MID-TERM EXAM

TERMS:

meantone vs. equal temperament:

Equal temperament is the system of tuning commonly used today. It divides the octave into twelve equal steps on the logarithmic scale (12-TET). These intervals can be calculated using the twelfth root of 2. However, equal temperament can also be calculated much more easily using only square and cubic roots. Aristoxenus (~ 300 BC), although he eschewed mathematical manipulations for intervals, is often seen as the first proponent of equal temperament since he says the octave can be divided into six equal whole steps.

Meantone tuning is similar to just tuning in the sense that the just major third (5:4) is seen as an important interval to include in the system. As opposed to just tuning, however, meantone tuning divides this major third into two equal parts using a geometric mean (thus the name "mean"-tone temperament). The fifths in the meantone system must be adjusted in order to make the thirds in tune. Since the Pythagorean third differs from the just third by a syntonic comma, and since four stacked fifths give what is the pitch-class equivalent of a third from the beginning note, the syntonic comma is divided in fourths and distributed equally among these fifths. These fifths are thus a little lower than just. At some point in the system, a "wolf" fifth occurs where the cycle does not line up any more. Often, this occurs between G# and Eb.

***trias harmonica*:**

The term was first coined by Johannes Lippius (~early 1600s). It refers to what we call "the triad" and recognizes the root, third, and fifth. As such, inversional theory has its beginnings with this term. Zarlino had discussed the *harmonia perfetta*, but with his term,

Zarlino saw the 5/3 and 6/3 chords as two distinct entities. Lippius, however, notes how the root can move into different voices, thereby distinguishing between the root and the bass. Lippius's term is foreshadowed by the writings of Avianus and Otto von Harnish.

***Stylus Gravis* vs. *Stylus Luxurians*:**

These two terms come from the writings of Christoph Bernhard (~mid 1600s) as shown in his *Tractatus*. *Stylus Gravis* refers to the older form of contrapuntal writing, typically associated with the chuch style (*prima pratica*). In *Stylus Gravis*, only a limited number of dissonances are allowed, such as the unaccented passing note or the properly-prepared-and-resolved suspension. Bernhard describes these types of dissonance with rhetorical names (the teaching of which is called *Figurenlehre*). In contrast, *Stylus Luxurians,* which encompasses both *Stylus Luxurians Communis* and *Theatralis*, allows more dissonant figures. *Theatralis* allows even more than *Communis*. Such figures as *heterolepsis* (jumping into another voice) describe the freedom of contrapuntal writing without taking a perjorative stance.

***occursus*:**

The term seems to have first appeared in Guido of Arezzo's *Mircologus* (c.1027). In his discussion of diaphony (organum), Guido uses *occursus* to describe the end of the line of chant. In the beginning of the chant, Guido's examples mostly show parallel intervals between the two voices. However, near the end, the voices end up converging to a unison, often through oblique or contrary motion. Thus the *occursus* can be seen as a predecessor to the notion of cadence. Interestingly, though, these cadential moments often include seemingly highly-dissonant counterpuntal relationships, such as parallel seconds.

tetractys vs. senario:

The tetractys is one of the numerological foundations of Pythagorean theory. It represents the numbers 1 through 4 (often with a diagram that resembles bowling pins that shows how 1+2+3+4 = 10). The tetractys was used as the basis of consonance for the Pythagoreans, where superparticular combinations of these numbers were consonant, i.e. 2:1, 3:2, and 4:3 (octave, fifth, and fourth, respectively).

Since the Pythagorean tetractys does not account for the major or minor thirds, Gioseffo Zarlino (1558) extended the numbers to include 1 through 6 in his senario. This way, the superparticular ratios of 5:4 and 6:5 (major and minor third respectively) could be included in the list of fundamental consonances.

