EECS 562: Introduction to Communication Systems

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Course Information

- Semester: Spring 2019
- Lecture: TR 09:30 -10:45 AM LEA 3152
- Discussion: Room 3152 Lea; Monday 5:00 - 07:00 PM will be used for test reviews, make up classes, and as needed homework reviews. **Will not meet every week; check class web site to find out if discussion session is meeting.**
- Text: Introduction to Analog & Digital Communications, 2nd Edition Simon Haykin and Michael Moher, Wiley, 2007

Course Information

Class Web Page:
http://www.ittc.ku.edu/~frost/EECS_562/index_EECS_562_Spring_2019.htm

Lab Web Site:
https://people.eecs.ku.edu/~jlialys/EECS562/
Lab GTA : Justinas Lialys jlialys@ku.edu
Labs start Week of Jan 28, 2019.
Lab schedule @ https://people.eecs.ku.edu/%7Ejlialys/EECS562/EECS562_Lab_Schedule.pdf

Office hours and Contact Information:

- Time: 8:00-9:00 TR
- Place: 2001 Eaton Hall
- Other times by appointment
- Phone:
  - Eaton 864-4486
  - Nichols 864-4833
  - Home 841-3244
- e-mail: frost@ku.edu

Course deliverables

- Exams
- Homework: problems will be assigned & graded.
- Labs
- Grading:
  - 2 - In class tests; (135 points/test or 22.5%/test) = 270 pts/test (45%)
  - Lab = 120 pts 20%
  - Homework & Short Quizzes = 45 pts 7.5%
  - Review Test (Signals & Systems) = 15 pts 2.5%
  - Final = 150 pts 25%

    Final: Wednesday, May 15, 7:30 - 10:00 am
- An approximately 30-40 minute test will be given near the beginning of the course to review Signals & Systems concepts from EECS 360.
- There maybe other unannounced quizzes at my discretion.
- General guidelines:
  - Only under very extreme conditions will make up tests be given. I MUST be notified BEFORE you miss a test otherwise you WILL get a 0.
  - Late homework will not be accepted. No makeup quizzes will be given.

Exams

- Closed book
- To be provided on tests as appropriate
  - Table A3.1 Table of Bessel Functions
  - Table A4.1 Table of the values of the Q-function
  - Table A6.2 Fourier Transform pairs
  - Table A6.4 Trigonometric Identities
  - Table A6.6 Integrals
  - Equations 11.17, 11.21, and 11.22

Initial Grading Scale

- 90 - 100 % A
- 80 - 89 % B
- 70 - 79 % C
- 60 - 69 % D
- 0 - 59 % F
  - Lower limit on these ranges maybe reduced as a function of the distribution of the final scores.
  - This class will not use +/- grading

Homework

- All homework assignments will be posted on the class web page
- Solution will not be posted, problems will be worked in class or during office hours upon request.
- Electronic submission of assignments is permitted.
- Electronic submissions must be in pdf format
- Electronic submissions must use this file naming format.
  - Homework: HW#_LastName.pdf
  - For example, for homework # 5 I would submit; HW5_Frost.pdf
- If you e-mail assignments, send them to the grader and cc me.
- Grader: Justinas Lialys jlialys@ku.edu

Homework Format

- All work containing more than one page must be stapled - no paper clips and no folded corners. In order to facilitate grading of homework problems, homework shall meet the following specifications:

  1. Hand written or typed single-sided on 8.5"x11" paper.

  2. If not typed then for text and equations, use an HB or No. 2 pencil (or darker), or blue or black ink. (Pencil is preferred.) No other colors please, except in diagrams or graphs.

  3. All pages should be numbered i/j in top right hand corner, with your name appearing at the top of each page. It is O.K. to use your initials after the first page.

  4. All work must be shown for full grade - be as thorough as possible.

  5. Writing should be legible and literate - if the grader cannot read your handwriting, you will receive no credit for the problem.

Homework Format

- 6. Answers are to be boxed and right justified, with the variables, values (if any) and units (if any), included in the box. Right justified means placed on the right side of the page.

  7. Leave half an inch between consecutive parts of a question, and draw a line across the page at the end of each complete question.

