ART

Art and Technology

I. ART FUNDAMENTALS 20%

A. Introduction to Art History

1. Methods and Inquiries of Art History
    a. The Nature of Art Historical Inquiry
    b. Sources, Documents, and the Work of Art Historians
    c. The Development of Art History
2. Brief Overview of Art in the Western World
    a. Ancient Civilizations
    b. Greek and Roman Art
    c. Early Christian and Medieval Art
    d. The Renaissance and Baroque
    e. Rococo, Neoclassicism, and Romanticism
    f. Realism and Impressionism
    g. Post-Impressionism and Other Late Nineteenth-Century Developments
    h. The Emergence of Modernism
    i. Abstraction
    j. Pop Art, Minimalism, and Photo Realism
    k. Earthworks, Installations, and Performance
3. Brief Overview of Non-Western Art
    a. Asian Art
    b. African and Oceanic Art
    c. Islamic Art
    d. The Americas

B. Elements of Art

1. Formal Qualities of Art
    a. Line
    b. Shape and Form
    c. Perspective
    d. Color
    e. Texture
    f. Composition
2. Processes and Techniques
    a. Drawing
    b. Printmaking
    c. Painting
    d. Photography
    e. Sculpture
    f. Mixed Media
    g. Performance
    h. Craft and Folk Art
    i. Architecture

II. PREMODERN ADVANCES IN TECHNOLOGY 15%
- A. Concrete in Ancient Rome
  1. The Concrete Revolution
  2. SELECTED WORK: THE PANTHEON, ROME, 126–128 CE
- B. The Art of Memorialization in Ancient Egypt
  1. SELECTED WORK: MUMMY WITH AN INSERTED PANEL PORTRAIT OF A YOUTH, EGYPT, ROMAN PERIOD, 80–100 CE
- C. Stained Glass in Gothic Architecture
  1. Lux Nova
  2. SELECTED WORK: SOUTH ROSE WINDOW OF CHARTRES CATHEDRAL, FRANCE, 1221–30
- D. Chinese Ceramics and the Kiln
  1. Blue-and-White Porcelain
  2. SELECTED WORK: *JAR WITH DRAGON*, CHINA, EARLY FIFTEENTH CENTURY

III. ART, TECHNOLOGY, AND THE ADVENT OF GLOBAL TRADE 20%
- A. The Compass and the Full-Rigged Ship Forge a New World
- B. Gutenberg's Printing Press
- C. Printmaking
  1. SELECTED WORK: *MELENCOLIA I*, ALBRECHT DÜRER, 1514
- D. The Invention of Linear Perspective
  1. SELECTED WORK: *THE ANNUNCIATION*, FRA FILIPPO LIPPI, C. 1450–53
- E. Filippo Brunelleschi's Dome and Renaissance Architecture
- F. The Advent of Oil Paint and Canvas
  1. SELECTED WORK: *JUDITH AND HER MAIDSERVANT WITH THE HEAD OF HOLOFERNES*, ARTEMISIA GENTILESCHI, C. 1623–25
- G. The Invention of Cristallo Glass
  1. SELECTED WORK: THE BEHAIM BEAKER, PROBABLY 1495
- H. The Benin Bronzes: Lost-Wax Casting in an African Kingdom
  1. African Lost-Wax Casting
  2. SELECTED WORK: BENIN PLAQUE WITH OBA, EDO ETHNIC GROUP, SIXTEENTH TO SEVENTEENTH CENTURIES
  3. The Benin Bronzes Today

IV. SCIENTIFIC INNOVATIONS IN PAINT 10%
- A. Prussian Blue: The First Modern Pigment
  1. SELECTED WORK: *SELF PORTRAIT IN A STRAW HAT*, MARIE-LOUISE-ELISABETH VIGÉE-LEBRUN, 1782
- B. Mass-Produced Tube Paint and the Impressionists
  1. SELECTED WORK: *THE BRIDGE AT ARGENTEUIL*, CLAUDE MONET, 1874

V. THE ADVENT OF PHOTOGRAPHY 15%
- A. The Camera Obscura
- B. Early Experiments in Fixing an Image
  1. SELECTED WORK: *VIEW FROM THE WINDOW AT LE GRAS*, NICÉPHORE NIÉPCE, 1827

C. The Daguerreotype
    1. SELECTED WORK: *FREDERICK DOUGLASS* C. 1855
D. Photographic Portraiture: Democratization and Control
E. Precisionism: Picturing Modern Architecture
    1. SELECTED WORK: *PENN STATION, INTERIOR*, BERENICE ABBOTT, C. 1935–38

