BITS, PILANI - DUBAI CAMPUS
KNOWLEDGE VILLAGE, DUBAI
III-Year II- Semester 2004- 2005
COMPREHENSIVE EXAMINATION (Closed Book)
COURSE TITLE: ANALOG ELECTRONICS (EEE UC364/ INSTR UC364)

TIME: 3 Hours   Date: 22-05-2005   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) A non – inverting amplifier is shown in figure. The open loop gain A_o = 50000. Input voltage v_s is +0.5V average dc, with an ac sine wave component of 0.3V peak - to - peak. Calculate
    (a)   the closed loop gain A_V taking A_o into account
    (b) A_V assuming $A_o = \infty$
    (c)   dc and ac values of v_o and
    (d)   draw input and output waveforms with all voltages marked.

   [8 marks]
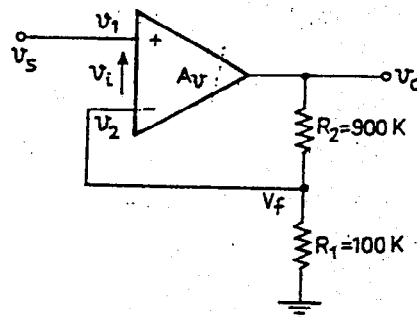
2) The integrator shown in figure has a square wave input as shown in figure. Find the waveshape and amplitude of the output waveform. R_2 is needed for dc feedback, to bring V_o to zero volts when there is no input signal and has very little effect on ac value of the output.   [6 Marks]
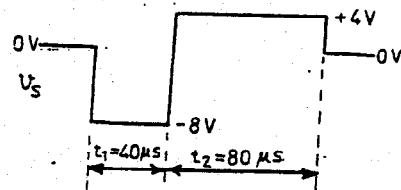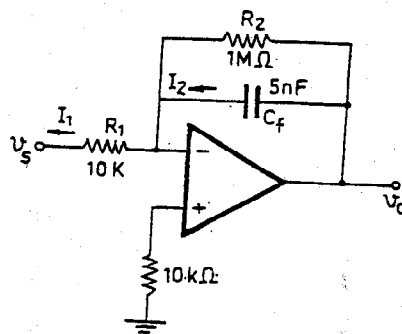
3) In the following circuit $R_1 = 10K\Omega$, $R_2 = 20K\Omega$ .Determine the voltages V_n, V_{OA} and V_O for each of the following inputs:

    (a) $V_S = +5V$

    (b) $V_S = -5V$

Assume that $\pm V_{sat} = \pm 13V$ and the forward drop V_D of the diode $= 0.7V$. What is the maximum value which can be obtained for V_o?   [6 marks]
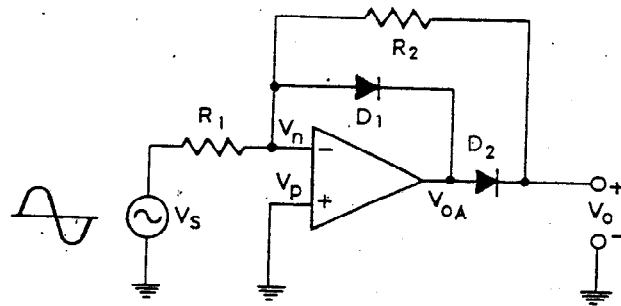

4) What is meant by an ultrasonic sensor? Explain different types of ultrasonic sensors?

An ultrasonic sensor emits a sound beam in a beam angle cone that eliminates side lobes. Target size versus beam spot size is important. Theoretically the smallest detectable target is one half of the wave length of the ultrasonic signal. Targets usually are larger and are sensed at various distances. Estimate the area covered by the ultrasonic signal at a distance of 400mm if the ultrasonic beam angle is $10°$ [6 Marks]

5) In the following circuit

    (a)   Determine the size of each step if $R_F = 27K\Omega$.

    (b)   Calculate the output voltage when the inputs b0, b1, b2 and b3 are at 5V.

    (c)   What is the advantage of this type of D/A converter over the one with binary weighted resistors?   [6 marks]
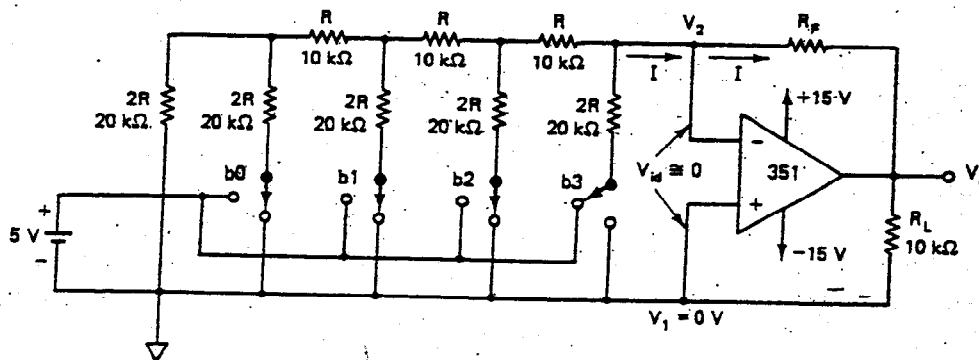
6) Draw one circuit to generate square wave using 555 timer (show internal diagram). Draw output and capacitor waveforms. Derive the expression for duty cycle. [6 marks]

