

JAM Mathematics Syllabus 2020

Units	Topics/ Sub Topics
Sequences and Series of Real Numbers	Bolzano-Weierstrass Theorem, Cauchy Sequences, Subsequences. Absolute Convergence, Series of Real Numbers, Tests of Convergence for Series of Positive Terms - Comparison Test, Ratio Test, Root test, Convergence of Sequences, Convergence Criteria for Sequences of Real Numbers, Bounded and Monotone Sequences, Sequence of Real Numbers, Leibniz Test for Convergence of Alternating Series.
Functions of One Real Variable	Limit, Intermediate Value Property, Continuity, Differentiation, Rolle's Theorem, Mean Value Theorem Taylor's Theorem, L'Hospital Rule, Maxima and Minima.
Functions of Two or Three Real Variables	Limit, Continuity, Partial Derivatives, Differentiability, Maxima, and Minima.
Integral Calculus	Integration as an Inverse Process of Differentiation, Fundamental Theorem of Calculus, Definite Integrals and their Properties. Double and Triple Integrals, Calculating Surface Areas and Volumes using Double Integrals, Change of Order of Integration, Calculating Volumes using Triple Integrals.
Differential Equations	Orthogonal Trajectories, Homogeneous Differential Equations, Linear Differential Equations of Second Order

	with Constant Coefficients, Variable Separable Equations, Method of Variation of Parameters, Cauchy-Euler Equation, Ordinary Differential Equations of the First Order of the Form $y'=f(xy)$, Bernoulli's Equation, Integrating Factor, Exact Differential Equations
Vector Calculus	Scalar and Vector Fields, Divergence, Gradient, Curl, Line Integrals, Green, Stokes and Gauss Theorems, Surface Integrals.
Group Theory	Groups, Subgroups, Non-Abelian Groups, Abelian Groups, Cyclic Groups, Permutation Groups, Normal Subgroups, Group Homomorphisms and Basic Concepts of Quotient Groups, Lagrange's Theorem for Finite Groups.
Linear Algebra	Matrix Representation, Rank-Nullity Theorem. Rank and Inverse of a Matrix, Determinant, Consistency Conditions, Solutions of Systems of Linear Equations, Eigenvalues, and Eigenvectors for Matrices, Finite-Dimensional Vector Spaces, Linear Independence of Vectors, Basis, Dimension, Linear Transformations, Range Space, Null Space, Cayley-Hamilton Theorem.
Real Analysis	Interior Points, Closed sets, Limit Points, Open Sets, Bounded Sets, Connected Sets, Compact Sets, Completeness of \mathbb{R} . Power Series (of Real Variable), Radius and Interval of Convergence, Taylor's Series, Term-Wise Differentiation and Integration of Power Series.

JAM Biotechnology Syllabus 2020

Units

Topics/ Sub Topics

General Biology

Taxonomy, Heredity, Genetic Variation, Conservation, Principles of Ecology, Evolution, Techniques in Modern Biology.

Biochemistry and Physiology

Carbohydrates, Proteins, Lipids, Nucleic Acids, Enzymes, Vitamins, Hormones, Metabolism – Glycolysis, TCA Cycle, Oxidative Phosphorylation, Photosynthesis, Nitrogen Fixation, Fertilization and Osmoregulation, Vertebrates-Nervous System, Endocrine System, Vascular System, Immune System, Digestive System, and Reproductive System.

Basic Biotechnology

Tissue Culture, Application of Enzymes, Antigen-Antibody Interaction, Antibody Production, Diagnostic Aids

Molecular Biology

DNA, RNA, Replication, Transcription, Translation, Proteins,
Lipids and Membranes, Operon Model, Gene Transfer

Cell Biology

Cell Cycle, Cytoskeletal Elements, Mitochondria, Endoplasmic
Reticulum, Chloroplast, Golgi apparatus, Signaling,

Microbiology

Isolation, Cultivation, Structural features of Virus, Bacteria, Fungi,
Protozoa, Pathogenic Microorganisms

Chemistry

Bohr's Theory and Schrodinger Wave Equation, Periodicity in
Properties, Chemical Bonding, Properties of s, p, d and f block
elements, Complex Formation, Coordination Compounds, Chemical
Equilibria, Chemical Thermodynamics (First and Second Law),
Chemical Kinetics (Zero, First, Second and Third Order Reactions),
Photochemistry, Electrochemistry, Acid-Base Concepts,