VI. THE MACHINE AS ART AND ARTIST 20%
A. The Physiognotrace
    1. SELECTED WORK: *MOSES WILLIAMS*, RAPHAELLE PEALE AND MOSES WILLIAMS, C. 1803
B. Eadweard Muybridge and Instantaneous Photography
    1. SELECTED WORK: *THE HORSE IN MOTION, "SALLIE GARDNER,"* EADWEARD MUYBRIDGE, C. 1878
    2. Muybridge's Zoopraxiscope: A Precursor to Film
C. Television
    1. SELECTED WORK: *MAGNET TV*, NAM JUNE PAIK, 1965
D. The Automobile
    1. SELECTED WORK: *VELVET WHITE*, JOHN CHAMBERLAIN, 1962

ECONOMICS

An Introduction to Economics and Technology, Innovation, and the Economy

I. FUNDAMENTAL ECONOMIC CONCEPTS 10%
- A. Basic Assumptions of Economics
  1. Scarcity
  2. Trade-offs
  3. Opportunity Cost
  4. Rationality
  5. Gains from Trade
- B. Models and Economic Theory
- C. Positive and Normative Economics
- D. Efficiency as a Goal
- E. Microeconomics and Macroeconomics

II. MICROECONOMICS 40%
- A. Perfectly Competitive Markets
  1. Markets
  2. Demand
  3. Shifts in the Demand Curve
     a. Income
     b. The Prices of Related Goods
     c. Tastes
     d. Expectations
     e. Number of Buyers
  4. Supply
  5. Shifts in the Supply Curve
     a. Input Prices
     b. Technology
     c. Expectations
     d. Number of Sellers
  6. Equilibrium
  7. The Characteristics of Competitive Market Equilibrium
- B. Applications of the Competitive Market Model
  1. Changes in Market Equilibrium
  2. Elasticity
  3. Using Elasticity
- C. Evaluating Government Policy: The Impact of Price Controls and Taxes
  1. Price Controls
  2. Taxes
- D. International Trade
  1. An Isolated Economy
  2. Adding the Opportunity to Trade

3. Comparative Advantage and the Gains from Trade
4. The Political Economy of Trade

E. The Profit Motive and the Behavior of Firms
1. Economic Profits and Accounting Profits
2. Finding the Firm's Supply Curve
3. Entry, Exit, and the Market Supply Curve

F. Imperfect Competition
1. Monopoly
2. Monopoly Supply
3. Welfare Consequences of Monopoly
4. Dealing with Monopolies
5. Price Discrimination
6. Oligopoly
7. Monopolistic Competition

G. Creative Destruction: The Profit Motive and the Sources of Economic Change

H. Market Failures
1. Externalities
2. The Effect of Externalities on Resource Allocation
3. Private Responses to Externalities
4. Government Regulation of Externalities
5. Property Rights
6. The Effects of Private Ownership
7. Public and Private Goods
   a. Private Goods
   b. Common Resources
   c. Collective Goods
   d. Public Goods

I. Institutions, Organizations, and Government
1. Pork Barrel Politics
2. Rent-Seeking
3. What Is the Proper Role for Government?

III. MACROECONOMICS 30%

A. Macroeconomic Issues
1. Economic Growth and Living Standards
2. Recessions and Expansions
3. Unemployment
4. Inflation
5. International Trade

B. Macroeconomic Measurement
1. Measuring Total Output: Gross Domestic Product
   a. Market Value
   b. Final Goods and Services
   c. Within a Country
   d. During a Specified Period

2. Understanding What GDP Measures
3. Other Ways to Measure GDP: Expenditures Equal Production
4. Yet Another Way to Measure GDP: Income Equals Production Equals Expenditures
5. Real GDP
6. Measuring Inflation
7. Unemployment
    a. Frictional Unemployment
    b. Structural Unemployment
    c. Cyclical Unemployment

C. Economic Growth, Productivity, and Living Standards
1. The Circular Flow Model of the Economy
2. What Determines How Much an Economy Produces?

D. Savings, Investment, and the Financial System
1. Financial Markets
    a. The Bond Market
    b. The Stock Market
2. Financial Intermediaries
    a. Banks
    b. Mutual Funds
3. Saving and Investment in Aggregate
4. International Capital Flows in an Open Economy
5. How Financial Markets Coordinate Saving and Investment Decisions

E. Money and Prices in the Long Run
1. What Is Money?
2. Measuring Money
3. The Federal Reserve System, Banks, and the Supply of Money
4. Bank Runs
5. Money and Inflation in the Long Run
6. Why Worry about Inflation?