Pythagorean vs. syntonic comma:

The Pythgorean comma (also known as the ditonic comma) is the difference between:
A) the note one gets (in a 12-tone system) when – after continuously stacking perfect fifths (3:2) on top of one another – one arrives back at the same letter name, and
B) the note that would be a pure octave (2:1) from the original starting note

The ditonic comma can also be generated by subtracting two limmas from a Pythagorean whole tone (9:8)

The syntonic comma is the difference between:
A) the Pythagorean third, which is the result of the addition of two Pythagorean whole tones (9:8*9:8) and
B) the just third, which is in the ratio of 5:4

The syntonic comma can be represented by the ratio 81:80, since the Pythgorean third equals 81:64 and the just third has a ratio of 80:64.

harmonic, arithmetic, and geometric means:

The harmonic, arithmetic, and geometric means are the three means that are commonly called the "Pythagorean means." Their first application to music is said to have been documented in Archytas (c 300 BC). The arithmetic mean is simply the average of two numbers. For frequency ratios, the arithmetic mean gives the Perfect Fifth between two notes an octave apart. The harmonic mean can be seen as a sort of inverse of the arithmetic mean. The harmonic mean is the reciprocal of the average of the reciprocals of two numbers. For string lengths, the harmonic mean gives the Perfect Fourth between two notes and octave apart. Since frequency and period (i.e. string length) are inversely proportional, the interval that is the harmonic mean in one domain will be the arithmetic mean in the other, and vice versa. A nice example is, given the numbers 600 and 1200, then 900 is the arithmetic mean and 800 is the harmonic mean.

The geometric mean is the square root of the the difference between two intervals, e.g. the geometric mean between 1 and 2 is the square root of 2 (~1.414). Using the geometric mean, one can calculate intervals in equal temperament (~1.414 is the equal-temperament tritone). It is surprising, given the availability of the geometric mean to Greek theorists, that divisions of the octave using this method weren't more commonly done.

***musica practica*/*musica poetica*:**

Musica Poetica was a term first introduced by Nikolai Listenius (~ mid 1500s) in his treatise *The Rudiments of Music*. Listenius was attempting to create a system of instruction in

composition that bridged the gap between the more abstract rules of counterpoint that had been the focus of theory up until this point and the the more *musica practica* (practical approach) of actually teaching how to compose music. Listenius was inspired by the rhetorical tradition of the Roman orator as circulated in treatises of Quintillian, Cassiodorus, and others from the first couple centuries AD. In this sense, Listenius was finally merging the *Trivium* of the liberal arts tradition with the *Quadrivium* mathematical-ratio tradition that had been the focus of many treatises.

Musica Poetica is also the name of a treatise by Burmeister (~1600). In this treatise, Burmeister describes the rhetorical process of compositional and divides the work into three parts, the *exordium*, the body, and the closing. The *exordium* typically has the quality of a fugue and acts as the introduction to the piece, serving the same function as the introduction to an essay or speech.

Pythagorean vs. just intonation:

Pythagorean intonation is based solely on the preference for the tetractys. As a result, all intervals are calculated based on the octave, fifth, and fourth. The whole tone, therefore, is defined as the difference between the perfect fifth (3:2) and the perfect fourth (4:3). This ratio ends up being (9:8). With just intonation, theorists attempted to reconcile Pythagorean intonation with the auditory consonance of the just major third (5:4). Ramis de Pareia (1440-1500) is a good example of a theorist who was concerned with just intonation. To produce the just major third, theorists typically develop two different sizes for the whole tone, which includes both the Pythagorean whole tone (9:8) but also the 10:9 whole tone. The just system finds its

insipiration in the sytonic diatonic tetrachord of Ptolemy (~100 AD). This syntonic diatonic tetrachord had ratios of 10:9, 9:8 and 16:15, thereby giving a just major third.

genera and "shades":

The notion of genera concerns qualities of tetrachords. Three genera form the collection of genera in Greek writing: the chromatic, the enharmonic, and the diatonic. Archytas (~ 300 BC) is said to be the first writer to describe these three genera. The basic intervals of the enharmonic genus seem to be something like a quarter-tone, followed by a quarter-tone, followed by a ditone. The chromatic genus intervals are roughly semitone, semitone, and then tone-and-a-half. The diatonic genus is typically around a tone, a semitone, and then a tone.