Stereochemistry of Carbon Compounds, Inductive, Electromeric, Conjugative Effects and Resonance, Chemistry of Functional Groups, Hydrocarbons, Alkyl Halides, Alcohols, Aldehydes, Ketones, Carboxylic Acids, Amines and their Derivatives, Aromatic Hydrocarbons, Halides, Nitro and Amino Compounds, Phenols, Diazonium Salts, Carboxylic and Sulphonic Acids, Mechanism of Organic Reactions, Soaps and Detergents, Synthetic Polymers, Biomolecules – Amino Acids, Proteins, Nucleic Acids, Lipids and Carbohydrates (Polysaccharides); Instrumental Techniques – Chromatography (TLC, HPLC), Electrophoresis, UV-Vis, IR and NMR Spectroscopy, Mass Spectrometry.

Mathematics

Sets, Relations and Functions, Mathematical Induction, Logarithms, Complex Numbers, Linear and Quadratic Equations, Sequences and

Series, Trigonometry, Cartesian System of Rectangular Coordinates, Straight lines and Family, Circles, Conic Sections, Permutations and Combinations, Binomial Theorem, Exponential and Logarithmic Series, Mathematical Logic, Statistics, Three Dimensional Geometry, Vectors, Matrices and Determinants, Boolean Algebra, Probability, Functions, limits and Continuity, Differentiation, Application of Derivatives, Definite and Indefinite Integrals, Differential Equations

Physics

Physical World and Measurement, Kinematics, Laws of Motion, Work, Energy and Power, Electrostatics, Current electricity, Elementary Statics and Dynamics, Magnetic Effects of Current and Magnetism, Electromagnetic Induction and Alternating Current, Optics, Dual Nature of Matter and Radiations, Electromagnetic Waves, Atomic Nucleus, Motion of System of Particles and Rigid

Body, Solids and Semiconductor Devices, Principles of Communication, Gravitation, Heat and Thermodynamics, Oscillations, Waves, Mechanics of Solids and Fluids,

JAM Mathematical Statistics Syllabus 2020

Units

Topics/ Subtopics

Mathematics

Sequences and Series

Comparison, Root and Ratio Tests for Convergence of Series of Real Numbers, Convergence of Sequences of Real Numbers.

Differential Calculus

Limits, Continuity and Differentiability of Functions of One and Two Variables. Rolle's Theorem, Mean

Value Theorems, Indeterminate Forms, Taylor's Theorem, Maxima and Minima of Functions of One and Two Variables.

Integral Calculus

Fundamental Theorems of Integral Calculus, Applications of Definite Integrals, Arc Lengths, Double and Triple Integrals, Areas and Volumes.

Matrices

Rank, Inverse of a Matrix, Systems of Linear Equations, Eigenvalues and Eigenvectors, Linear Transformations, Symmetric, Cayley-Hamilton Theorem, Skew-Symmetric and Orthogonal Matrices.

Statistics

Probability

Axiomatic Definition of Probability and Properties, Multiplication Rule, Theorem of Total Probability, Conditional probability, Bayes' Theorem and Independence of Events

Random Variables

Probability Mass Function, Distribution of a Function of a Random Variable, Mathematical Expectation, Probability Density Function and Cumulative Distribution Functions, Moments and Moment Generating

Function, Chebyshev's Inequality.

Standard Distributions

Geometric, Binomial, Negative Binomial, Poisson, Hypergeometric, Uniform, Beta and Normal Distributions, Exponential, Gamma. Poisson and Normal Approximations of a Binomial Distribution.

Joint Distributions

Joint, Marginal and Conditional Distributions, Distribution of Functions of Random Variables, Joint Moment Generating Function, Correlation, Simple Linear Regression, Product Moments, Independence of Random Variables.

Sampling distributions

Chi-Square, T and F Distributions and their Properties.

Limit Theorems

Weak Law of Large Numbers, Central Limit Theorem (i.i.d. with Finite Variance Case only).

Estimation

Unbiasedness, Method of Moments and Method of Maximum Likelihood, Consistency and Efficiency of Estimators. Sufficiency, Factorization Theorem, Rao-Blackwell and Lehmann-Scheffe Theorems, Completeness, Uniformly Minimum Variance Unbiased Estimators, Confidence Intervals for the

Parameters of Univariate Normal, Two Independent Normal, and one Parameter Exponential Distributions.

