

Course Description: Study of frequency response, feedback and stability in amplifiers. Analysis and design of multi-stage amplifiers, wave generation and power circuits.

Pre-requisite: INEL 4201, INEL 4102

Textbook: Sedra, Adel S.; Smith, Kenneth C.; *Microelectronic Circuits, 6th Edition*, Oxford University Press, New York, 2010.

Primary objectives of course: To develop the ability to analyze and design wide band analog multi-stage amplifiers with and without feedback, as well as circuits based on operational amplifiers, active filters, and power amplifiers.

Professor Information:

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- **Office hours:** Will be posted at <http://www.ece.uprm.edu/~mtoledo>
- **Course web page:** <http://www.ece.uprm.edu/~mtoledo/web/index-4202.html>

Course Examinations and Grading:

Evaluation will consist of three partial examinations (25% each), and a final exam (25%).

Course's Rules:

- Preliminary grade curve: 90-100 = A ; 80-89 = B ; 70-79 = C ; 60-69 = D ; 0-59 = F.
- The course is expected to be *presential*. This modality allows for up to 25% of the lectures to take place on-line. Presentations and other material will be available on UPR's Moodle platform (<https://online.upr.edu>). However, the university administration can decide to change the modality of the course.
- The final exam will cover all the course topics.
- Students are responsible for attending or watching recorded lectures and studying the corresponding material.

Reference Books:

1. Microelectronic Circuit Design, Jaeger and Blalock, 2nd ed., McGraw Hill, 2004.
2. Engineering Electronics, Robert Mauro, Prentice Hall, 1989

Preliminary Schedule

Lesson	TOPIC	Article	Problems
1	Introduction, frequency response, Bode plots	1.6	1.(65, 66, 67)
2	Bypass and coupling capacitors	9.1	9.(1, 3, 5, 11, 12, 14, 15)
3	BJTs and FET high frequency models	9.2	9.(21, 25)
4	Common emitter and common source amplifiers, Miller's theorem	9.(3-5)	9.(33, 34, 38, 39, 60, 61, 64, 65, 68, 69)
5	CG/CB/CD and CC amplifiers	9.(6-7)	9.(76, 84,85, 86, 88, 89)
6	Multistage amplifiers, Effect of bandwidth on pulse response	9.9, 9.10, App. E	9.(102, 104, 108, 109, 112)
7	OpAmp inverting and non-inverting amps, summers, Integrators and differentiators, Applications.	2.(1-5)	2(1, 2, 8, 9, 11, 12, 16, 20, 22, 30, 44, 46, 49, 60, 62, 72, 74, 79, 80)

8	Review Exam I		
9	Exam I		
10	Feedback and its effect on gain, bandwidth and distortion; Classes of feedback amplifiers, effect of feedback on input and output impedance	10.(1-3)	10.(1,7,16,20, 27,28,30)
11	Feedback topologies. Analysis of feedback amplifiers with discrete devices	10.(4-8)	10.(31, 34, 35, 43, 46, 47)
12	Analysis of feedback amplifiers with discrete devices (cont.)	10.(4-8)	10.(53, 55, 57, 61, 65)
13	Analysis of feedback amplifiers with discrete devices (cont.)		
14	Stability, gain and phase margins	10.(9,10, 12)	10.(89, 90, 92, 95, 96, 98)
15	Sinusoidal oscillators, RC oscillators	17.(1,2)	17.(9, 13, 14, 18)
16	LC Sinusoidal oscillators, quartz crystal oscillators	17.3	17.(21, 22, 23)
17	Review Exam II		
18	Exam II		
19	Current sources and differential amplifier	7.(4,5) 8.(1-3, 5)	7.(46, 47, 48, 55, 56, 58, 67, 70, 76, 77, 78) 8.(1, 2, 9, 25, 27, 29, 32, 33, 53, 60, 61, 62, 63, 64, 85, 91, 94, 102)
20	DC analysis of the 741 opamp	12.(3,4)	12.(23, 24, 25, 28, 29, 37, 39)
21	AC analysis of the 741 op-amp	12.5	12.(42, 43, 47, 50)
22	Frequency response and slew rate	12.6	12.(59, 62, 63)
23	CMOS opamp DC and AC analysis	12.1	12.(2, 3, 5, 6)
24	Freq. resp. and slew rate of CMOS opamp		12.(9, 10, 11)
25	Folded cascode opamp	12.2	12.(15, 16, 18, 19)
26	Review Exam III		
27	Exam III		
28, 29	Class A output stages, Class B and AB amplifiers, biasing.	11.(1-5)	11.(15, 19, 22, 23)
30	Power Amplifiers	Notes	