BITS, PILANI - DUBAI CAMPUS

KNOWLEDGE VILLAGE, DUBAI

III-Year II- Semester 2003- 2004

COMPREHENSIVE EXAMINATION(Closed Book)

COURSE TITLE: ANALOG ELECTRONICS (EEE UC364/ INSTR UC364)

TIME: 3 Hours Date : 08-06-2004 MARKS: 60

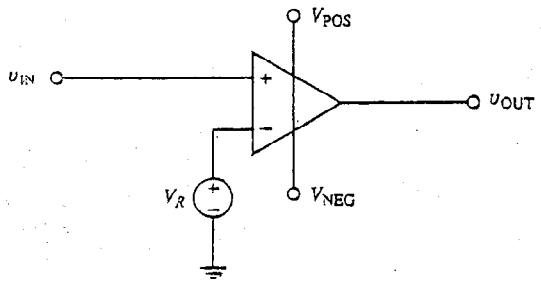
NOTE:

i. Answer all Questions.
ii. Assume any missing data suitably
iii. Answer all parts of question in continuation
iv. Do not leave any blank page in between the answers

1) The 741op-amp is connected as an inverting amplifier. The input an feedback resistors values are 10KΩ, and 20KΩ respectively. It's inpu signal is a ±10V peak-to-peak triangular wave and $V_{sat} = \pm 13V$. Sketc and label the input(V_s), the voltage at the inverting terminal(V_n) and th output voltage(V_o) V_s time. [6 marks]

2) A 6-V peak triangular wave is applied to the circuit shown in figure. I the op-amps are powered by ±12V supplies, plot the resulting output fo the following cases:

(a) $V_R = 0$
(b) $V_R = +3V$
(c) $V_R = -5V$ [6 marks]

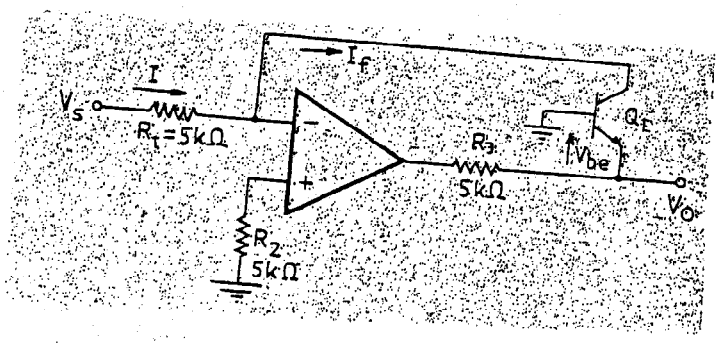


3) A singing group has a lead vocalist and two background musician Each sings into one of three microphones, producing an electrical signa with 10mV maximum magnitude. Using the summation amplifie configuration, design an op-amp circuit that mixes the thre microphone signals and feeds them to a common output. The lea vocalist's signal is to be amplified by twice the amplification factor o the other two singers. The circuit should be designed so that the op-amp does not saturate even if the maximum peak signal is receive simultaneously from all three microphones. The magnetic coil windin

in each microphone contributes a series resistance of 500Ω and ha
negligible inductance. The available power supply voltages are ± 15V
The gain of any one input should not exceed 100 in magnitude. Choo
R_F as 100KΩ
[6 marks]

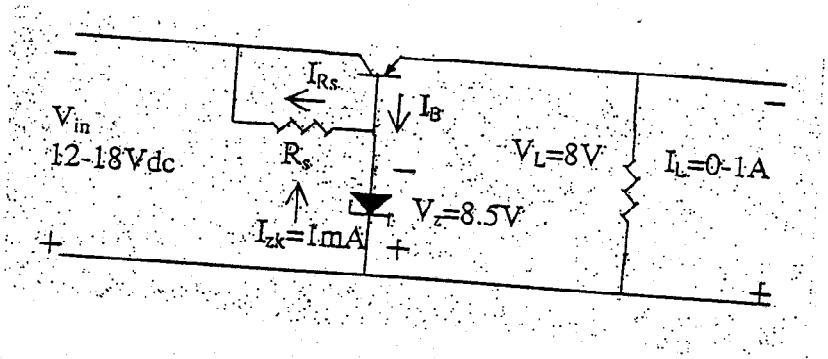
4) Design a wide band-pass filter with f_L = 200Hz, f_H = 1Khz and a pa
band gain = 4.
(a) Calculate R_1, R_F, R, R', R_1' and R_F'.
(b) Calculate the value of Q for the filter.
(c) Calculate voltage gain in dB for frequencies of input signal
(i) 10 Hz (ii) 100 Hz (iii) 200Hz (iv) 447.2 Hz (v) 1000 Hz
Take capacitor in LPF section = 0.01μF and in HPF section =0.05μF.
[6 marks]

