BITS, PILANI - DUBAI CAMPUS

KNOWLEDGE VILLAGE, DUBAI

III-Year II- Semester 2005- 2006

COMPREHENSIVE EXAMINATION (Closed Book)

COURSE TITLE: ANALOG ELECTRONICS (INSTR UC364)

TIME: 3 Hours **Date: 16-05-2006** **MARKS: 60**

NOTE:

i. Answer all Questions, all questions carry equal marks..
ii. Assume any missing data suitably and mention explicitly
iii. Answer all parts of question in continuation
iv. Do not leave any blank page in between the answers

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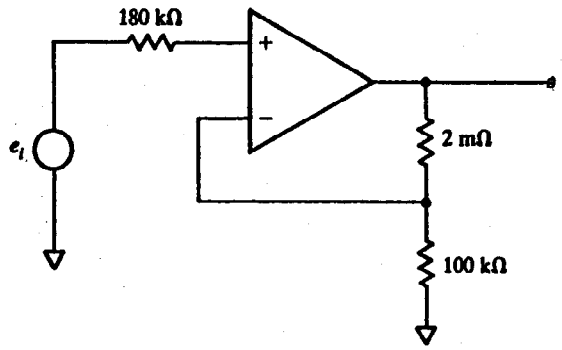
1) a) It is necessary to amplify a $20mV_{rms}$ sine wave, 15 kHz, to $6V_{rms}$, $\pm 1\%$. Can a 741 be used? Slew rate of 741= 0.5V/μs. Explain.
b) What is the biggest advantage of crystal oscillator?
c) A 2-MHz quartz crystal is specified to have L = 0.52H, C_s = 0.012pF, C_p = 4 pF, and r = 120Ω. Find f_s and f_p

2) Calculate the output voltage in the following circuit. Assume that e_i is off(=0 V), V_{ios} = 19.25μV, I_B+ = 79.38nA, I_B- = 79.76nA

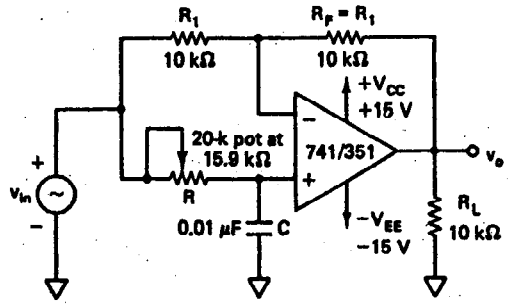


3) An analog signal in the range 0 to +10V is to be converted to an 8-bit digital signal. Clock frequency = 100 kHz
a) Determine the resolution of the conversion in volts.
b) What is the digital representation of an input of 6.2V?
c) What is the error made in the quantization of 6.2V as a percentage of the input?
d) What is the conversion time required for the above case?

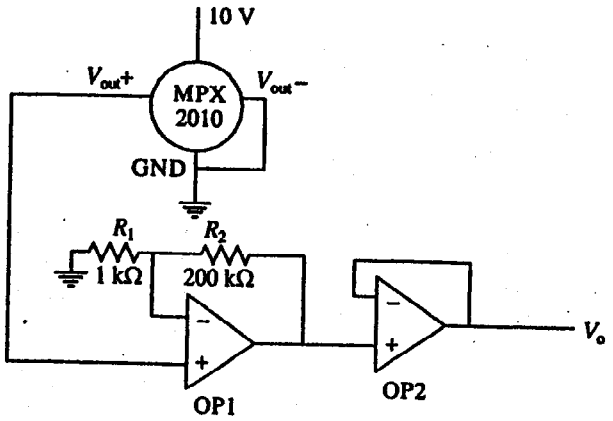
4) For a class B amplifier V_{CC} = 7V and R_L = 5 Ω. If the output is a sinusoid with 7V peak-to-peak amplitude, find

a) the power efficiency
b) the peak currents supplied by V_I, assuming that $\beta_N = \beta_P = 50$
c) the maximum power that each transistor must be capable of dissipating safely

5) For the following circuit
a) find the phase angle if the frequency of V_{in} is 1kHz.
b) Draw both input and output waveforms
c) Mention one application of the circuit.

