)}$ > V_{cc}. Draw the circuit diagram and insert the designed values. **(08 Marks)**

PART – B

5 a. Sketch a precision rectifier peak detector circuit, draw the input and output waveforms and explain the circuit operation. Write the equation for calculating the capacitor value for a peak detector circuit. **(06 Marks)**

b. With a neat circuit diagram and waveforms, explain the operation of triangular/rectangular wave generator. **(08 Marks)**

c. Using a 741 op-amp with a supply of ±12V, design a phase-shift oscillator to have an output frequency of 3.5 kHz. **(06 Marks)**

6 a. Explain the operation of an op-amp based monostable multivibrator. Use relevant waveforms. **(06 Marks)**

b. With a neat circuit diagram and waveforms, explain the operation of inverting Schmitt trigger. **(06 Marks)**

c. Design a 2^{nd} order high pass active filter to have a cutoff frequency of 12 kHz. Use a 715 op-amp and estimate the highest signal frequency that will be passed. **(08 Marks)**

7 a. What is the principle of switch-mode power supplies? Discuss their advantages and disadvantages. **(06 Marks)**

b. Explain the functional block-diagram of IC 723 regulator. **(06 Marks)**

c. Design a voltage regulator using IC 723 to meet the following specifications :
$V_o = 5V$, $I_o = 100$ mA, $V_{in} = 15 \pm 20\%$, $I_{sc} = 150$ mA, $V_{sense} = 0.7V$. **(08 Marks)**

8 Explain the following with neat diagrams and waveforms :

a. 555 timer as astable multivibrator **(07 Marks)**

b. 566 voltage controlled oscillator **(07 Marks)**

c. Successive approximation ADC **(06 Marks)**

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