5) In the circuit shown determine V_o(in terms of log). Given R1=5 KΩ,
Bolt'z man's constant = 1.38 * 10^{-23}J/°K, T = +298°K(room
temperature) and electron charge = 1.6 * 10^{-19}C. Neglect reverse
saturation current of the transistor.
[5 marks]



6) Provide a design of precision rectifier in which the gain is –2 for
negative inputs and zero otherwise and the input resistance is 100KΩ.
Draw the circuit with all component values.
[5 marks]

7) Design a negative voltage regulator as shown in figure.



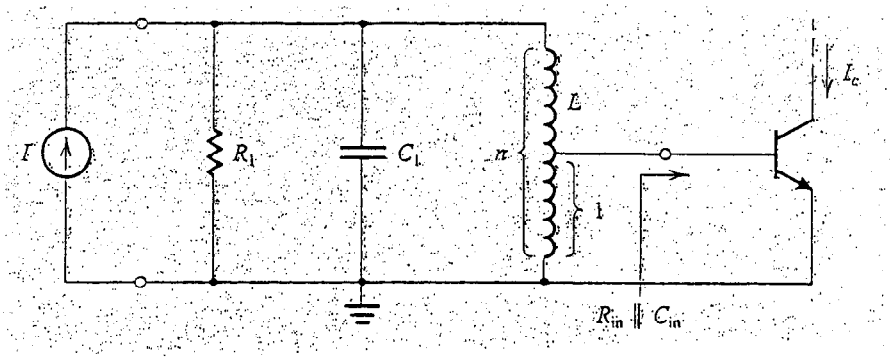
The load current varies between 0-1mA, and the unregulated dc input varies from 12-18V for all line and load changes. The 8.5Vzener diode requires at least 1mA of current to stay in it's regulating region(I_{zk} = 1mA). Assume h_{FE} = 50

(a) Determine the value of R_s to ensure proper circuit operation

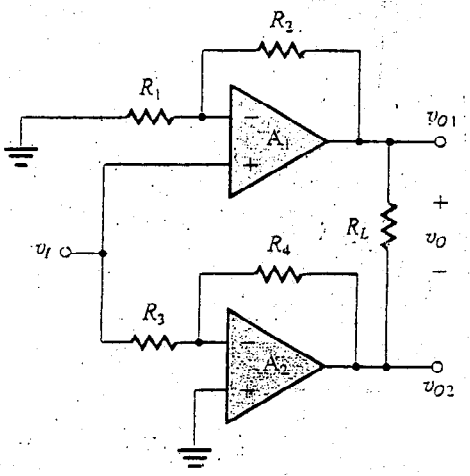
(b) Determine worst case power dissipation of R_s & Q1[6 marks]

8) Design an astable multivibrator using 555, to obtain a square wave with a 50KHz frequency and a 75% duty cycle. Specify the values of R_A and R_B. Take value of timing capacitor as 680pF. [5 marks]

9) Consider the circuit shown first without tapping the coil. Let L = 5μH and assume that R_1 is fixed at 1KΩ. Design a tuned amplifier with f_o = 455KHz and a 3dB BW of 10KHz. If the BJT has R_{in} = 1KΩ and C_{in} = 200pF, find the actual bandwidth obtained and the required value of C1. [5 marks]



10) Consider the circuit shown in figure where R_1 = R_3 = 10KΩ, R_2 = 5KΩ, R_4 = 15KΩ and R_L = 8Ω. Find the voltage gain and input resistance. The power supply used is ±18V. If V_I is a 20V peak- to-peak sine wave, what is the peak- to - peak o/p voltage? What is the peak load current? [5 marks]



11) An amplifier operating from a single 15V supply provides a 12V peak – to - peak sine wave signal to a 1KΩ load and draws negligible current from the signal source. The DC current drawn from 15V supply is 8mA. What is the power dissipated in the amplifier and what is the amplifier efficiency?