F. Short-Run Economic Fluctuations
1. Characteristics of Short-Run Fluctuations
2. Potential Output, the Output Gap, and the Natural Rate of Unemployment
3. Explaining Short-Run Fluctuations in Output
4. The Aggregate Demand Curve
    a. Wealth Effects
    b. Interest Rate Effects
    c. Foreign Exchange Effects
5. The Aggregate Supply Curve
6. The Keynesian Model of Short-Run Fluctuations
7. Inflation in the Keynesian Model
8. Using Fiscal and Monetary Policy to Stabilize the Economy

IV. THE ECONOMICS OF TECHNOLOGY AND INNOVATION 20%

A. Life in the Preindustrial World
1. Material Hardship

        a. Work
        b. Home
        c. Food
        d. Possessions
    2. Isolation
    3. Disease and Disaster
B. Dramatic Improvements in the Last Two Hundred Years
    1. Wealth
    2. Connectedness
    3. Health and Safety
    4. Costs and Risks of Progress
C. How Did the "Great Enrichment" Happen?
    1. Mechanization
    2. Materials
    3. Agriculture
    4. Energy
        a. The Steam Engine
        b. The Oil Industry
        c. Electricity
    5. Transportation
    6. Communications
    7. The Germ Theory of Disease
D. Origins and Diffusion of Technology-Driven Growth
    1. Key Concepts in Economic Growth
        a. Technology and Technological Progress
        b. Labor Productivity and Capital
        c. Solow and TFP
E. Creative Destruction and Technological Unemployment
F. Innovation Today
    1. Measuring the Rate of Progress
    2. Paying for Progress
G. Appropriation and the Value of R&D
    1. The Challenge of Appropriation
    2. Secrecy
    3. Lead Time
    4. Complementary Assets and Related Factors
    5. Intellectual Property
H. Other Important Drivers of Innovation
    1. Non-Profit Support of R&D
    2. The Size of the Market and R&D
    3. Cities and Innovation
    4. Institutions and Innovation
    5. Culture and Innovation

LITERATURE

An Introduction to Science Fiction

I. CRITICAL READING 15%
   A. Purpose and Main Idea
   B. Structure
   C. Restatement of Information
   D. Genres and their Characteristics
   E. Language and Tone
   F. Grammar and Syntax
   G. Vocabulary in Context
   H. Diction

II. HISTORICAL OVERVIEW OF THE SCIENCE FICTION GENRE 5%
   A. Science and Fiction to Science Fiction
   B. *Frankenstein*, *The Chemical Wedding*, *Symzonia*, and Debates about the First Science-Fiction Novel
   C. Science and Nineteenth-Century American Literature
   D. Pulp Magazines and the Golden Age of Science Fiction
   E. Changing Technology: Radio, Film, and Television
   F. Cold War Tensions and the Race for Technological Supremacy
   G. New Voices, New Visions: The New Wave
   H. The Emergence of Cyberpunk
   I. Steampunk
   J. Science Fiction in the Twenty-First Century
      1. Solarpunk
      2. New Delivery Technologies, Inclusivity, and Internationalism
      3. Ongoing Debates on Defining the Genre

III. URSULA K. LE GUIN AND *THE LATHE OF HEAVEN* (1971) 50%
   A. Concerns about Artificial Intelligence
   B. Technology Anxiety: From Prometheus to Frankenstein
   C. Technology as a Double-Edged Sword
   D. *The Lathe of Heaven* and the Theme of Technology and Humanity
      1. Overview of *The Lathe of Heaven*
      2. Haber and Orr, Doctor and Patient
      3. The Augmentor
      4. The Aldebaranians
      5. Lelache, Orr, and the Unintended Consequences of Dreams
      6. The Trope of the Infernal Machine
      7. The Contrasting Characters of Orr and Haber
      8. Activity versus Passivity
   E. The Biographical Context of *The Lathe of Heaven*: Ursula K. Le Guin's Life
      1. Le Guin's Parents

2. Le Guin's Parents and Ishi
3. Le Guin's Upbringing
4. Le Guin's Adult Life
5. Le Guin's Writing
6. Le Guin's Influence and Critical Reception

F. Historical Context of *The Lathe of Heaven*: From the Atomic Bomb to Artificial Intelligence
1. Le Guin's Work and Feminism
2. Moral Issues of the Cold War Era
3. Concerns about Ecological Catastrophe

