SBASSE Subject Test Guidelines

Biology

The Biology subject test would consist of multiple-choice questions from the following areas.

- Molecular Biology
- Cell Biology
- Biochemistry
- Genetics (Basic Principals)
- Microbiology (Basic Principals)
- Bioinformatics (Basic Principals)

The format of the questions will be similar to the GRE Biology Subject Test (https://www.ets.org/gre/subject/about/content/biology)

Following is the list of recommended readings.

- Molecular Biology of the Cell, Bruce Alberts
- Biochemistry, Lehninger
- An introduction to Genetic Analysis, Griffiths
- Microbiology, Prescott Harley and Klein

Chemistry

The chemistry graduate admission test (MS and PhD programs) will consist of about 80 multiple choice questions. A periodic table and essential information regarding physical constants and conversion factors will be provided at appropriate places. Use of calculators and mobile phones is not allowed.

The content of the test emphasizes physical chemistry, inorganic chemistry, analytical chemistry and organic chemistry as described below.

I. Physical Chemistry (~30%)

Thermodynamics: First, second and third laws, thermochemistry, ideal and real gases and solutions, Gibbs and Helmholtz energy, chemical potential, chemical equilibria, phase equilibria, colligative properties, statistical thermodynamics.
Quantum Chemistry and Applications to Spectroscopy: Classical experiments, principles of quantum mechanics, atomic and molecular structure, molecular spectroscopy.
Dynamics: Experimental and theoretical chemical kinetics, solution and liquid dynamics, photochemistry.

II. Inorganic Chemistry (~25%)

General Chemistry: Periodic trends, stoichiometry, oxidation states, nuclear chemistry.
Ionic Substances: Lattice geometries, lattice energies, ionic radii, and radius/ratio effects.
Covalent Molecular Substances: Lewis diagrams, molecular point groups, VSEPR concept, valence bond description and hybridization, molecular orbital description, bond energies, covalent and van der Waals radii of the elements, intermolecular forces.
Metals and Semiconductors: Structure, band theory, physical and chemical consequences of band theory.
Acids and Bases: Bronsted-Lowry approaches, Lewis theory, solvent system approaches.
Chemistry of the Main Group Elements: Electronic structures, occurrences and recovery, physical and chemical properties of the elements and their compounds.
Chemistry of the Transition Elements: Electronic structures, occurrences and recovery, physical and chemical properties of the elements and their compounds, coordination chemistry.
Special Topics: Organometallics, catalysis, bioinorganic chemistry, solid state chemistry and environmental chemistry.

III. Analytical Chemistry (~15%)

Data Acquisition and Use of Statistics: Errors, statistical considerations
Solutions and Standardization: Concentration terms, primary standards
Homogeneous Equilibria: Acid-base, oxidation-reduction, complexometry
Heterogeneous Equilibria: Gravimetric analysis, solubility, precipitation titrations, chemical separations.

Instrumental Methods: Electrochemical methods, spectroscopic methods, chromatographic methods, thermal methods, calibration of instruments.

IV. Organic Chemistry (~30%)

Structure, Bonding and Nomenclature: Lewis structures, orbital hybridization, configuration and stereochemical notation, conformational analysis, systematic IUPAC nomenclature, spectroscopy (IR, ^{1}H and ^{13}C NMR).
Functional Groups: Preparation, reactions, and interconversions of alkanes, alkenes, alkynes, dienes, alkyl halides, alcohols, ethers, epoxides, sulfides, thiols, aromatic compounds, aldehydes, ketones, carboxylic acids and their derivatives, amines.
Reaction Mechanisms: Nucleophilic displacements and additions, nucleophilic aromatic substitutions, electrophilic additions, electrophilic aromatic substitutions, eliminations, Diels-Alder and other cycloadditions.
Reactive Intermediates: Chemistry and nature of carbocations, carbanions, free radicals, carbenes, benzynes, enols.
Organometallics: Preparation and reactions of Grignard and organolithium reagents, and other modern main group and transition metal reagents and catalysts.
Special Topics: Resonance, molecular orbital theory, catalysis, acid-base theory, carbon acidity, aromaticity, antiaromaticity, macromolecules, lipids, amino acids, peptides, carbohydrates, nucleic acids, terpenes, asymmetric synthesis, orbital symmetry, polymers.

