# Midterm Exam Study Guide
# Tuesday, March 3, 10:30-11:30 am, in MSEE 239

**Material covered:**

- Chapters 1, 4, 5, and 6 of McCarthy text (3rd Ed)
- Lecture Notes: Foundations, Summation, Enclosures, Perception, and Evaluation
- Research Paper (hard copy only): "Introduction to Transmission Line Loudspeaker Enclosure Design" (D. G. Meyer)
- *JAES* Paper: "Loudspeakers on Damped Pipes" (G. L. Augspurger)
- U.S. Patents 2,031,500 and 3,523,589
- Written Homework Assignments 1-4 *(be sure to review posted solutions)*

Scientific calculator required (TI-30X IIS is "officially approved" for engineering exams)

**Chapter 1 – Foundations**

- acoustic decibel
- good sound: context, complications, and quality factors
- acoustic environment indoors and outdoors
- relationship between wavelength and frequency
- effect of temperature on speed of sound
- how sound propagates
- environmental effects on speed of sound
- acoustic waveform: compression and rarefaction
- frequency and phase response
- waveform combining
- crest factor and sound power levels
- loudspeaker sensitivity, calculation of electrical power required
- inverse square law
- loudspeaker beamwidth
- pistonic approximation of cone loudspeaker radiation
- change in directivity pattern and sidelobes as a function of frequency
- maximum frequency a given size driver should radiate

**Chapter 4 – Summation**

- stable summation criteria
- adding/subtracting dB levels *(formulas will be given – be able to apply them)*
- phase wheel
- response ripple
- summation zones (know McCarthy's "icons")
  - coupling
  - cancellation
  - combing
  - combining
  - isolation

- flanging vs. phasing
- triangle type and affect at summation point
- divider/crossover terminology
- acoustic crossover
- spectral vs. spatial dividers
- crossover class (overlap, unity, gap)
- crossover slope ($1^{st}$ / $2^{nd}$ / $3^{rd}$ order)
- spectral vs. spatial crossovers (differences and analogous functions)
- spatial shapes vs. speaker orders
- speaker array types *(know the crossover class progressions)*
  - coupled vs. uncoupled
  - line source
  - point source
  - point destination
- speaker/room summation

**Loudspeaker Enclosures**

- how loudspeakers work
- open back loudspeaker cabinet analysis
- damped pipe analysis
- loudspeaker small signal parameters (e.g., Fs, Vas, Q)
- sonic effect of loudspeaker cable (damping)
- loudness level and power requirement
- baffles
  - enclosure-related parameters (e.g., EBP, Fc, Vc, Vb, Q)
  - infinite baffle
  - sealed box
    - electromechanical equivalent
    - response shape as a function of $Q_{TC}$
    - enclosure volume and efficiency
    - box filling or damping
    - design example
    - golden ratio box dimension ratios
  - vented box
    - bass reflex
      - design example
    - passive radiator
    - compound/band-pass
    - rear-loaded horn
    - labyrinth/transmission line/damped pipe
    - waveguides
    - Bose Wave Radio case study/comparison
      - AWR1
      - WRII

**Chapter 5 – Reception**

- loudness perception
- crest factor
- equal loudness contours
- localization
    - vertical – HRTF
    - horizontal – ITD and ILD
- panoramic perception
- level vs. delay panning
- precedence (Haas) effect
- tonal, spatial, and echo perception
- stereo scaling for different size/shape venues
- panoramic angle
- myth of “stereo everywhere”

**Chapter 6 – Evaluation**

- Features of natural emission/transmission/reception
- Features of amplified emission/transmission/reception
- Subjective room parameters *(quiz each other over these)*
    - intimacy
    - liveness
    - warmth
    - definition/clarity
    - brilliance
    - diffusion
    - balance
    - blend
    - ensemble
    - immediacy of response
    - texture
    - dynamic range
    - tonal quality
    - uniformity