G. *The Lathe of Heaven*: Cast of Characters
1. George Orr
2. Dr. William Haber
3. Heather Lelache
4. Mannie Ahrens
5. Tiua'k Ennbe Ennbe
6. E'nememen Asfah

H. Themes of *The Lathe of Heaven*
1. Shifting Versions of Reality
2. Philosophical Viewpoints
3. The Enduring Problem of Warfare
4. Issues of Racism, Immigration, and Xenophobia
5. The Power of Love and Friendship
6. Patterns of Dominance and Control
7. Setting
   a. Oregon and the Ring of Fire
   b. Sea Imagery
   c. Mount Hood
   d. Climate Change
   e. "Self Is Universe"

I. The Role of Psychology in *The Lathe of Heaven*
1. Dr. William Dement and the AASM
2. Sigmund Freud, Psychoanalysis, and the Interpretation of Dreams
3. Carl Gustav Jung
4. Dreams and *The Lathe of Heaven*

J. The Role of Philosophy in *The Lathe of Heaven*
1. Le Guin's Epigraphs and Taoism
2. Western Philosophy and Haber's Utilitarianism

K. The Publication History and Media Afterlife of *The Lathe of Heaven*

IV. SHORTER SELECTIONS 30%

A. SELECTED WORK: NATHANIEL HAWTHORNE'S "RAPPACCINI'S DAUGHTER" (1844)
1. Nathaniel Hawthorne: Biography
2. Analysis of "Rappaccini's Daughter": Botany and Biology as Technology

B. SELECTED WORK: AMBROSE BIERCE'S "MOXON'S MASTER" (1899)
1. Ambrose Bierce: Biography

2. Analysis of “Moxon’s Master”: Man vs. Machine

C. Selected Work: Ray Bradbury’s “I Sing the Body Electric!” (1969)
   1. Ray Bradbury: Biography
   2. Analysis of Ray Bradbury’s “I Sing the Body Electric!”: Technological Mothering

D. Selected Work: Octavia E. Butler’s “Childfinder” (1970; published in 2014)
   1. Octavia E. Butler: Biography
   2. Analysis of Octavia E. Butler’s “Childfinder”: Telepathic Communication as Technology

E. Selected Work: John Crowley’s “Snow” (1985)
   1. John Crowley: Biography
   2. Analysis of John Crowley’s “Snow”: Memory and Technology

F. Selected Work: C.L. Moore’s “No Woman Born” (1944)
   1. C.L. Moore: Biography
   2. Analysis of C.L. Moore’s “No Woman Born”: The Promise of Prosthetics

G. Selected Work: Neil Gaiman’s “The Mushroom Hunters” (2017)
   1. Neil Gaiman: Biography
   2. Analysis of “The Mushroom Hunters”: Knowledge as Technology

H. Selected Work: Sarah Howe’s “Relativity” (2015)
   1. Sarah Howe: Biography
   2. Analysis of “Relativity”: Scientific Theory and Poetry

MATHEMATICS

General Mathematics, Geometry, and an Introduction to Differential Calculus

I. GENERAL MATHEMATICS 25%

A. Simple and Compound Interest

B. Basic Counting
   1. The Multiplication Principle
   2. Permutations and Combinations

C. Probability of Equally Likely Events and Binomial Distribution

II. GEOMETRY 65%

A. Right Triangles
   1. Pythagorean Theorem
   2. Special Right Triangles

B. Coordinate Geometry
   1. The Midpoint Formula
   2. Slope
   3. The Distance Formula
   4. Parallel and Perpendicular Lines
   5. Properties of Quadrilaterals in the *x*-*y* Coordinate Plane

C. Plane and Solid Figures
   1. Area and Properties of Polygons
   2. Surface Areas and Volumes of Three-Dimensional Figures
      a. Prisms
      b. Cylinders
      c. Pyramids
      d. Cones
      e. Spheres
   3. Properties of Similar Figures
   4. Circles
      a. Area
      b. Angle Measures in Circles
      c. Lengths of Tangents, Secants, and Intersecting Chords