Shades of these genera, as described in Aristoxenus (also c 300 BC), are different subtle tunings and shifts of the particular notes without going too far away from the baseline of the genus. These shades were described in Aristoxenus as parts of a whole tone and were descriptive names, such as the "tense" diatonic or the "soft" diatonic.

ESSAYS:

1) interval vs. pitch (and their collections) from Greeks to Middle Ages:

As we purvey the history of the concept of "interval" and "pitch" from the ancient Greeks to the Middle Ages, we can see a general trend from the more abstract and flexible conceptions to more fixed, concrete and inflexible definitions for these terms.

In the Greek era, the Pythagoreans were less interested in "pitch" as a fixed place in auditory space as they were with the ratios between two pitches. Intervals for the Pythagoreans were defined by specific mathematical ratios and given a hierarchy according to the simplicity of these ratios. Because of this focus on the mathematical qualities between notes (as opposed to their sensory qualities) the Pythagoreans made some qualifications of intervals that may seem strange to modern readers. For example, the 8:3 ratio – i.e. a Perfect Fourth plus as Octave – was seen by the Pythagoreans as not being a consonant value since the ratio was not superparticular (epimoric) like 4:3 was. Therefore, octave equivalence was not something recognized by the Pythagoreans.

Aristoxenus, on the other hand, was very concerned with the sensory experience and recognized the similarity that notes had when they were an octave apart. Yet Aristoxenus did not revisit the ratios of the Pythagoreans and develop a more concrete notion of pitch and interval. Instead, Aristoxenus argued for the complete variability of pitches within space, based on what shade or genus the pitch was a part of. Even with a fixed number of genera and shades, though, Aristoxenus allowed for the infinitie possibilities within performance of where pitches actually lay. The lichanos, for example (the third note in the hypton and meson tetrachords) can have great variability. Thus Aristoxenus criticized the Harmonicists – who seemed to be preoccupied with mapping out pitch space based – for being too concerned with fixed pitches.

The writings of Nicomachus of Gerasa (~ 100 AD) basically transmit those of the Pythagoreans, but it is in his contemporary Ptolemy that we see a more critical and sensory approach to the Pythagorean principles. Ptolemy states that the octave and perfect fourth must be a consonance. Yet Ptolemy criticizes Aristoxenus for the "sloppiness" of his non-mathematical approach. Therefore Ptolemy can be seen as an early attempt to recognize the octave periodicity within note collections, but on a more mathematical basis.

In Boethius's *Fundamentals of Music* (~500 AD), there is a mixture of Nicomachus and Ptolemy. Boethius lays out the two basic scales of the Greek system – the two-octave Greater Perfect System (systema teleion) and the octave-and-a-fourth Lesser Perfect System (systema synemmon). These two systems are the result of combinations of tetrachords, the GPS being a disjunct/conjuct system of tetrachords while the LPS is a conjuct system only (and therefore necessarily introduces a Bb in the upper tetrachord). Even though Boethius transmits the octave equivalence of consonance (from Ptolemy), the very nature of pitch names in the GPS and LPS show no such octave equivalency. For example, in the GPS, the hypate hypton and the hypate meson have similar names, but in what would be the octave above the hypate hypton, the note is called the paramese. Thus we can see that note names have not been reconciled with the systems of consonance that the theorists of this time are recognizing via their senses.

Perhaps the best example of this confusion can be seen in the *Musica enchiriadis* and *Scolica enchiriadis* treatises. In these works (c. late 800s-900s), a scale is laid out that is composed entirely of disjunct tetrachords. Symbols for equivalent notes in these tetrachords (the first note in each being the protus, second the deuterus, etc.) are similar. In this manner, the *enchiridadis* system is focused on the Perfect Fifth as the interval-level at which note qualities repeat themselves. However, the author(s) of these treatises also recognize the similar quality

between notes an octave apart, which is dubbed the "miraculous mutation". The reconciliation between tetrachordal and octave qualities is thus left unaddressed.