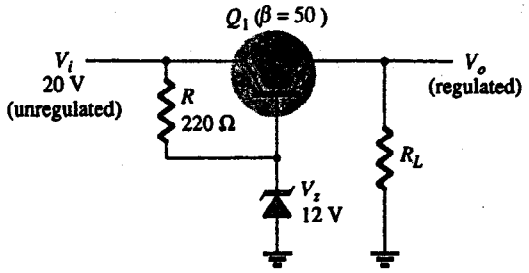


6) Explain briefly the basic working principle of pressure sensors?
Figure shows a low pressure sensing circuit using MPX2010 pressure sensor. Given the offset of the sensor as 1mV, find the differential pressure measured by the circuit if the output voltage V_0 measured is 1.2V. OP1 and OP2 are ideal op-amps. Assume temperature of measurement as 25°C and $P_1 > P_2$

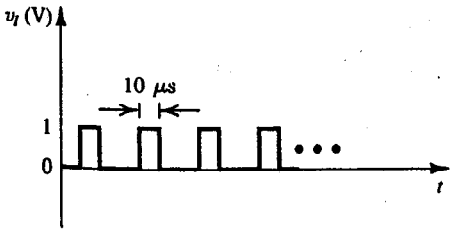


7) Consider a bistable circuit having a non-inverting transfer characteristic with $V_{sat} = -V_{sat} = 12V$, $V_{TL} = -1V$ and $V_{TH} = +1V$
Draw both input and output waveforms clearly indicating all voltages and phase shift (if any) for the following cases.
a) For a 0.5V amplitude sine wave input having zero average
b) For an input sinusoid of frequency f and amplitude 1.1V.

8) Calculate the output voltage and current through zener diode and the two resistors in the regulator circuit for $R_L = 1\ k\Omega$.

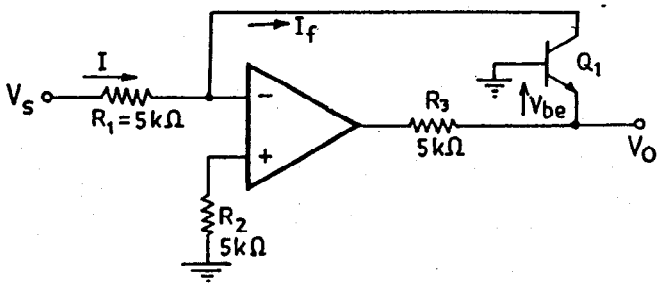


9) Consider a miller integrator having a time constant of 1ms, and whose output is initially zero, when fed with a string of pulses of 10 μs duration and 1V amplitude rising from 0V. Sketch and label output waveform resulting. How many pulses are required for an output voltage change of 1V?



10) Mention one application of log Amplifier.

In the circuit shown derive an expression for V_0 and determine V_0 when V_s=2V. 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.



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III-Year II- Semester 2005- 2006

TEST II (Open Book)

COURSE TITLE: ANALOG ELECTRONICS (INSTR UC364)

TIME: 50 minutes **Date: 16-04-2006** **MARKS: 20(=10%)**

NOTE:

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

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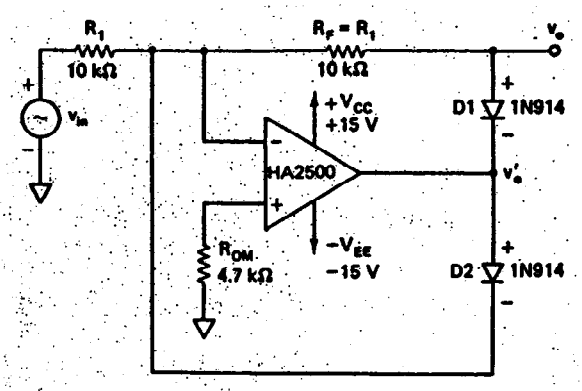
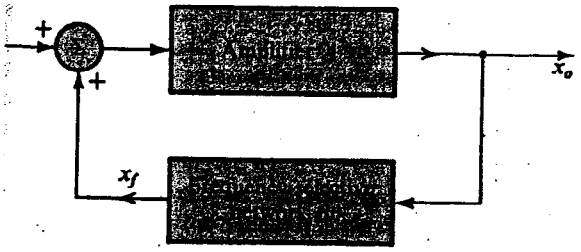
1) In the following circuit v_{in} = 100 mv peak sine wave. Draw input and output voltage waveforms with all voltages marked. Explain the working of the circuit. What is the function of D_1 and D_2? Draw input and output voltage waveforms with all voltages marked when D_1 and D_2 are reversed? [4 marks]

