Inorganic Screening Topics—University of Southern California

(1) Three-Center Bonding
Molecular orbital descriptions of three-center bonding and the relationship between electron delocalization, molecular structure, and stability in electron-deficient molecules.
(2) Hypervalency
Molecular orbital descriptions of hypervalent molecules, including the octet rule, the role of *d* orbitals in bonding, and modern interpretations of hypervalency.
(3) Second-Order Jahn-Teller Effects
Orbital mixing, structural distortions, and the molecular orbital origin of geometric preferences in main-group compounds.
(4) Covalency in Transition Metal Complexes
Molecular orbital descriptions of covalent bonding in transition metal complexes, including the origin of ligand field splitting, metal-ligand orbital mixing, and the electronic basis of the 18-electron rule.
(5) Extension of Molecular Orbital Theory to Extended Solids
Extension of qualitative molecular orbital theory from finite molecules to periodic solids, including the evolution of molecular orbitals into electronic bands and the electronic origin of metallic and semiconducting behavior.
(6) 18-Electron Rule
The 18-electron rule, including the circumstances under which it is rigorously followed, the two other commonly observed classes of stable transition metal complexes that follow different electron-counting rules, and the behavior of metal complexes that fall outside these three categories.
(7) Ligand Classification
Ligand classifications and their influence on metal-ligand bonding, reactivity, coordination geometry, and arrangement around a metal.
(8) Reaction Types
Fundamental reaction types available to transition metal complexes, including when a particular reaction is reasonable for a given metal complex and ligand environment.
(9) Catalysis
Cross-coupling, hydrogenation, and hydrofunctionalization, including construction of correct and reasonable catalytic cycles with appropriate arrow pushing, and the rationale for homogeneous versus heterogeneous catalysis.
(10) Spectroscopic Characterization of Inorganic Molecules and Materials
Fundamentals of UV-visible absorption and FT-IR vibrational spectroscopy of inorganic molecules and materials, including the types of electronic and vibrational transitions observed, selection rules, expected molar absorptivities, and the origin of the observed transitions.
(11) Symmetry and Group Theory
Symmetry elements, symmetry operations, point groups, character tables, and their application to the analysis of molecular symmetry.
(12) Breadth of Transition Metals
Differences across the transition metal series and the associated periodic trends, including common oxidation states, preferred reaction and catalysis types, the lanthanide contraction, and relativistic effects.