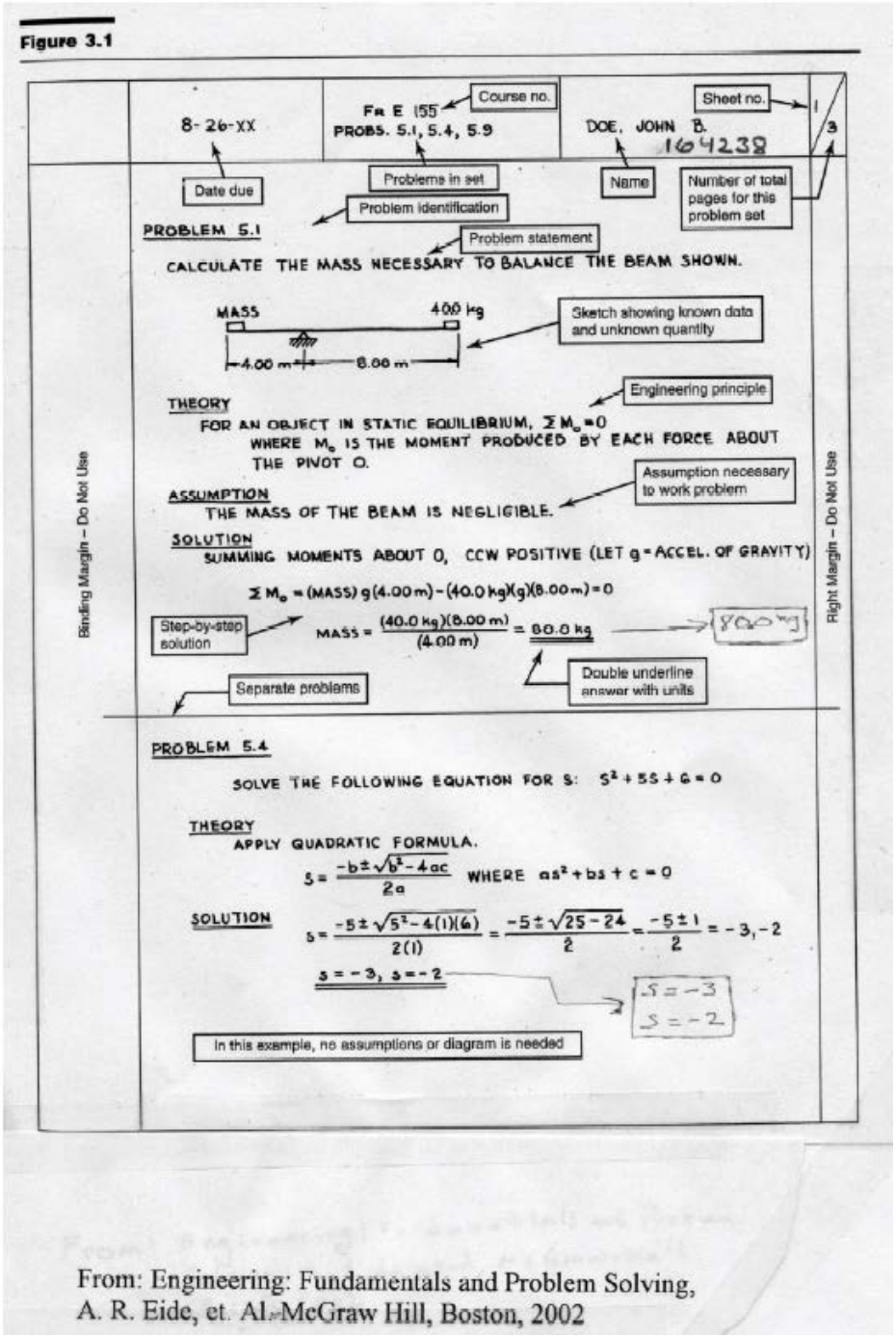
  8. No part of a question should appear in any margin of the paper.

  9. Diagrams and graphs should be of a good size (say at least 3x5 sq. inch), and may contain colors. Diagrams and graphs must be titled, labeled, and clearly drawn. Tables should also be titled.

  10. Graphs should be scaled (put number on axes), labeled (put names /units on axes), and titled at the bottom of the graph. Any graph which occupies an area of less than 3x5 sq. inch and which is not titled will not be graded.

  11. Where possible use conventional units such as bits/sec, Hz and km

Figure 3.1



From: Engineering: Fundamentals and Problem Solving, A. R. Eide, et. Al. McGraw Hill, Boston, 2002

Tools Used for Some Class Assignments and Demonstrations

- Wolfram CDF Player
  - Interactive documents
  - Installed on all EECS Windows computers
  - http://www.wolfram.com/products/player/
- You will need to use a software tool to create plots, e.g., matlab or excel.
- For homework you can also use WolframAlpha to solve integrals and perform other math calculations, see https://www.wolframalpha.com/

Course Outline

- Introduction: Chapter 1
- Signals & systems review: Sections 2.1- 2.7 & 2.10
- **Signals & Systems quiz**
- Spectral Densities: Sections 2.8 & 2.9
- Double-sideband AM: Sections 3.1-3.3
- Frequency Division Multiplexing (FDM): Section: 3.9
- Superheterodyne Receiver: Section: 3.9
- Quadrature Modulation: Section: 3.5
- Single-sideband Modulation: Section 3.6
- Vestigial-sideband Modulation: Section 3.7
- Angle modulation (FM/PM): Sections 4.1-4.9

~ Test 1 

Course Outline

- Noise models & Link Budgets: Sections 11.1-11.6
- Analog modulation noise analysis: Sections 9.1-9.8
- Baseband Data Transmission: Sections 6.1-6.8
- Time Division Multiplexing (TDM): Section 5.10
- Quantizing, coding: Sections 5.1, 5.5, 5.6, 5.9
- Digital carrier modulation: Sections 7.1-7.4 & 7.7-7.8

~ Test 2 

- Performance of Digital Modulation systems: 10.1-10.6 & 10.8
- Orthogonal Frequency Division Multiplexing (OFDM): Section 7.9 + handouts

Course Outcomes

- Calculate and use Fourier Series and Transforms, Energy Spectral Density and Power Spectral Density of signals.
- Explain the basics of analog modulation, DSB-SC, DSB-LC, SSB, PM and FM.
- Compare analog modulation in terms of bandwidth and power requirements.
- Use FDM to combine signals and calculate required bandwidth.
- Explain the operation of a superhetrodyne receiver.
- Explain the basics of baseband digitial transmission.
- Calculate the required bandwidth for baseband digital signals.
- Use TDM to combine signals and calculate required bandwidth.

Course Outcomes

- Explain the basics of digital modulation, ASK, FSK, PSK, QPSK, and M-QAM
- Compare digital modulation techniques in terms of bandwidth requirements and power.
- Calculate signal-to-noise ratios and link budgets.
- Compare the noise performance of DSB-SC, DSB-LC, SSB, PM, and FM. Explain system trade-offs for analog modulation techniques.
- Calculate bit error rate for BPSK, QPSK, M-QAM. Explain system trade-offs for digital modulation techniques.
- Explain the operation of OFDM systems.
- Operate a spectrum analyzer and perform laboratory investigations of analog and digital communication systems.