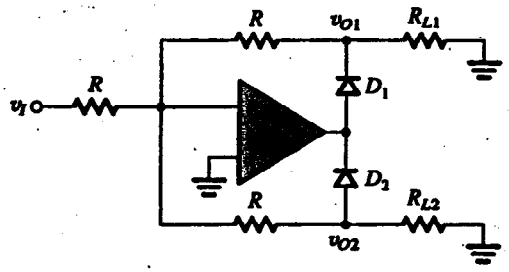


2) A zener diode exhibits a constant voltage of 5.6V for currents greater than five times the knee current (I_{ZK}). I_{ZK} is specified to be 1 mA. The zener is to be used in the design of a shunt regulator fed from a 15 V supply. The load current varies over the range of 0mA to 15mA.Find a suitable value for the resistor R. What is the maximum power dissipation of the zener diode? [4 marks]

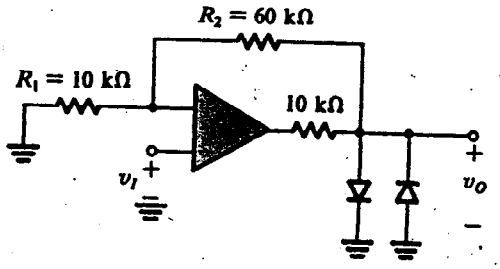
3) In a particular oscillator characterized by the structure as shown in figure, the frequency selective network exhibits a loss of 20dB and a phase shift of 180° at $\acute{\omega}_o$. What is the minimum gain and the phase shift that the amplifier must have, for oscillation to begin? [4 Marks]



4) Plot the transfer characteristics v_{01}-v_I and v_{02}-$v_I$of the circuit in figure. Explain the working. [4 marks]



5) In the following circuit R_1 is eliminated and R_2 is short circuited. Sketch and label the transfer characteristics v_o - v_I. Assume that the diodes have a constant 0.7V drop when conducting and that the op-amp saturates at ±12V [4 marks]



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III-Year II- Semester 2005- 2006

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

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

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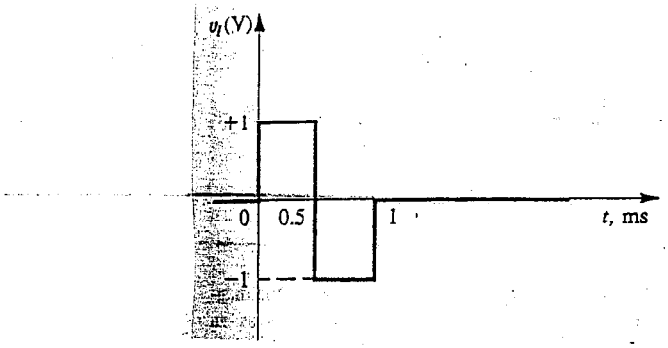
1) An integrator whose input and output voltages are initially zero and whose time constant is 1ms is driven by the signal shown in figure. Sketch and label the output waveform that results. Indicate what happens if the input levels are ±2 V, with the time constant the same (1 ms) and with the time constant raised to 2 ms [6 marks]

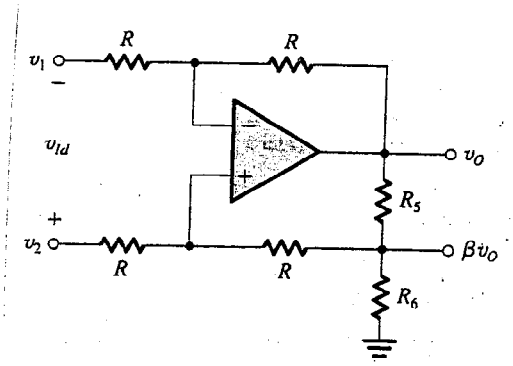


2) For an amplifier having a slew rate of 60V/μs, what is the highest frequency at which a 20V peak-to-peak sine wave can be produced at the output? [3 marks]

3) In an op-amp differentiator R = 10kΩ and C = 0.1μF. When a triangle wave of ±1V peak amplitude at 1 kHz is applied to the input, what form of the output results? What is its frequency? What is its peak amplitude? What is its average value? Draw input and output waveforms with all the values marked. What value of R is needed to cause the output to have 10V peak amplitude? When a 1V peak sine wave at 1 kHz is applied to the original circuit, what output waveform is produced? What is its peak amplitude? Draw both input and output waveforms. Mark when peak value occurs. [6 marks]

[P.T.O]