Rao-Cramer Inequality

Testing of Hypotheses

Basic Concepts, Applications of Neyman-Pearson Lemma for Testing Simple and Composite Hypotheses,

Likelihood Ratio Tests for Parameters of Univariate Normal Distribution.

JAM Physics Syllabus 2020

Units

Topics/ Subtopics

Mathematical Methods

Calculus of Single and Multiple Variables, Taylor Expansion, Partial Derivatives, Jacobian, Fourier Series, Imperfect and Perfect Differentials, Vector Algebra, Vector Calculus, Multiple Integrals, Green's Theorem, Divergence Theorem, Stokes' Theorem, Matrices and Determinants, Algebra of Complex Numbers, First Order Equations and Linear Second Order Differential Equations with

Mechanics and General Properties of Matter

Constant Coefficients

Velocity and Acceleration in Cartesian, Centrifugal and Coriolis Forces, Uniformly Rotating Frame, Kepler's Laws, Motion under a Central Force, Newton's Laws of Motion and Applications, Polar and Cylindrical Coordinate Systems, Gravitational Law and Field, Conservative and Non-Conservative Forces. Equation of Motion of the CM System of Particles, Center of Mass, Conservation of Linear and Angular Momentum, Elastic and Inelastic Collisions.

Conservation of Energy, Variable Mass Systems.

Oscillations, Waves and Optics

Superposition of two or more Simple Harmonic Oscillators, Differential Equation for Simple Harmonic Oscillator and its General Solution, Damped and Forced Oscillators, Resonance, Lissajous Figures, Energy Density and Energy Transmission in

Waves, Wave Equation, Traveling and Standing Waves in One-Dimension, Doppler Effect, Fermat's Principle, Group Velocity and Phase Velocity. Sound Waves in Media

Electricity and Magnetism

Superposition of two or more Simple Harmonic Oscillators, Differential Equation for Simple Harmonic Oscillator and its General Solution, Damped and Forced Oscillators, Resonance, Lissajous Figures, Energy Density and Energy Transmission in Waves, Wave Equation, Traveling and Standing Waves in One-Dimension, Doppler Effect, Fermat's Principle, Group Velocity and Phase Velocity. Sound Waves in Media

Kinetic theory, Thermodynamics

Elements of Kinetic Theory of Gases, Specific Heat of Mono-, Di- and Triatomic Gases, Velocity Distribution and Equipartition of Energy, Ideal Gas, Van-Der-Waals Gas and Equation of State,

Mean Free Path, Carnot Cycle, Zeroth Law and Concept of Thermal Equilibrium, Reversible, Irreversible and Quasi-Static Processes, First Law and its Consequences, Second Law and Entropy, Laws of Thermodynamics, Isothermal and Adiabatic Processes

Modern Physics

Postulates of Special Relativity. Lorentz Transformations. Inertial Frames and Galilean Invariance, Time Dilation, Length Contraction, Relativistic Velocity Addition Theorem, Mass Energy Equivalence, Blackbody Radiation, Photoelectric Effect, Compton Effect, Bohr's Atomic Model, X-rays.

Solid State Physics, Devices and Electronics

Crystal Structure, Miller Indices. X-Ray Diffraction and Bragg's Law, Bravais Lattices and Basis, Intrinsic and Extrinsic Semiconductors, Variation of Resistivity with Temperature, Fermi

Level. P-N Junction Diode, I-V Characteristics, BJT, Characteristics in CB, CE, CC Modes, Zener Diode and its Applications.

JAM Geology Syllabus 2020

Units	Topics/ Subtopics
The Planet Earth	Origin of the Solar System and the Earth, Geosphere and the Composition of the Earth, Shape and Size of the Earth, Earth-Moon System, Formation of Continents and Oceans, Dating Rocks and Age of the Earth, Volcanism and Volcanic Landforms, Interior of Earth, Earthquakes, Earth's Magnetism and Gravity, Isostasy, Elements of Plate Tectonics, Orogenic Cycles, Geomorphology, Weathering and Erosion, Transportation and Deposition due to Wind, Ice, River, Sea, and Resulting Landforms, Structurally Controlled Landforms.