[5 marks]

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III-Year II- Semester 2003- 2004

QUIZ-I (Closed Book)

COURSE TITLE: ANALOG ELECTRONICS (EEE UC364/ INSTR UC364)

TIME: 30 minutes **Date : 24-05-2004** **MARKS: 15**

NAME: **ID:**

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1) Since the closed loop gain is smaller than the open loop gain in a negative feedback circuit, the closed loop cut-off frequency is _____ the open loop cut-off frequency
   a) <
   b) >
   c) =
   d) >=

2) When a PLL is locked what is the relation between VCO frequency and the input frequency?
   a) <
   b) >
   c) =
   d) >=

3) In a wein bridge oscillator the lead-lag network provides _____ feedback and the voltage divider provides _____ feedback.
   a) +, +
   b) +, -
   c) _ , +
   d) _ , -

4) Negative feedback increases the _____ impedence of a non-inverting amplifier.
   a) Input
   b) Output
   c) Both input & output

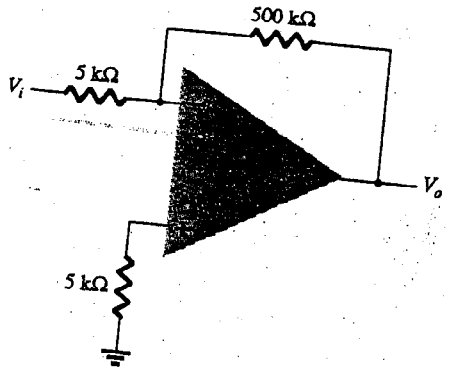
5) In the inductor simulation experiment, the op-amp is connected as

a) An inverting amplifier
b) A non-inverting amplifier
c) A voltage follower
d) Open loop comparator

6) The type of feedback in non-inverting op-amp circuits is
a) Voltage shunt
b) Current shunt
c) Voltage series
d) Current series

7) In 555 timer if V_{cc} = +15V, trigger voltage must be slightly less than _____ V to reset the RS flip-flop.

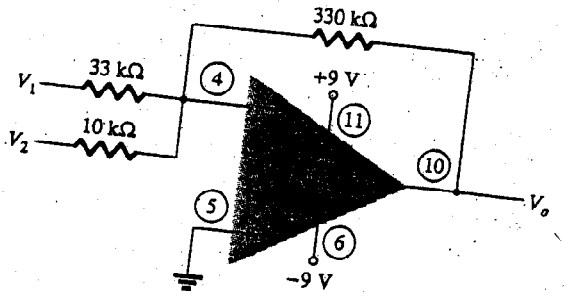
8) What is the total offset voltage for the following circuit for an op-amp with specified values of input offset voltage, V_{IO} = 4mv and input offset current I_{IO} = 150nA



a) 429μv
b) 429mv
c) 329mv
d) 479mv

9) The input _____ current is the difference of the two input base currents.

10) Calculate the output voltage for the given circuit.



The inputs are

$V_1 = 50mv \sin(1000t)$ and

$V_2 = 10mv \sin(3000t)$

11) If the diode offset voltage is 0.7V and an op-amp has a voltage gain of 100,000 the effective offset voltage is _____

12) Well above cut-off a second order active low pass filter has voltage gain that decreases _____ dB/octave ,equivalent to _____ dB/decade.

13) What is the cause of slew rate?

14) What is the physical significance of an input offset current of 15nA?

15) An amplifier with a gain of 10 gives 2vp-p sine wave output. If the input is lifted up by adding 2v DC to it what will be the output?