4) In the given circuit assume that R_5 and R_6 are much smaller than R so that the current through R is much lower than the current in the voltage divider, with the result that $\beta = R_6/(R_5 + R_6)$. Find an expression for A_d in terms of β .Design the circuit to obtain a differential gain of 10V/V and differential input resistance of 2MΩ. Select values for R, R_5 and R_6 such that $(R_5 + R_6) \leq R/100$ [5 marks]



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III-Year II- Semester 2005- 2006

QUIZ-I (Closed Book)

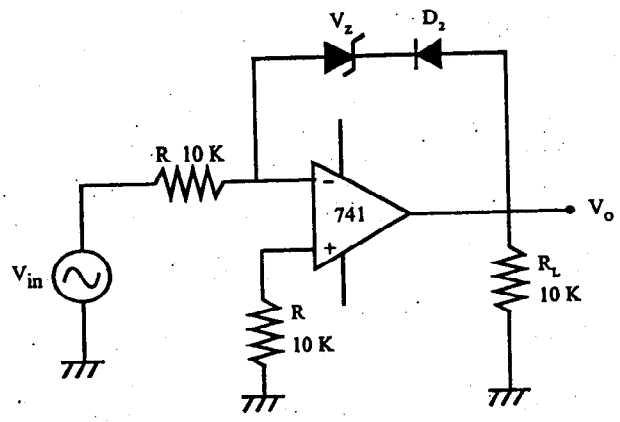
COURSE TITLE: ANALOG ELECTRONICS (INSTR UC364)

DURATION: 30 minutes **Date: 23-03-2006** **MARKS: 10** (5%)

NAME: **ID NO:**

1) Draw the transfer characteristics of a half wave rectifier using op-amp
[1 Mark]

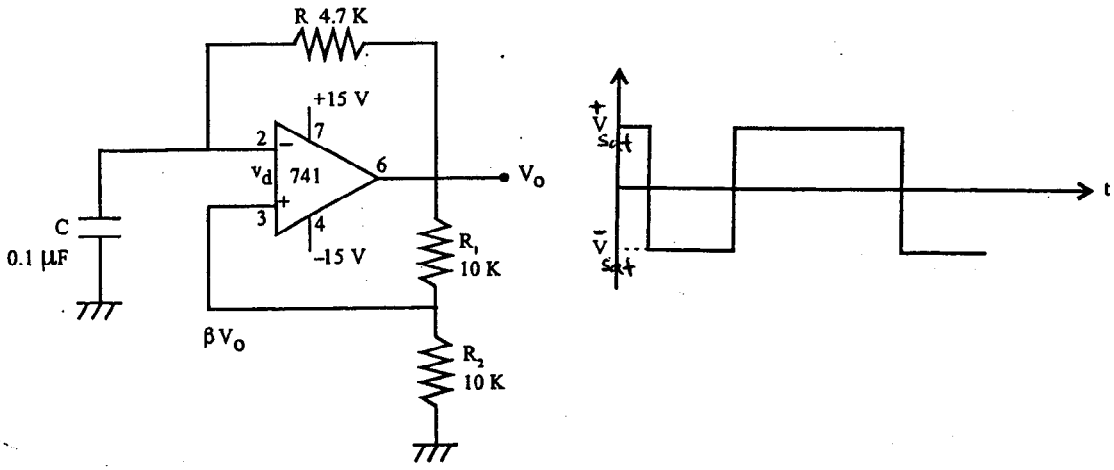
2) Predict the waveforms if the direction of zener diode is reversed in the following circuit. V_{in} = 3V (peak). Draw both input and output waveforms.
[2 Marks]



3) Op-amps with low slew rate are used in clipping circuits (TRUE / FALSE)
[1 Mark]

4) For a particular phase shift oscillator the following specifications are given: $C = 0.1\mu F$, $R = 3.9k\Omega$ and $R_F/R_1 = 29$. Determine the frequency of oscillation. [1 Mark]

5) Modify the given circuit to generate the following waveform [2 Marks]



6) An op-amp comparator outputs $+V_{sat}$ when the voltage at the non-inverting input exceeds the voltage at the inverting input and outputs $-V_{sat}$ when the voltage at the inverting input exceeds the voltage at the noninverting input (TRUE / FALSE) [1 Mark]

7) Diodes can be used as
   (a) an amplifying device
   (b) a rectifying device
   (c) Both (a) & (b) [1 mark]

8) Negative feedback increases the _____ impedence of a non-inverting amplifier.
   (a) Input
   (b) Output
   (c) Input & output [1 mark]