Structural Geology	Concept of Stratum, Contour, Outcrop Patterns, Maps and Cross Sections, Dip and Strike, Classification and Origin of Folds, Faults, Joints, Unconformities, Foliations and Lineations, Shear zones, Stereographic and Equal-Area Projections of Planes and Lines, Computation of True Thickness of Beds from Outcrops and Bore-Holes.
Paleontology	Major Steps in the Evolution of Life Forms, Fossils and their mode of Preservation and Utility, Morphological Characters, Major Evolutionary Trends and Ages of Important Groups of Animals – Brachiopoda, Mollusca, Trilobita, Graptolitoidea, Anthozoa, Echinodermata; Gondwana Plant Fossils, Elementary Idea of Vertebrate Fossils in India.
Stratigraphy	Principles of Stratigraphy, Litho-, Chrono- and Biostratigraphic Classification, Distribution and Classification of the Stratigraphic Horizons of India from Archaean to Recent.
Mineralogy	Symmetry and forms in Common Crystal Classes, Physical Properties of Minerals, Isomorphism and

Polymorphism, Classification of Minerals, Structure of Silicates, Mineralogy of Common Rock-Forming Minerals, Mode of Occurrence of Minerals in Rocks, Transmitted Polarized Light Microscopy and Optical Properties of Uniaxial and Biaxial Minerals.

Petrology

Definition and Classification of Rocks, Igneous Rocks-Forms of Igneous Bodies, Crystallization from Magma, Classification, Association and Genesis of Igneous Rocks, Sedimentary Rocks – Classification, Texture and Structure, Size and Shape of Sedimentary Bodies, Metamorphic Rocks – Classification, Facies, Zones and Texture, Characteristics Mineral Assemblages of Pelites in the Barrovian Zones and Mafic Rocks in Common Facies

Economic Geology

Properties of Common Economic Minerals, General Processes of Formation of Mineral Deposits, Physical Characters, Mode of Occurrence and Distribution in India both of Metallic and Non-Metallic Mineral Deposits, Coal and Petroleum Occurrences in India.

Applied Geology

Ground Water, Principles of Engineering Geology

JAM Chemistry Syllabus 2020

Units**Topics/ Subtopics****Physical Chemistry**

Basic Mathematical Concepts

Functions, Maxima and Minima, Integrals, Ordinary Differential Equations, Vectors and Matrices, Determinants, Elementary Statistics and Probability Theory

Atomic and Molecular
Structure

Fundamental Particles, Bohr's Theory of Hydrogen-like Atom, Wave-Particle Duality, Uncertainty Principle, Schrödinger's Wave Equation, Quantum Numbers, Shapes of Orbitals, Hund's Rule and Pauli's Exclusion Principle, Electronic Configuration of Simple Homonuclear Diatomic Molecules

Theory of Gases

Equation of State for Ideal and Non-Ideal (Van Der Waals) Gases, Kinetic Theory of Gases, Maxwell-Boltzmann Distribution Law, Equipartition of Energy.

Solid state

Crystals and Crystal Systems, X-rays, NaCl and KCl Structures, Close Packing, Atomic and Ionic Radii, Radius Ratio Rules, Lattice Energy, Born-Haber Cycle, Isomorphism, Heat Capacity of Solids.

Chemical Thermodynamics	Reversible and Irreversible Processes, First Law and Its Application to Ideal and Nonideal Gases, Thermochemistry, Second Law, Entropy and Free Energy, Criteria for Spontaneity.
Chemical and Phase Equilibria	Law of Mass Action, K_p , K_c , K_x and K_n , Effect of Temperature on K , Ionic Equilibria in Solutions, PH and Buffer Solutions, Hydrolysis, Solubility Product, Phase Equilibria–Phase Rule and its Application to One-Component and Two-Component Systems, Colligative Properties
Electrochemistry	Conductance and its Applications, Transport Number, Galvanic cells, EMF and Free Energy, Concentration Cells with and without Transport, Polarography, Concentration cells with and without Transport, Debye-Huckel-Onsager Theory of Strong Electrolytes, Chemical Kinetics, Reactions of Various Order, Arrhenius Equation, Collision Theory, Transition State Theory, Chain Reactions – Normal and Branched, Enzyme Kinetics, Photochemical Processes, Catalysis.
Adsorption	Gibbs Adsorption Equation, Adsorption Isotherm, Types of Adsorption, Surface Area of Adsorbents, Surface Films on Liquids.
Spectroscopy	Beer-Lambert Law, Fundamental Concepts of Rotational, Vibrational, Electronic and Magnetic

Resonance Spectroscopy.