III. INTRODUCTION TO DIFFERENTIAL CALCULUS 10%

A. Average Rate of Change of Basic Polynomial Functions

B. Basic Limits and Continuity

C. First Derivative of Basic Polynomial Functions and Graphical Interpretation

D. Equations of Tangent Lines

MUSIC

Music in Science-Fiction Films

I. BASIC ELEMENTS OF MUSIC THEORY 20%
   A. Sound and Music
      1. Definitions
         a. Music Is Sound Organized in Time
         b. Music of the Western World
      2. Physics of Musical Sound
         a. Sound Waves
         b. Instruments as Sound Sources
   B. Pitch, Rhythm, and Harmony
      1. Pitch
         a. Pitch, Frequency, and Octaves
         b. Pitch on a Keyboard
         c. Pitch on a Staff
         d. Pitch on the Grand Staff
         e. Overtones and Partials
         f. Equal Temperament: Generating the Twelve Pitches by Dividing the Octave
         g. Scales: Leading Tone, Tonic, Dominant
         h. Intervals
         i. Intervals of the Major Scale
         j. Minor Scales and Blues Inflections
         k. Melody Defined; Example, Using Scale Degrees
         l. Contour
         m. Range and Tessitura
      2. Rhythm
         a. Beat
         b. Tempo
         c. Meter: Duple, Triple, and Quadruple
         d. Rhythmic Notation
         e. Time Signature
         f. Simple and Compound Subdivision
         g. Mixed and Irregular Meter
         h. Syncopation
         i. Polyrhythm
      3. Harmony
         a. Common-Practice Tonality
         b. Chords
            i. Triads
            ii. Inversions
         c. Keys
            i. Keys and Key Signatures

ii. Hierarchy of Keys: Circle of Fifths
d. Harmonic Progression
i. Dissonance and Consonance
ii. Diatonic Triads
iii. The Dominant Triad's Special Role
iv. Bass Lines
v. The Dominant Seventh Chord
vi. Example: A Harmonized Melody
e. Other Diatonic Chords
f. Chromatic Harmonies and Modulation
g. Beyond Common Practice

C. Other Aspects of Musical Sound
1. Texture, Counterpoint, Instrumentation, More Timbre
2. Dynamics, Articulation, Ornamentation

D. Form in Music
1. Perceiving Musical Form
2. Elements of Form
a. Motive
b. Phrase
c. Cadence
d. Theme
e. Introduction and Coda
3. Common Forms
a. Repetition
b. Variation
i. Theme and Variations
ii. 12-Bar Blues
iii. Improvisation
c. Contrast
i. Ternary and Rondo Forms
ii. 32-Bar Form
iii. Verse-Chorus Form
d. Development
i. Fugue
ii. Sonata Form

E. Which Is the Real Music? Scores, Recordings, and Performance

II. BUILDING FROM THE FAMILIAR 30%

A. The Vaudeville Foundation
B. Music as a Mask for Noisy Film Projectors
1. Skladanowsky's Berlin Screenings
2. The Lumières' Paris Screenings
C. The First Science Fiction Film
1. *A Trip to the Moon*
2. An Original Film Score?
D. Méliès's Film Comes to America

E. Greater Musical Ambition
    1. Co-opting the Vaudeville Orchestra
    2. Stretching the Boundaries
    3. Fritz Lang's *Metropolis*
    4. LISTENING COMPANION 1: *METROPOLIS*, "METROPOLIS THEMA" (METROPOLIS THEME) AND "MASCHINEN" (MACHINES) (1927) – GOTTFRIED HUPPERTZ
F. Synchronized "Sound"
    1. Sound-on-Disk vs. Sound-on-Film
    2. Breaking the Sound Barrier: *The Jazz Singer*
    3. Spending the Money: *King Kong*'s Original Score
    4. Temp Tracks (Temp Scores)
G. A Notorious Case of "Temp Love"
    1. *2001: A Space Odyssey*
    2. A Compilation Score (Fifty Years Late)
    3. LISTENING COMPANION 2: *2001: A SPACE ODYSSEY*, "ALSO SPRACH ZARATHUSTRA (SUNRISE)" (1896/1968) – RICHARD STRAUSS
H. *E.T.*, the Eighties Blockbuster
    1. Spielberg's Film
    2. Williams' Score Helps Create a Beloved Character
    3. LISTENING COMPANION 3: *E.T.: THE EXTRA-TERRESTRIAL*, "SENDING THE SIGNAL" (1982) – JOHN WILLIAMS
I. Romantic Gestures in a Modern Genre
    1. The Major Tritone Progression
    2. The MTTP and the Romantic Era
    3. *Dune*: A Messy Film, A Masterful Score
    4. LISTENING COMPANION 4: *DUNE*, "PROLOGUE" AND "MAIN TITLE" (1984) – TOTO

