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06EC46

Fourth Semester B.E. Degree Examination, June/July 08
Linear ICs and Applications

Time: 3 hrs. Max. Marks:100

Note :1. ***Answer any FIVE full questions selecting atleast two questions from each part.***
2. ***Justify any assumptions made.***

Part A

1 a. Define CMRR of an operational amplifier. An LM308 Op-amp circuit with a closed loop gain of 33 has a common-mode input of 1.5 V. Calculate the maximum output voltage this might produce. The minimum CMRR for LM308 is 80 dB. **(04 Marks)**

b. Calculate the typical input and resistances of a non-inverting amplifier with a voltage gain of 25, i) Using a 741 op-amp ii) Using a 715 op-amp.

For 741 : $Z_i = 2M\Omega$, $M = 2\times10^5$, $Z_0 = 75\Omega$

For 715 : $Z_i = 1M\Omega$, $M = 3\times10^4$, $Z_0 = 75\Omega$ **(06 Marks)**

c. Compare a voltage follower and an emitter follower. **(04 Marks)**

d. Two signals which each range from 0.1 V to 1 V are to be summed. Using a 741 op-amp design a suitable inverting summing circuit. **(06 Marks)**

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

b. A capacitor coupled non inverting amplifier using op-amp is to have A_V = 100 and $V_0 = 5V$. The load resistance is 10 kΩ and the lower cut off frequency is to be 100 Hz. Design a suitable circuit. **(08 Marks)**

c. Draw the circuit diagram of a capacitor coupled inverting amplifier using a single polarity supply and briefly explain. **(06 Marks)**

3 a. Draw the circuit of a lag compensation network. Explain its operation and show how it affects the frequency response of an op-amp. **(06 Marks)**

b. Determine the upper cut off frequency and the maximum distortion – free output amplitude for a voltage follower : i) when a 741 op-amp is used and ii) when an LF353 op-amp is used.

For 741 : $f_2 = 800kHz$, $S = 0.5V/\mu s$

For LF353 : $f_2 = 5MHz$, $S = 13V/\mu s$ **(06 Marks)**

c. List the precautions that should be observed for op-amp circuit stability. Briefly explain each. **(08 Marks)**

4 a. Draw the circuit of a current source using op-amp for a floating load and explain its operation. **(05 Marks)**

b. A current amplifier circuit with grounded load has an input current of approximately 1 mA and a 100 Ω load resistor. Design the circuit so that the current gain ranges from 5 to 10. Select a suitable op-amp. **(07 Marks)**

c. Using bipolar op-amps with $V_{CC} = \pm15V$, design a high input impedance precision full-wave rectifier circuit. The input peak voltage is to be 1 V and no amplification is to occur. **(08 Marks)**

Part B

5 a. Draw an op-amp sample and hold circuit. Sketch the signal, control and output voltage waveforms and explain the operation of the circuit. **(07 Marks)**

b. Using a bipolar op-amp with ±9V supply, design a phase shift oscillator to have an output frequency of 10 kHz. **(07 Marks)**

c. Show how op-amp can be used as a logarithmic amplifier. **(06 Marks)**

6 a. An inverting Schmitt trigger circuit is to have UTP = 0 V and LTP = 1V. Design a suitable circuit using a bipolar op-amp and ± 15V supply. **(07 Marks)**

b. Draw the circuit of an op-amp monostable multivibrator and explain its operation. **(07 Marks)**

c. Using op-amp, design a second order high pass filter to have a cut-off frequency of 7 kHz. **(06 Marks)**

7 a. List and briefly explain the characteristics of three terminal IC regulators. What are the limitations of these regulators? **(07 Marks)**

b. Design a high voltage 723 regulator so as to get an output voltage of 25 V. **(07 Marks)**

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

8 a. A 555 astable multivibrator has $R_A = 2.2$ kΩ and $R_B = 6.8$ kΩ and C = 0.01 μF. Calculate i) t_{High} ii) t_{Low} iii) free-running frequency and iv) duty cycle, D. Draw the connection diagram. **(07 Marks)**

b. Explain the following for a phase locked loop (PLL),
   i) Lock-in range
   ii) Capture range
   iii) Pull-in time. **(06 Marks)**

c. What is the main disadvantage of Flash ADC? With the help of a neat diagram explain the operation of a successive approximation type ADC. **(07 Marks)**

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06EC46

Fourth Semester B.E. Degree Examination, June-July 2009
Linear ICs and Applications

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions selecting at least TWO from each part.*

PART – A

1 a. With a neat circuit diagramed explain basic operational amplifier circuit. **(06 Marks)**

b. Explain potential divider bias for an op-amp input, with the necessary design steps. **(06 Marks)**

c. i) With a neat circuit diagram, explain direct-coupled inverting amplifier.

ii) Also, design an inverting amplifier using a 741 op-amp, for which voltage gain is to be 66 and the output voltage amplitude is to be 3V. Given : $I_{B(max)} = 500$ nA. **(08 Marks)**