The format of the questions will be similar to the GRE Chemistry Subject Test. Sample questions can be downloaded from the link: https://www.ets.org/s/gre/pdf/practice_book_chemistry.pdf

Computer Science

The Computer Science subject test would consist of multiple choice questions from the foundation courses of Computer Science. Topic-wise question distribution will be as follows:

- Discrete Structures (25 – 30)%
    A. Functions, relations and sets
    B. Basic logic
    C. Proof techniques
    D. Basics of counting
    E. Graphs and trees
    F. Discrete probability
- Programming and problem solving (25 – 30)%
    A. Programming Fundamentals: fundamental programming constructs, basic algorithms and problem solving, fundamental data structures, recursion, event-driven programming, object-oriented programming
    B. Programming Languages: features, paradigms, implementation techniques
- Algorithms and Complexity (20 – 25)%
    A. Advanced data structures and algorithms (including graph algorithms), algorithmic strategies, distributed algorithms, basic computability and complexity
    B. Automata theory and formal languages
- Systems (15 – 22)%
    A. Architecture: digital logic and digital systems, machine level representation of data, assembly level machine organization, interfacing and communication
    B. Operating Systems: operating system principles, concurrency, scheduling and dispatch, and memory management
    C. Networking
- Additional Topics (8 – 12)%
    A. Software Engineering
    B. Database systems
    C. Linear Algebra and calculus

The format of the questions will be similar to the GRE CS Subject Test. A sample test can be downloaded from the link: https://www.ets.org/Media/Tests/MFT/pdf/mft_samp_questions_compsci.pdf

Electrical Engineering

The Electrical Engineering subject test consists of multiple choice questions from the foundation courses of EE program. Most of the questions would be from the following courses:

- Circuits I
- Circuits II
- Signals and Systems
- Devices and Electronics
- Digital Logic Circuits
- Electromagnetic Fields and Waves
- Control Systems
- Communication Systems
- Electro-mechanical systems
- Electrical power systems
- Basic Probability

Mathematics

Mathematics subject test will be from the following subjects of undergraduate level:

1. Calculus (I, II)
2. Analysis (1st course on undergraduate analysis)
3. Linear algebra
4. Complex Variables
5. Set Topology
6. Ordinary differential equations
7. Algebra-I (Group theory)

There will be about 25 MCQ type questions from the above subjects.

Physics

Subject Test

The Physics subject test assesses the background in three fundamental areas of physics, namely Quantum Mechanics, Classical Mechanics, and Electricity Magnetism at the undergraduate level. It's a two hours written exam where the applicants are required to solve problems in the space provided on the answer sheets. There will not be any multiple choice question. The questions in each section may cover various ideas or they may cover a single idea at various levels of difficulty. In preparing for the test, a thorough review of calculus, ordinary differential equations and the analysis of functions will be very helpful.

Following is the syllabus covered by the exam and the suggested reading material,

Classical Mechanics

Kinematics. Newton's laws. Work and Energy. Oscillatory motion. Rotational motion about a fixed axis. Central forces and celestial mechanics.

Suggested reading

Physics, by Halliday, Resnick and Krane.

Physics for Engineers and Scientists, by Hans C. Ohanian and John T. Markart

Quantum Mechanics

Fundamental concepts like eigenvalues and expectation values of operators. The interpretation of the wavefunction and its general properties. The basic linear algebra in Dirac ket-bra language. The matrix representation of states and operators. The solutions of the schrödinger equation for the rectangular potentials. The angular momentum algebra and the Spin.

Suggested reading

Introduction to Quantum Mechanics, by Griffiths

Introductory Quantum Mechanics, by Richard L. Liboff

Electromagnetism

Electrostatics, Coulomb's and Guass's laws, discrete and continuous charge distribution, currents and DC circuits, scalar electric potential, static magnetic fields in free space, current loops, Lorentz force, induction, vector magnetic potential, Maxwell's equations in differential form, plane waves.

Suggested reading

Physics, by Halliday, Resnick and Krane.

Physics for Engineers and Scientists, by Hans C. Ohanian and John T. Markart

Introduction to electrodynamics, by Griffiths

Griffiths