III. EXPLORING NEW TIMBRES 20%

A. Music by a Master: Bernard Herrmann
    1. The Big-Budget Treatment: *The Day the Earth Stood Still*
    2. The Plot of *The Day the Earth Stood Still*
    3. Herrmann's Freedom to Experiment
    4. LISTENING COMPANION 5: *THE DAY THE EARTH STOOD STILL*, "PRELUDE" AND "OUTER SPACE" (1951) – BERNARD HERRMANN
B. Bebe and Louis Barron and *Forbidden Planet*
    1. A Movie Full of Firsts
    2. Shakespeare on Altair IV
    3. Music From Machines
    4. LISTENING COMPANION 6: *FORBIDDEN PLANET*, "MAIN TITLES (OVERTURE)" (1956) – BEBE AND LOUIS BARRON
C. Starring the Synthesizer
    1. Vangelis, *Blade Runner*, and Future Noir
    2. Ridley Scott's Film
    3. Music for Dystopia
    4. LISTENING COMPANION 7: *BLADE RUNNER*, "END TITLES" (1982) – VANGELIS
D. *TRON*

1. A CGI Pioneer
2. *TRON*'s Plot
3. Wendy Carlos's Score: A Blending of Colors
4. LISTENING COMPANION 8: *TRON,* "CREATION OF TRON" (1982) – WENDY CARLOS

IV. MUSIC PLAYS A ROLE 30%

A. John Williams, *Star Wars*, and Source Music from the Cantina Band
   1. Building a Blockbuster
   2. Lucas's Film
   3. Williams's Case for an Original Score
   4. Dolby Sound
   5. LISTENING COMPANION 9: *STAR WARS,* "CANTINA BAND" (1977) – JOHN WILLIAMS

B. Spielberg's *Close Encounters of the Third Kind*
   1. Columbia Pictures Takes a Chance
   2. Spielberg's Film
   3. Solfège Through the Centuries
   4. LISTENING COMPANION 10: *CLOSE ENCOUNTERS OF THE THIRD KIND,* "WILD SIGNALS" (1977) – JOHN WILLIAMS

C. Music as a Means of Establishing Setting
   1. Back to the Future, Yet Again
   2. *Back to the Future III*
   3. Silvestri and ZZ Top's "Doubleback"
   4. LISTENING COMPANION 11: *BACK TO THE FUTURE III,* "DOUBLEBACK (EXTENDED VERSION)" (1990) – ZZ TOP AND ALAN SILVESTRI

D. *WALL•E*: Music Humanizes
   1. "Pixar's Ninth Consecutive Wonder"
   2. A Robot Love Story
   3. "Borrowed" Songs from *Hello, Dolly!*
   4. Thomas Newman's Score
   5. LISTENING COMPANION 12: *WALL•E,* "2815 A.D." (2008) – THOMAS NEWMAN

E. *Inception* and Édith Piaf's "Non, je ne regrette rien"
   1. Christopher Nolan's *Inception*
   2. Mental Espionage
   3. Hans Zimmer and Music as a Plot Signpost
   4. LISTENING COMPANION 13: *INCEPTION, "*DREAM IS COLLAPSING" (2010) – HANS ZIMMER

F. *Mars Attacks!* And Music Saves the Day
   1. Tim Burton and an A-List Cast for a B-Movie Tribute
   2. Burton's Film: A Tribute to Cheesiness
   3. The Integral Role of Music in the Film
   4. LISTENING COMPANION 14: *MARS ATTACKS!,* "MAIN TITLES" (1996) – DANNY ELFMAN

SCIENCE

An Introduction to Neuroscience

I. CELLS AND THE ANATOMY OF THE BRAIN 15%
- A. Neurons
  1. Parts of the Neuron
  2. The Morphology of Neurons
  3. Grey Matter and White Matter
- B. Glia
  1. Oligodendrocytes and Schwann Cells
  2. Astrocytes
  3. Microglia
- C. The Anatomy of the Central Nervous System
  1. The Meninges
  2. The Lobes of the Brain
  3. Subcortical Structures
  4. The Brainstem
  5. The Spinal Cord
  6. The Ventricular System
- D. The Anatomy of the Peripheral Nervous System
  1. The Somatic Nervous System
  2. The Autonomic Nervous System
     a. The Sympathetic Division
     b. The Parasympathetic Division

II. NEURAL COMMUNICATION 20%
- A. The Resting Membrane Potential
  1. Ionic Concentrations
  2. Electrical Potentials
  3. Ion Channels and Pumps
  4. Equilibrium Potential
     a. The Nernst Equation
     b. The Goldman Equation
- B. The Action Potential
  1. The Phases of the Action Potential
  2. Reaching Threshold
  3. Voltage Gated Sodium Channels
  4. Voltage Gated Potassium Channels
  5. Action Potential Conduction
     a. The Nodes of Ranvier and Saltatory Conduction
- C. Synaptic Transmission
  1. The Presynaptic Cell
  2. The Axon Terminal
  3. Vesicles and Neurotransmitters