2 a. Explain the operation of a high input impedance capacitor-coupled voltage follower, with a neat circuit diagram. Obtain the expression for input impedance of the circuit. **(08 Marks)**

b. Briefly discuss the upper cutoff frequency of an op-amp circuit. Show how the cutoff frequency can be set for inverting and noninverting amplifiers. **(06 Marks)**

c. Design a capacitor-coupled inverting amplifier to operate with a + 20V supply. The minimum input signal level is 50mV, the voltage gain is to be 68, the load resistance is 500Ω, and the lower cutoff frequency is to be 200Hz. Use 741 op-amp. **(06 Marks)**

3 a. Define and briefly explain:

i) Loop gain

ii) Loop phase shift

iii) Phase margin

iv) Unity gain bandwidth. **(08 Marks)**

b. With a neat circuit diagram, explain Zin Mod method of frequency compensation. Write the equation for the feedback factor. **(08 Marks)**

c. Calculate the slew rate-limited cutoff frequency for a voltage follower circuit using a 741 op-amp, if the peak of sine wave output is to be 6V. Determine the maximum peak value of the sinusoidal output voltage that will allow the 741-voltage follower. Circuit to operate at the 800 kHz. Unity – gain cutoff frequency. Given : S = 0.5 v/μs. **(04 Marks)**

4 a. With a neat circuit diagram, explain the operation of high input impedance full-wave precision rectifier. Draw the voltage waveforms at various points and write the appropriate equations to show that full-wave rectification is performed. **(12 Marks)**

b. Design an instrumentation amplifier to have an overall voltage gain of 625. The input signal amplitude is 10mV, 741 op-amps are to be used, and the supply is ± 20V. **(08 Marks)**

PART – B

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

b. Explain working of an Wein bridge oscillator with the help of circuit diagram, waveforms and equations. **(06 Marks)**

c. Using a 741 op-amp with a supply of ±15V, design a phase-shift oscillator to have an output frequency of 5.5KHz. Given : Av = 29. **(06 Marks)**

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

b. Using a 741 op-amp, design a second order high-pass filter to have a cutoff frequency of 15KHz. (06 Marks)

c. A capacitor-coupled zero crossing detector is to handle a 2KHz square wave with a peak-to-peak amplitude of 10V. Design a circuit using a 741 op-amp with a ±15V supply. Estimate the minimum op-amp slew rate to give a reasonably undistorted output. Also, calculate the lowest sine wave input frequency that can be applied without the phase shift error exceeding 3°. Given : $V_B = 0.1$ V, $I_{B(max)} = 500$ nA. (08 Marks)

7 a. With a neat schematic, explain the salient features of a 723 regulator. (08 Marks)

b. Explain the terms line regulation, load regulation and ripple rejection for a dc voltage regulator. (06 Marks)

c. What is the principle of switch-mode power supplies? Discuss its advantages and disadvantages. (06 Marks)

8 Explain the following with neat diagrams and waveforms:

a. 555 timer as a stable multivibrator

b. 566 voltage controlled oscillator

c. R-2R ladder DAC

d. Dual-slope ADC. (20 Marks)

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06EC46

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
Linear ICs and Applications

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define the following terms as applied to an operational amplifier and mention their typical values for IC 741:
   i) CMRR
   ii) PSRR
   iii) Slew rate
   iv) Output impedance. **(08 Marks)**

   b. Explain the block diagram of an operational amplifier with the help of a diagram indicating the various building blocks. **(08 Marks)**

   c. Sketch and explain a typical gain versus frequency graph for an operational amplifier. **(04 Marks)**

2 a. Design a capacitor-coupled voltage follower using IC741 operational amplifier. The lower cutoff frequency for the circuit is to be 100Hz and the load resistance is 4.7 kΩ. Draw the circuit and explain the operation. **(12 Marks)**

   b. Sketch the circuit of a capacitor-coupled inverting amplifier using a single polarity supply. Briefly explain the operation. **(08 Marks)**

3 a. Discuss the operational amplifier circuit stability and show how feedback in an inverting amplifier can produce instability. Explain the conditions necessary for oscillations to occur in an operational amplifier circuit. **(08 Marks)**

   b. Sketch and explain a circuit to show the Z_{in} mod method of frequency compensation. State the application of the circuit. **(08 Marks)**

   c. List the precautions that should be observed for operational amplifier circuit stability. **(04 Marks)**

4 a. Draw the circuit of an instrumentation amplifier. Discuss the characteristics of the circuit and show how the voltage gain can be varied. Also show the method of nulling common mode outputs and how the dc output voltage can be level shifted. **(12 Marks)**

   b. A voltage source is to be designed to provide a constant output voltage of approximately 6V. The load resistance has a minimum value of 150Ω and the available supply voltage is ±12V. Design a suitable circuit using IC 741 and a zener diode with V_z of 6.3V. **(08 Marks)**