In the contemporary writings of Hucbald (~ 900 AD), we see an early attempt to organize the pitch collections into something more efficient. Hucbald merges the GPS and LPS as transmitted into one giant scale system. Hucbald includes both a B-natural and a B-flat in his scale. He also develops a new notational system. The neumatic system that had been common up until Hucbald's time was too "uncertain" for him. Thus in Hucbald we can see a strong desire to pin down pitches as fixed notes within pitch-space and assign specific values to these notes.

It was not until the *Dialogus* (formerly attributed to Odo) and then the *Micrologus* (c. 1027) of Guido of Arezzo (who based his work strongly on the *Dialogus*) that the notion of pitch and pitch collections began to approach more closely what is our modern conception. Guido assigns letter names to the pitches that correlate exactly with the letter names used today. By using these letter name, Guido is inherently taking the octave as the basic modular component of the scale system (instead of the perfect fifth as the *enchiriadis* treatises had done). Guido maintains the notion of similarity between tetrachords, however, by using the notion of "affinities" (*modus vocum*). As well, Guido's purported invention of the hexachordal solmization system (ut-re-mi-fa-so-la) extends the range at which pitches are seen to be equivalent within a collection. Guido also gives very precise methods (in two different manners) with which to tune to tune the monochord to arrive at these pitches. Thus "pitch" becomes strong associated with a particular point in space. Lastly, Guido extends the scale system by adding further notes to the upper end of the GPS-plus-synemmenon system of Hucbald. Therefore, we see that the notion of pitch is approaching more of an infinite continuum that merely a fixed set of discrete tones.

Chromatic pitches within Gudio's mostly white-note system begin to be introduced throughout the waning years of the Middle Ages. By the time of John of Garland (~ 1300), we see that he is using 12 chromatic pitches within the octave. Mostly, these pitches arise from *musica ficta* – as opposed to *musica vera* – and so there is still an inequality amongst the pitches themselves even within the chromatic collection.

Guido's hexachordal solmization sytems would persist for centuries. Again, it is the lack of an octave solmization system for so many years that points to the lack of complete acceptance as the octave as the definitive organizational system for the pitches that is striking. Not until Ramis de Pariea (1440-1500) do we begin to see evidence of an octave-based solmization system, such as his *psal-li-tur...* method. And only until the acceptance of equal temperament are all the pitches finally given equal status within pitch space.

3) dissonance treatment from late 1400s through Fux:

The history of dissonance from the Renaissance through the Baroque is basically a general trend towards the increased allowance of further levels of dissonance, perhaps relateable to deeper levels of understanding of dissonances and their treatment.

Prior to the late 1400s, notions of dissonance and consonance in counterpoint were fairly black and white. On one level, the categorizations of what intervals actually *were* dissonant – without even regard to counterpoint itself – was a subject of much development during the 1300s and 1400s. Part of this development is intricately tied to the tuning and temperament systems themselves (such as the consonance or lack thereof for the third). By John of Garland (c1300), though, the third receives the label as a consonance – although it is an intermediate one at that. Note that this theorist, however, still labels the sixth as a dissonance.

Many late Middle Ages theorists were obsessed with consonance tables as viable ways of classifying all the allowable intervals between voices. Dissonances were strictly prohibited. Prosdocimus de' Beldomandi, for example, takes this approach in his treatise of 1412.

The use of consonance tables persists throughout the 1400s. In Tinctoris's treatise from 1477 (*The Art of Counterpoint*), most of the work is concerned with listing all of these possible consonant combinations. However, Tinctoris goes one step further, and begins to open the door for categorizing dissonances, which of course were common among the practice of music at this time. In order to affect this dissonance discussion, Tinctoris differentiates between "simple counterpoint" and "diminished counterpoint". In simple counterpoint, the old style of note-against-note is retained and the prohibition against any dissonance is maintained. However, when smaller note values are added – i.e., the longer notes are diminished – certain dissonances are in fact allowed. Tinctoris's treatment of these allowable dissonances is extremely short (especially as compared to the rest of his voluminous treatise), but he does describe what in modern terms can be called the unaccented passing note and the suspension.