4. The Process of Exocytosis
5. The Postsynaptic Cell
    a. Ionotropic Receptors
    b. Metabotropic Receptors
6. Neuropharmacology
    a. Neurotransmitter Receptor Agonists
    b. Neurotransmitter Receptor Antagonists
7. Neurotransmitter Systems
    a. Catecholamines
    b. Serotonin
    c. Acetylcholine

III. SENSORY AND MOTOR SYSTEMS 35%

A. The Visual System
    1. The Retina
        a. Photoreceptors
        b. Phototransduction
        c. Retinal Circuitry
    2. The Retinofugal Pathway
        a. Crossing Fibers Give Rise to Depth Perception
    3. The Lateral Geniculate Nucleus
        a. LGN Input Layers
        b. Receptive Fields in the LGN
    4. The Primary Visual Cortex
        a. The Layers of the Visual Cortex
        b. Spatial Maps in the Visual Cortex
    5. The Dorsal Extrastriate Pathway
        a. Motion Perception
    6. The Ventral Extrastriate Pathway
        a. Object Recognition
B. The Auditory System
    1. The Middle Ear
        a. The Ossicles
    2. The Inner Ear and the Cochlea
        a. Cochlear Structure
        b. The Basilar Membrane and the Organ of Corti
        c. Auditory Transduction via Inner Hair Cells
    3. The Auditory Pathway
        a. Auditory Localization
        b. The Medial Geniculate Nucleus (MGN) of the Thalamus
    4. The Primary Auditory Cortex
        a. Tonotopic Mapping of the Auditory Cortex
C. The Chemical Senses
    1. Gustation/Taste
        a. The Five Tastes
        b. Tastebuds and Taste Cells

c. Taste Transduction
d. Cranial Nerves—Pathways to the Brain

2. Olfaction/Smell
   a. Smell Receptor Neurons and Smell Transduction
   b. Glomeruli of the Olfactory Bulb
3. Population Coding of Odors and Tastes

D. The Somatosensory System
1. The Touch Receptors
   a. Touch Receptive Fields
   b. Two-Point Discrimination
   c. Dermatomes
2. Temperature Receptors
3. Pain Transduction
4. Pathways to the Brain
   a. The Dorsal Column Medial Lemniscal System
   b. The Anterolateral Spinothalamic System
5. The Primary Somatosensory Cortex
   a. Somatotopic Mapping of the Somatosensory Cortex
   b. The Sensory Homunculus

E. The Motor System
1. The Primary Motor Cortex
   a. Motor Planning
2. The Descending Motor Pathways
   a. The Lateral Pathways: Corticospinal and Rubrospinal
   b. The Ventromedial Pathways: Vestibulospinal, Tectospinal, and Reticulospinal
3. The Basal Ganglia
   a. The Circuitry of the Basal Ganglia
4. The Cerebellum
   a. The Circuitry of the Cerebellum
   b. Motor Learning

IV. SYNAPTIC PLASTICITY AND MEMORY 15%

A. Experience-Based Cortical Changes
1. Monocular Deprivation
2. Rodent Barrel Fields
3. Phantom Limb Syndrome

B. Strengthening and Weakening Synapses
1. Habituation and Sensitization
2. Long-term Potentiation at Synapses

C. Memory Systems
1. The Circuitry of the Hippocampus
2. The Encoding and Storage of Memory

V. TECHNOLOGY AND NEUROSCIENCE 15%

A. Methods of Perturbing the Brain
1. Electrical Stimulation

2. Optogenetics
3. Transcranial Magnetic Stimulation

B. Methods of Recording from the Brain
1. EEG
2. MRI
3. Brain–Computer Interface

C. Computational Neuroscience
1. Modeling Neurons
2. Artificial Intelligence and Neuroscience

D. Computational Psychiatry

SOCIAL SCIENCE

The History of Computers

I. EARLY INFORMATION PROCESSING 20%
   A. Early Information Processing in Great Britain
      1. The Influence of Adam Smith
      2. The Work of Charles Babbage
         a. Babbage's Difference Engine
         b. Babbage's Analytical Engine
         c. The Work of Ada Lovelace
         d. Babbage and the British Banking Industry
      3. Railway Communications and the Invention of Telegraphy
      4. Church, Turing, and Hilbert's *Entscheidungsproblem*
      5. Turing's Work on Codebreaking
   B. Early Information Processing in the United States
      1. Herman Hollerith's Work with the Census
      2. Early Office Automation Devices
         a. The Development of the Typewriter
         b. Filing Cabinets
         c. Adding Machines
         d. The Cash Register
      3. Thomas Watson, Sr., and IBM
      4. The Electrification of Office Equipment
      5. Vannevar Bush and the Differential Analyzer
      6. Howard Aiken, IBM, and the Mark I
      7. The Atanasoff-Berry Computer (ABC)
   C. Early Information Processing in Germany and the Work of Konrad Zuse