PART – B

5 a. A voltage follower type peak detector is to be designed. The pulse type signal voltage has a peak value of approximately 2.5V with a rise time of 5 μs and the output voltage is to be held at 2.5V for a time of 100 μs. The maximum output error is to be approximately 1%. Calculate the required component values and specify the output current and slew rate of the op-amps. **(12 Marks)**

   b. Draw the circuit of a phase shift oscillator using an operational amplifier. Sketch the output and feedback voltage waveforms and explain the circuit operation. **(08 Marks)**

6 a. Explain the operation of an inverting Schmitt trigger circuit with different UTP and LTP voltages, with the help of a suitable circuit. Discuss the design procedure for components used. Also indicate the input/output characteristics for the inverting Schmitt trigger circuit. **(10 Marks)**

b. Design a second order low pass filter circuit to have a cutoff frequency of 2 kHz. Draw the circuit and indicate the frequency response of the filter. **(10 Marks)**

7 a. List and explain the characteristics of three terminal IC regulators. **(04 Marks)**

b. Explain the principle of operation of a switching regulator. Discuss its advantages and disadvantages. **(08 Marks)**

c. Design a voltage regulator using IC 723 to get a voltage output of 5V. **(08 Marks)**

8 a. Explain the functional diagram of IC 555 with a neat sketch. **(10 Marks)**

b. Write explanatory notes on:
   i) PLL
   ii) A/D converters. **(10 Marks)**

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06EC46

Fourth Semester B.E. Degree Examination, May/June 2010
Linear IC's and Applications

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting at least TWO questions from each part.*
2. Use of resistor, capacitor standard values list and op-amp data sheets is permitted.

PART – A

1 a. Define the following parameters :
i) Input offset voltage
ii) CMRR
iii) Slewrate.
Mention their typical values for op-amp 741. **(06 Marks)**

b. Sketch the circuit of a two-input inverting summing amplifier. Explain the operation of the circuit and derive the equation for the output voltage. **(08 Marks)**

c. A non-inverting amplifier is to amplify a 100 mV signal to a level of 3V. Using a 741 op-amp, design a suitable circuit. **(06 Marks)**

2 a. Sketch the circuit of a high Z_{in} capacitor coupled voltage follower. Briefly explain its operation and show that the input impedance is very high compared to the capacitor coupled voltage follower. **(06 Marks)**

b. Explain how the upper cutoff frequency can be set for inverting and on-inverting amplifiers. **(06 Marks)**

c. Design Z_{in} capacitor coupled voltage follower using an op-amp having lower cutoff frequency of 50 Hz and maximum input bias current of 500 nA. The load resistance is 3.6 KΩ. If the open loop gain is 2×10^5, find ideal value of input impedance of the circuit. **(08 Marks)**

3 a. With a neat sketch, explain the working of a lag compensation network. Show how it affects the frequency response of an op-amp. **(08 Marks)**

b. List the precautions to be observed for op-amp circuit stability. **(08 Marks)**

c. Determine the upper cutoff frequency and the maximum distortion free output amplitude for a voltage follower when a 741 op-amp is used. **(04 Marks)**

4 a. With a neat sketch, explain the working of a precision voltage source using op-amp with a zener diode. Derive an expression relating V_0 and V_Z. **(08 Marks)**

b. Draw the circuit of an instrumentation amplifier. Explain its characteristics. Also show how the voltage gain can be varied. **(08 Marks)**

c Determine the range of resistance R_G for a LH0036 IC instrumentation amplifier to give a voltage gain adjustable from 30 to 300. **(04 Marks)**

PART – B

5 a. Draw and explain an op-amp sample and hold circuit with signal, control and output waveforms. **(08 Marks)**

b. With a neat sketch, explain the working of Wein-Bridge Oscillator circuit. **(06 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. What are the advantages of active filters over passive filters? **(04 Marks)**

b. Sketch the circuit of a second order active high pass filter, explain its working. **(08 Marks)**

c. An inverting Schmitt trigger circuit is to have UTP = 0 and LTP = 2.5 V. Design a suitable circuit using a bipolar op-amp and a ± 18 V supply. **(08 Marks)**

7 a. Explain the application of IC 723 as basic low voltage regulator. **(06 Marks)**

b. Explain the principle of switch mode power supplies. Enumerate their advantages and disadvantages. **(08 Marks)**

c. Using 7805 design a current source to deliver 0.2 A current to a 22 Ω, 10W loads. Take quiescent current as 4.2 mA. **(06 Marks)**

8 a. Draw and explain the functional diagram of 555 timer. **(06 Marks)**

b. With a sketch, explain the working of R-2R ladder DAC. **(08 Marks)**

c. An 8 bit ADC outputs all 1's when $V_i = 2.55$ V. Find its :

i) Resolution in mV/LSB and

ii) Digital output when $V_i = 1.28$ V. **(06 Marks)**

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