Organic Chemistry

Basic Concepts in Organic Chemistry and Stereochemistry	Electronic Effects (Resonance, Inductive, Hyperconjugation) and Steric Effects and its Applications (Acid/Base Property), Optical Isomerism in Compounds with and without any Stereocenters (Allenes, Biphenyls), Conformation of Acyclic Systems (Substituted Ethane/n-Propane/n-Butane) and Cyclic Systems (Mono- and Di-Substituted Cyclohexanes).
Organic Reaction Mechanism and Synthetic Applications	Dozens Reaction, Wittig Reaction and McMurry Reaction, Pinacol-Pinacolone, Favorskii, Benzilic Acid Rearrangement, Dienone-Phenol Rearrangement, Baeyer-Villiger Reaction, Oxidation and Reduction Reactions in Organic Chemistry, Organometallic Reagents in Organic Synthesis (Grignard, Organolithium and Organocopper), Diels-Alder, Electrocyclic and Sigmatropic Reactions, Functional Group Inter-Conversions and Structural Problems using Chemical Reactions, Chemistry of Reactive Intermediates (Carbocations, Carbanions, Free Radicals, Carbenes, Nitrenes, Benzyne etc...), Hofmann-

Curtius-Lossen Rearrangement, Wolff Rearrangement, Simmons-Smith Reaction, Reimer-Tiemann Reaction, Michael Reaction.

Qualitative Organic Analysis

Identification of Functional Groups by Chemical Tests, Elementary UV, IR and ¹H NMR Spectroscopic Techniques as Tools for Structural Elucidation

Natural Products Chemistry

Chemistry of Alkaloids, steroids, Terpenes, Carbohydrates, Amino Acids, Peptides and Nucleic Acids.

Aromatic and Heterocyclic
Chemistry

Monocyclic, Bicyclic and Tricyclic Aromatic Hydrocarbons, and Monocyclic Compounds with One Hetero Atom, Synthesis, Reactivity and Properties.

Inorganic Chemistry

Periodic Table

Periodic Classification of Elements and Periodicity in Properties, General Methods of Isolation and Purification of Elements, Chemical Bonding and Shapes of Compounds, Types of Bonding, VSEPR

	Theory and Shapes of Molecules, Hybridization, Dipole Moment, Ionic Solids, Structure of NaCl, CsCl, Diamond and Graphite, Lattice Energy
Main Group Elements (s and p blocks)	General concepts on Group Relationships and Gradation in Properties, Structure of Electron Deficient Compounds involving Main Group Elements
Transition Metals (d block)	Characteristics of 3d Elements, Oxide, Hydroxide and Salts of First Row Metals, Coordination Complexes, Structure, Isomerism, Reaction Mechanism and Electronic Spectra, VB, MO and Crystal Field Theoretical Approaches for Structure, Color and Magnetic Properties of Metal Complexes, Organometallic Compounds having Ligands with Back Bonding Capabilities such as Metal Carbonyls, Carbenes, Nitrosyls and Metallocenes, Homogeneous Catalysis.
Bioinorganic Chemistry	Essentials and Trace Elements of Life, Basic Reactions in Biological Systems and the Role of Metal Ions, especially Fe^{2+} , Fe^{3+} , Cu^{2+} and Zn^{2+} , Structure and Function of Hemoglobin and Myoglobin and Carbonic Anhydrase.
Instrumental Methods of	Essentials and Trace Elements of Life, Basic Reactions in Biological Systems and the Role of Metal

Analysis

Ions, especially Fe^{2+} , Fe^{3+} , Cu^{2+} and Zn^{2+} , Structure and Function of Hemoglobin and Myoglobin and Carbonic Anhydrase.

Analytical Chemistry

Principles of Qualitative and Quantitative Analysis, Acid-Base, Oxidation-Reduction and Complexometric Titrations using EDTA, Precipitation Reactions, Use of Indicators, Use of Organic Reagents in Inorganic Analysis, Radioactivity, Nuclear Reactions, Applications of Isotopes.