II. GENERAL PURPOSE ELECTRONIC COMPUTERS 25%
   A. The ENIAC
      1. Firing Tables: A Problem in Need of a Solution
      2. The Role of Dr. Herman Goldstine
      3. The Work of John Mauchly
      4. Goldstine, Mauchly, and Eckert's Proposal
      5. The Design of the ENIAC
      6. The ENIAC's Programmers
      7. John von Neumann and the EDVAC
      8. The Completion of the ENIAC
   B. Progress in England
      1. Max Newman, Frederic Williams, and the Manchester Baby
      2. Maurice Wilkes and the EDSAC
   C. The Completion of the EDVAC
   D. The Eckert-Mauchly Computer Corporation (EMCC)
      1. The UNIVAC

2. The BINAC
3. Acquisition by Remington Rand
4. The Completion of the UNIVAC

E. The Growth of IBM
F. Other Players in the Mid-Twentieth-Century Computer Industry
G. Advances in Hardware
   1. The Processor
      a. Vacuum Tubes
      b. Transistors
      c. Microchips
   2. Memory
      a. Delay Lines
      b. Williams Tubes
      c. Magnetic Drums
      d. Core Memory
      e. Microchips
   3. Storage
      a. Punched Cards
      b. Magnetic Tape Drives
      c. Disk Storage
H. Software
   1. Machine Code
   2. Assembly
   3. Grace Hopper, Compilers, and High-Level Languages
      a. FORTRAN
   4. Business-Oriented Programming Languages
      a. COBOL
      b. LISP
I. IBM System/360
   1. Microprogramming
   2. The Challenges of OS/360
   3. Brooks's Law
   4. The Legacy of the IBM System/360
J. The ENIAC Patent Case

III. TOWARD "PERSONAL" COMPUTING 30%

A. Project Whirlwind
B. SAGE
C. SABRE
D. Timesharing
   1. CTSS
   2. BASIC
   3. Multics
E. DEC and the Rise of Minicomputers
   1. The PDP-1

2. The PDP-8
3. The PDP-11

F. UNIX
1. C Programming Language

G. Networking
1. Store and Forward Packet Switching
2. ARPANET
3. Usenet
4. Other Early Networks
5. The Minitel Network
6. ALOHAnet 50

H. XEROX PARC
1. The Alto
2. Bravo
3. Smalltalk and Object-Oriented Programming
4. The Xerox Star

I. The Microprocessor

J. Personal Computers
1. The Altair 8800
2. The Commodore PET, TRS-80, and Apple II
3. The TRS-80
4. The Commodore PET
5. The Apple II

K. Video Games

L. VisiCalc

M. The IBM PC

N. The Apple Macintosh

O. PC Clones

P. The Graphical User Interface Goes Mainstream
1. OS/2 and Windows

IV. THE INTERNET, SOCIAL MEDIA, AND MOBILE COMPUTING 25%

A. The GNU Project and the Open Source Movement
1. Linux

B. Hypertext
1. Tim Berners Lee and the World Wide Web

C. Browser Wars
1. Mosaic
2. Netscape
3. Internet Explorer

E. Search Engines
1. Yahoo
2. Google

F. The Dot-com Bubble

G. Java

H. NeXT

I. The iMac
J. Microsoft's Gradual Decline
    1. Lawsuits in the U.S. and Europe
    2. Competition from Apple and Mobile Devices
K. Mobile Computing
    1. PDAs
    2. Portable GPS Devices
    3. Portable Music Players
    4. Cellular Phones
L. Smartphones
        1. BlackBerry
        2. The iPhone
        3. Android
        4. App Stores
M. Web 2.0
    1. Social Media
        a. Facebook
        b. Instagram
    2. New Business Models
N. Tablets
O. Oracle vs. Google
P. Moore's Law and Multi-Core Processors
Q. Cloud Computing
    1. Hosting
    2. Software as a Service
R. The Impact of COVID-19
S. Blockchain
    1. Bitcoin
    2. NFTs
T. Artificial Intelligence
    1. Machine Learning
    2. Robotics
U. Quantum Computing