Course Syllabus

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ABET COURSE OUTLINE

Helen and John C. Hartmann

Department of Electrical and Computer Engineering

New Jersey Institute of Technology

Academic Year: **2024-2025**

Term: **Fall 2024**

Course Instructor: ***Josh Taylor***

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Course Number and Title*:*

ECE 232_102, HM4: Circuits and Systems II (3 credits, 3 contact hours, required course)

Textbook (optional):

Nilsson, J.W. and Riedel, S.A., Electric Circuits, 10th Edition, Pearson Prentice Hall, Upper Saddle River, NJ. [ISBN 0-13-376003-0]

Course Catalog Description (including prerequisites and co-requisites):

A continuation of circuits and systems with special emphasis on transient response. Topics include Laplace transform analysis, transfer functions, convolution, Bode diagrams, and Fourier series.

Prerequisites: ECE 231. **Co-requisite:** Math 222.

Specific course learning outcomes (CLO):

The student will be able to

1. Solve for transient responses of first order resonant circuit with single or sequential switching.
2. Solve for transient responses of a second order resonant circuit.
3. Determine Laplace Transform of an arbitrary signal including delays.
4. Demonstrate the ability to perform Inverse Laplace Transform of a rational function (including non-proper
5. and function with exponential factors).
6. Calculate a response of a circuit to an arbitrary signal using Laplace transform.
7. Develop a firm understanding of a concept of frequency response. Determine frequency response of a linear system, use Bode diagrams.
8. Determine the transfer function for a circuit and understand it's properties (poles and zeros, memory and
9. weighting function concept)
10. Use transfer function to find impulse, step and steady state sinusoidal response of a linear system.
11. Use convolution to find response of a linear system to an arbitrary time varying excitation composed of studied time signals.
12. Design a passive/active high, low, band pass, and band reject filter.
13. Find a Fourier series representation of a periodic wave form.
14. Perform power calculation for a circuit with periodic function.
15. Calculate a steady state response of a linear system to an arbitrary periodic wave.

Relevant student outcomes (ABET criterion 3):

(a) an ability to apply knowledge of mathematics, science, and engineering (CLO 1-15)

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints (CLO 1-15)

(e) an ability to identify, formulate, and solve engineering problems (CLO 1- 15)

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Course Outline:

Week	Chapter/ Sections	Topics	Problems*
1		Mathematical expression of signals.	Complex Numbers Homework
2	Ch 9.1-9.9	Sinusoidal Sources, Phasors. Passive Elements in Frequency Domain Kirchhoff's Laws in Frequency Domain, Argand Diagrams. Node Methods of Circuit Analysis with Harmonic excitation. Power levels and dB, half power point, Gain and Attenuation.	9.1, 9.2, 9.3, 9.7, 9.8H, 9.9, 9.11, 9.13, 9.15, 9.16*, 9.18H, 9.22, 9.23, 9.24, 9.28, 9.29, 9.30.

3	Ch 7.1-7.2 Ch 7.3-7.7	**First Order Systems, RL & RC. Natural Response. First Order Systems Step response.** **First Order Systems General Solution with Abrupt PowerChange** **Sequential Switching of First order systems.** ***(Repeat Mutual Inductance problems)*** **Unbounded Response. Integrating amplifier.**	**7.1, 7.2, 7.4, 7.8,* 7.12, 7.14, 7.23, 7.25, 7.26, 7.28, 7.337.36, 7.37, 7.39, 7.42 *H*, 7.44, 7.49, 7.50, 7.57** **7.50, 7.55, 7.60, 7.65, 7.66 *H, 7.68, 7.69, 7.70, 7.71*, 7.72, 7.74, 7.75, 7.81, 7.83, 7.85, 7.87, 7.92, 7.94 *H*, 7.95**
4	Ch 8.1&8.	**Second Order Systems, Series and Parallel Natural Response. Series and Parallel Step Response.** **General Solution with Abrupt Power Change.**	**8.1, 8.4, 8.5, 8.6 8.7, 8.11, 8.14, 8.17 *H*, 8.27, 8.30, 8.35, 8.38, 8.41,** **8.42, 8.44, 8.45, 8.46, 8.53, 8.54, 8.57 *H***
5		***QUIZ I***	
6	Ch. 12.1-12.6	**Definition of Laplace Transform.** **Properties and Theorems.**	**12.1, 12.2, 12.3, 12.4, 12.5 *H*, 12.7,** **12.8, 12.12, 12.14, 12.17, 12.19,** **12.20, 12.22, 12.24, 12.27, 12. 28, 12.29, 12.30, 12.31**
7	Ch. 12.7-12.9	**Functional Transforms,** **Properties of Operational Transforms.** **Inverse Laplace Transform. Initial/Final value Theorem.**	**12.34, 12.36, 12.40, 12.41, 12.42,** **12.43, 12.44 *H*, 12.45 *H*, 12.47, 12.50, 12.51, 12.53, 12.54**

8	**Ch. 13.1-13.3**	**Circuit Analysis using S-domain.** -	**13.1, 13.2, 13.3, 13.4, 13.5, 13.6, 13.7, 13.9, 13.10, 13.13, 13.16*_(plot)_, 13.18, 13.21, 13.23, 13.25, 13.27, 13.28, 13.32_H_, 13.35, 13.36, 13.43, 13.44**
9		***QUIZ II***	
10	**Ch. 13.4-13.5**	**Transfer Functions**	**13.48, 13.49, 13.51, 13.52, 13.56, 13.57_(plot)_**
11	**Ch. 13.6-13.7**	**Convolution.** **Steady State Sinusoidal Response.**	**13.59, 13.60, 13.61, 13.63, 13.64,** **13.65, 13.66, 13.67, 13.69, 13.73, 13.74**
12	**Appendix E**	**Frequency Response. Bode Diagrams.**	
13		***QUIZ III***	
14	**Ch. 14.4-15.4** **Ch. 16.1-16.4** **Ch. 16.5**	**Passive and Active Filters** **Fourier Series, Symmetries, Complex Form** **Application of Fourier Series to Linear System Analysis**	**14.1, 14.2, 14.5, 14.9, 14.11, 14.12, 14.14, 14.18, 14.19, 14.20, 14.25, 14.32, 15.1, 15.5, 15.14, 15.15, 15.30** **16.1, 16.2, 16.12, 16.13, 16.15,** **16.28, 16.30, 16.34**

Grading Policy: Three in-class examinations: 22%, 22%, 22%.

Final examination: 34%

Honors class will have slightly different exam questions.

Attendance: required. **Cell phones:** Shut off or in quiet mode.

NJIT Honor Code will be upheld, and any violations will be brought to the immediate attention of the Dean of Students

Course Summary:

Date	Details	Due
Tue Sep 10, 2024	Academic Engagement: Fall 2024 (https://njit.instructure.com/courses/40681/assignments/482312)	due by 11:59pm

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