Electronics and Instrumentation
ENGR-4300 Spring 2005 Section _____

Extra Credit
Op-Amp Circuits

You can receive extra credit the second ¼ of the semester by building simple oscillator circuits found in the *Engineer's Mini-Notebook* on Op-Amp Circuits by Forrest M. Mims. There are two small circuits. One creates a square wave pulse and one generates a sine wave. You can get extra credit on the second quiz, ONE of the experiments for this part of the course (4 or 5), OR the second project The points available are as follows:

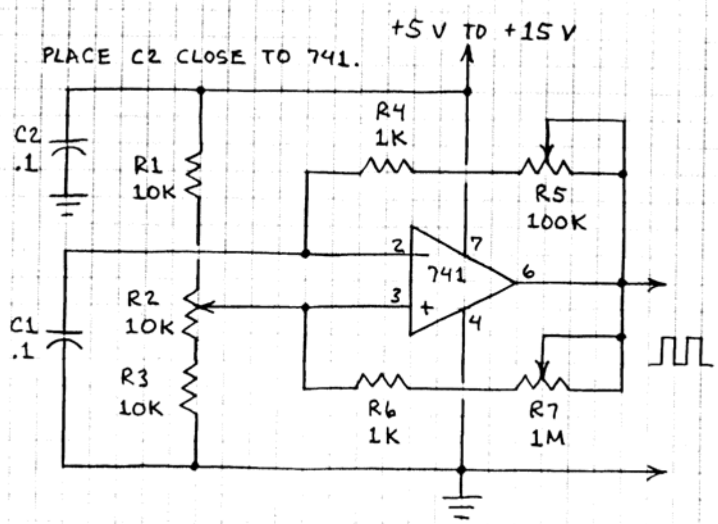
Circuit	Points on Experiment	Points on Project 2	Points on Quiz 2
square wave	3	1.5	5
sine wave	3	1.5	5
cutoff	50	25	100

You can build only one circuit or you can build both. Since there are two different circuits, you can apply each towards a different grade. Fill out one sheet for each circuit. YOU MUST do the project as an individual. Your points will be applied towards your grade on an individual basis. These circuits are not difficult, so it is unlikely that it will take more than one open shop to build one of them.

Ground Rules:
1) We will provide you with a protoboard.
2) The two circuits and some basic instructions are included on the following page.
3) Build your circuit using components from your kit. If you do not have a particular component, ask the staff.
4) Demonstrate that it generates the appropriate output.
5) Have a staff member sign the attached sheet.
6) Return the protoboard. (If you are not finished, we will store the board for you and return it when you wish to continue.)
7) YOU MUST tell the staff member what you would like to apply the extra credit towards at the time s/he signs the sheet.

SQUARE WAVE GENERATOR

PLACE C2 CLOSE TO 741.



THIS CIRCUIT IS AN EASILY ADJUSTABLE SQUARE WAVE GENERATOR. THE TIMING COMPONENTS ARE C1, R4, R5, R6 AND R7. R1-R2-R3 CONTROL THE DURATION (OR "WIDTH") OF THE PULSES. THE PULSES ARE SYMMETRICAL WHEN R2 IS AT ITS CENTER POSITION. OK TO CONNECT R2 DIRECTLY TO +V AND ⏚, THEREBY ELIMINATING R1 AND R3. TYPICAL RESULTS:

C1	FREQUENCY
.001	11, 480 Hz
.047	3, 848 Hz
.01	2, 155 Hz
.047	462 Hz
.1	227 Hz
.47	45 Hz
1.0	24 Hz

FOR THESE RESULTS, R1-R2-R3 REPLACED BY 4.7K FROM PIN 3 TO +V AND 4.7K FROM PIN 3 TO GROUND.
R4 + R5 = 100K,
R6 + R7 = 22K, AND
+V = +12 VOLTS.

OK TO ADD FOLLOWER STAGE TO BUFFER OUTPUT.

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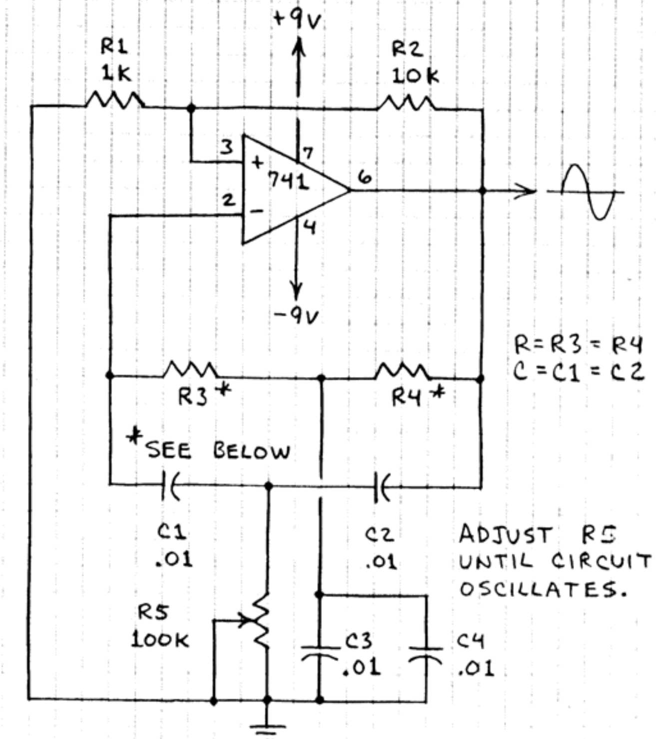
SINE WAVE OSCILLATOR



R = R3 = R4
C = C1 = C2

ADJUST R5 UNTIL CIRCUIT OSCILLATES.

R3, R4, R5, C1, C2, C3, AND C4 FORM A TWIN-TEE FILTER. WHEN CONNECTED IN THE FEEDBACK LOOP OF AN OP-AMP, THE RESULTING CIRCUIT GENERATES A SINE WAVE. THE FREQUENCY IS $1/(2\pi RC)$.

TYPICAL RESULTS FROM TEST CIRCUIT:

R3 = R4	FREQUENCY
4.7 K	2926 Hz
10 K	1356 Hz
15 K	927 Hz

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Extra Credit

Names of Participant(s):_____

Section _____ Group _____

Circuit built _____

Apply Towards: _____

Points _____ (Points per circuit: quiz = 5, project = 1.5, experiment = 3)

Protoboard returned _____

Staff Signature _____