7) The circuit shown is a single tuned circuit using high speed op-amp AD 817. Design the circuit for centre frequency of 455 KHz and quality factor of 80. Find the bandwidth and gain at the centre frequency of the circuit. [6 marks]
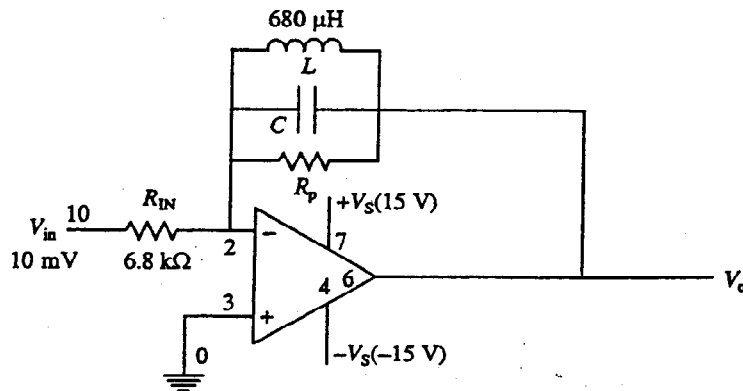
8) Consider the instrumentation amplifier in figure with a common mode input voltage of +5V (dc) and a differential input signal of 10 mV peak sine wave. Let $2R_1 = 1K\Omega$, $R_2 = 0.5M\Omega$ and $R_3 = R_4 = 10 K\Omega$. Find the voltage at every node in the circuit (in volts). [8 marks]

(b)
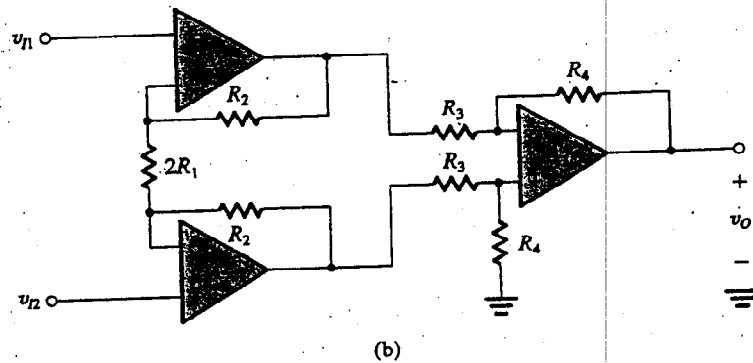
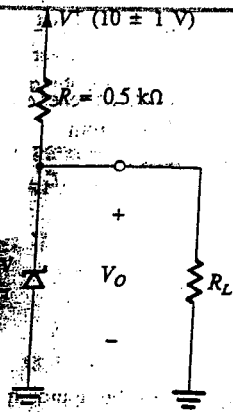9) In the following circuit $V_Z = 6.8V$ at $I_Z = 5MA$, $r_Z = 20 \Omega$ and $I_{ZK} = 0.2mA$. The supply voltage V^+ is nominally 10V but can vary by $\pm 1V$
   (a) Find V_O with no load and with V^+ at its nominal value.
   (b) Find the change in V_O resulting from the $\pm 1V$ change in V^+

(c) Find the change in V_O resulting from connecting a load resistance R_L that draws a current $I_L = 1mA$. Find Load regulation also. [8 marks]

COURSE NO: EEE UC364/ INSTR UC364   COURSE TITLE: ANALOG ELECTRONICS
TIME: 50 minutes   MARKS: 20   WEIGHTAGE:(10%)

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

---

1) An op-amp having the following parameters is connected as shown in figure. A=200,000, R_i = 2MΩ, R_o = 75Ω, R_1 = 470Ω, R_F = 4.7KΩ, supply voltages = $\pm$15V. Compute the values of A_F, R_{iF} and R_{oF}.

   [4 marks]
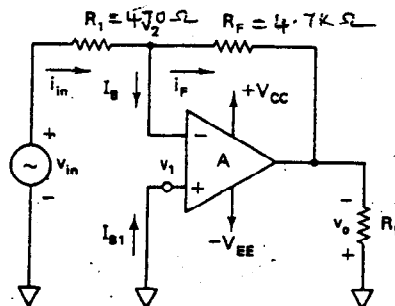
2) Consider an inverting amplifier with a gain of 1000 constructed from an op-amp with an input offset voltage of 3mv and with output saturation levels of $\pm$10V.

   (a) What is the peak sine-wave input signal that can be applied without output clipping?

   (b) If the effect of input offset voltage is nulled , how large an input can be without output clipping?   [4 marks]

3) Consider a symmetrical square wave of 20V peak- to - peak , 0 average, and 2ms period applied to an integrator. Find the value of time constant CR such that the triangular waveform at the output has a 20V peak- to – peak amplitude. Sketch input and output waveforms with all voltages marked.   [4 marks]

4) 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 $10\mu A$.   [4 marks]
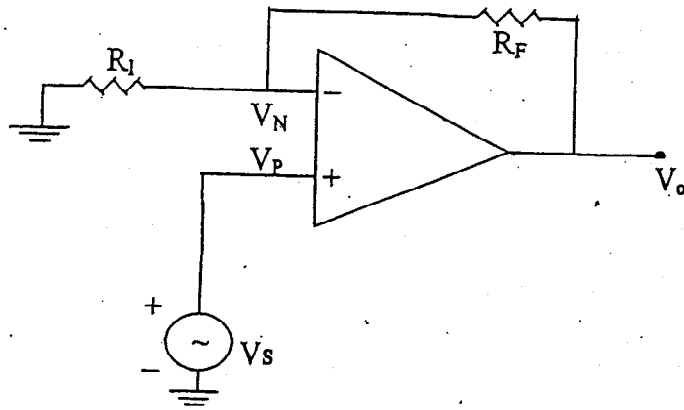
5) Design and sketch a narrow bandpass filter with all component values
so that $f_c = 1kHz$, $Q = 3$, and $A_F = 10$.Change the center frequency to
1.5kHz, keeping A_F and the bandwidth constant.   [4 marks]

choose $C_1 = C_2 = C = 0.01\mu F$