By the time of Zarlino, dissonance treatment had become much more flexible. In his *Le Istitutione harmoniche* (first ed. 1558, second ed. 1573), Zarlino includes both the accented passing note and suspension of Tinctoris, but goes on to include numerous other options. Zarlino's "Rule Three" from his *Art of Counterpoint* (Part III of his *Le Istitutione harmoniche*) describes an accented passing note (or neighbor) that is something like an embellished anticipation to a downbeat consonance. Furthermore, Zarlino also allows the tritone to exist as long as it is prepared by a fourth and then resolves to a third. Zarlino also allows the second to resolve to the unison, which previously had been forbidden in countrapuntal treatises.

A student of Zarlino, Giovannia Maria Artusi continued the teachings of Zarlino in his *Art of Counterpoint* (~ late 1590s). Artusi clarifies the use of the suspension by labeling the note that prepares the suspension as the *agente* and the note that resolves the suspension as the *patiente*. Artusi was very concerned with dissonance treatment, as he states that dissonance a powerful tool to represent tears and pain. It is somewhat ironic, therefore, that Artusi is mainly remembered in musicology for his critique of a book of Madrigals by Monterverdi which appeared in the first decade of the 1600s. Artusi complained that Monterverdi's dissonance treatment was not "correct," and that Monteverdi was taking too many "licenses." Monterverdi's brother (Giulio Ceasare) came to Monterverdi's defence in what became to be known as an explanation of the *seconda pratica*, in which dissonance is used freely to represent the text as needed. Artusi represented the limited dissonance treatment of *prima pratica*.

At around the same time as Artusi and Monteverdi's public dispute, Vincenzo Galilei (1588-91) published his *Discourso*. In this treatise, which does not seem to have been widely distributed at the time, Galilei describes a much more liberal approach to dissonance. Suspensions, for example, do not necessarily need to resolve down by step; Galilei allows them to resolve upwards or even be left by a leap. Galilei even goes so far as to create dissonance tables, similar to the consonance tables that were pervasive a century earlier.

The polemical views regarding dissonance in counterpoint were perhaps smoothed over in the work of Christoph Bernhard. In his *Tractatus* (~mid 1600s), Bernhard takes a *Figurelehren* approach to dissonance inspired by the rhetorical school of *musica poetica*. In Bernhard's approach, dissonance as a concept itself is not barred from music, but merely associated and categorized with different styles of music (the *Stylus Grave*, *Stylus Luxurians Communis*, and *Stylus Luxurians Theatralis*). Even what at the time were considered extreme

dissonances – such as the intervals of the augmented second or diminished seventh – were allowed in the *Theatralis* style, where these devices were categorized as rhetorical figures.

During the height of the Baroque era, figured-bass teachings were of course predominant. As a method of improvised counteropint, figured-bass treatises often went to great lengths in categorizing the types of intervals that could appear above a given bass note. It was in response to this increasingly ornate (and perhaps confusing) system of contrapuntal realization that Jean-Philippe Rameau published his *Treatise on Harmony* in 1722. Although not a true counterpoint treatise *per se*, Rameau attempts to great simplify dissonance and dissonance treatment by labeling all dissonances as some sort of manifestation of seventh chords. Even when faced with ninths or elevenths, Rameau posits that the fundamental bass actually exists *above* (in terms of stacked thirds) the sounding bass.

With J. J. Fux's 1725 treatise, *Gradus ad Parnassum*, the study of dissonance treatment reaches a crystallized form. Although contemporary with Rameau, Fux takes an approach that ignores chordal thinking, even as it is on some levels is beholden to triadic formations. Based on a species approach that finds its roots in Diruta's *Il Transylvanio* and the works of Banchieri and others, Fux systematizes what was the *prima pratica* (or as Bernhard would call it, the *Stylus Gravis*). In this sense, Fux can be seen as a throwback in the treatment of dissonance since Fux's rules are far more strict than those allowed by writers over a century prior (e.g. Galilei). However, it is the pedagogical organzation and power that makes Fux's approach to dissonance treatment the approach which we (for better or worse) most readily associate with the music of the Renaissance. Thus we may posit an arc from Tinctoris through Artusi and Galilei to Fux, where the "licenses" in contrapuntal treatises began from a simple baseline, rose to great heights, and then were brought back down to earth.