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III-Year II- Semester 2003- 2004

TEST II(Open Book)

COURSE TITLE: ANALOG ELECTRONICS (EEE UC364/ INSTR UC364)

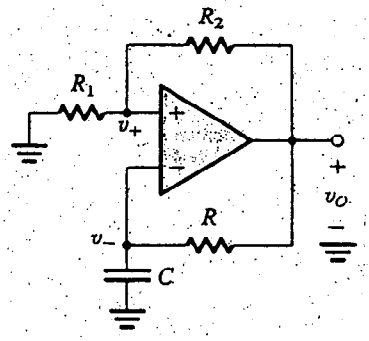
TIME: 50 minutes Date : 02-05-2004 MARKS: 30(=10%)

NOTE:

i. **Only Class notes and EDD notes are allowed**
ii. Answer all Questions.
iii. Assume any missing data suitably
iv. Answer all parts of question in continuation
v. Do not leave any blank page in between the answers

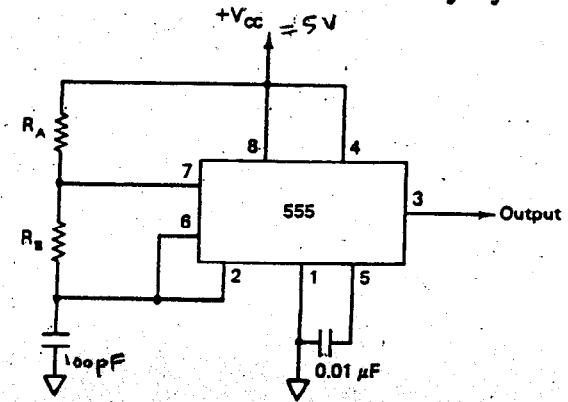
1) A zener shunt regulator utilizes a zener diode whose voltage is 5.1 at a current of 100mA and whose incremental resistance is 7Ω. The diode is fed from a supply of 15V nominal voltage through a 100Ω resistor. What is the output voltage at no load? Find the line regulation and load regulation. [5 marks]

2) In the circuit shown R_1 is replaced by a pair of diodes connected in parallel in opposite directions.

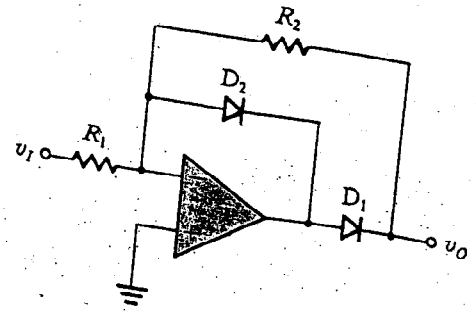


For V_{sat} = 12V, R_2 = R = 10KΩ, C=.1μF and the diode voltage a constant denoted V_D, find an expression for frequency as a function of V_D. If V_D = 0.7V at 25°C with a temperature coefficient(TC) of −2mv/ °C, find the frequency at 25 °C. [4 marks]

3) In the following circuit find the values of R_A and R_B that result in an oscillation frequency of 100KHz and a duty cycle of 75%. [5 marks]



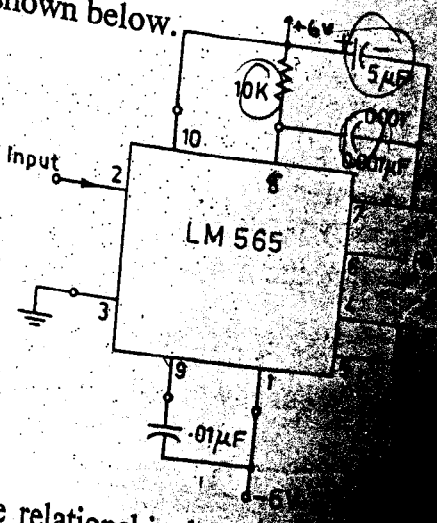
4) In the circuit shown $R_1 = 1K\Omega$, $R_2 = 10K\Omega$. Find V_o and the voltage at the amplifier output for $V_I = +1V$ & $-10mV$. Explain the working for both cases. Assume the op-amp to be ideal with saturation voltages of ±12V. The diodes have 0.7V voltage drop at 1mA and the voltage drop changes by 0.1V per decade of current change. [5 marks]



5) What is the maximum resistor ratio required by a 12-bit D/A converter utilizing a binary weighted ladder. [2 marks]

6) Design a timer circuit using 555 device that operates with a 15V supply and turns on an LED(Light Emitting Diode) for a duration of approximately 10ms every time it receives a negative trigger pulse. The LED requires about 20mA of operating current and forward voltage drop V_f of 1.4V. The high output of timer is $[V_{cc} - 2\ V_{BE}]$. Take C(timing capacitor) = .22μF. Draw the circuit with all values.

7) Refer to the circuit shown below.



Calculate & show the relationship between ... indicating all boundary values.

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III-Year II- Semester 2003- 2004

COURSE NO: EEE UC364/ INSTR UC364 COURSE TITLE: ANALOG ELECTRONICS
TIME: 50 minutes Test - I MARKS: 25

NOTE: (Answer all Questions, Data provided are complete)

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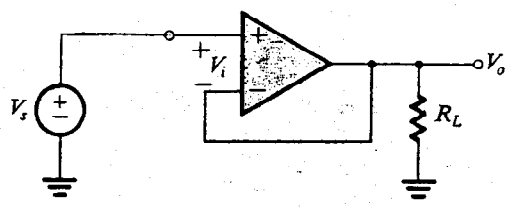
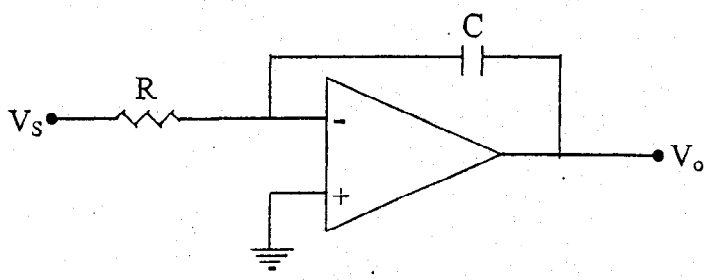
1) A non - inverting op-amp configuration is shown in figure. Assume that the op-amp has infinite input resistance and zero output resistance. If A=100, what is the closed loop voltage gain? What is the amount of feedback in dB? If A decreases by 10%, what is the corresponding decrease in A_f ? (Express it in percentage.) [5 marks]

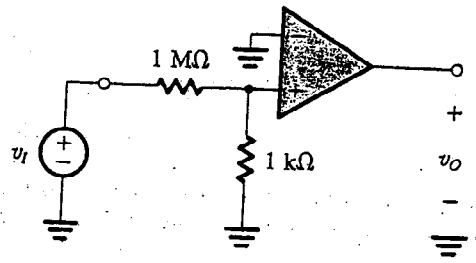


2) Design an inverting op-amp circuit to form the weighted sum V_o of two inputs V1 and V_2. It is required that $V_o = -(V_1+5V_2)$. Choose values for R_1, R_2 and R_f so that for a maximum output voltage of 10V the current in the feedback resistor will not exceed 1mA. [4 marks]

3) Design an integrator (shown in figure) with a resistance of 100KΩ and a time constant of 1 second. For a dc input of –1V applied at the input at time 0, $V_o = -10v$
   (a) How long does it take the output to reach 0 volt?
   (b) How long does it take the output to reach 10 volt? [5 marks]



4) The circuit shown uses an op-amp, that is ideal, except for having a finite gain A. Measurements indicate $V_0 = 3.5V$. When $V_I = 3.5V$, what is the op-amp gain A?
[3 marks]



5) The following specifications are given for a certain wide band pass filter. f_l=400Hz, f_h=1KHz, and pass band gain=1. Calculate the value of Q for the filter. Mention one application of All pass filter.[4 marks]

6) Design a non - inverting amplifier(shown in figure) with a gain of 2. At the maximum output voltage of 10V, the current in the voltage divider is to be 10μA.
[4 marks]