



JEE ADVANCED Syllabus



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JEE Advanced Syllabus 2020

1. JEE Advanced Syllabus for Physics
2. JEE Advanced Syllabus for Chemistry
3. JEE Advanced Syllabus for Mathematics

JEE ADVANCED SYLLABUS 2020 (PHYSICS)

Topics	Sub Topics
General Physics	<ul style="list-style-type: none"> • Units and dimensions • dimensional analysis; least count, significant figures • Different methods of measurement(parallex method) • error analysis for physical quantities for following experiments <ol style="list-style-type: none"> 1. Experiments based on Vernier calipers and screw gauge (micrometer) 2. Determination of g using simple pendulum 3. Young's modulus by Searle's method 4. Specific heat of a liquid using calorimeter 5. focal length of a convex lens and concave mirror using u-v method 6. Speed of sound using resonance column 7. Verification of Ohm's law using voltmeter and ammeter 8. Specific resistance(of the material) of wire using <ul style="list-style-type: none"> • meter bridge • post office box.
Mechanics	<ul style="list-style-type: none"> • Kinematics in 1-D and 2-D (Cartesian coordinates only), projectiles • Uniform circular motion • Relative velocity • Newton's laws of motion • Uniformly accelerated and Inertial frames of reference • Static and dynamic friction • Kinetic and potential energy • Work and power • Conservation of linear momentum and mechanical energy • Systems of particles:- Centre of mass of the body and its motion • Impulse • Elastic and inelastic collisions • Law of gravitation; Gravitational potential and field • Acceleration due to gravity • Motion of planets and satellites in circular orbits • Escape velocity • Rigid body • moment of inertia • parallel and perpendicular axes theorems • moment of inertia of uniform bodies (simple geometrical shapes) • Angular momentum • Torque

	<ul style="list-style-type: none"> • Conservation of angular momentum • Dynamics of rigid bodies(along with fixed axis of rotation). • Rolling without slipping of rings, cylinders and spheres • Equilibrium of rigid bodies • Collision of point masses with rigid bodies • Linear and angular simple harmonic motions • Hooke's law, Young's modulus • Pressure in a fluid <ol style="list-style-type: none"> 1. Buoyancy 2. Surface energy 3. Pascal's law 4. surface tension 5. capillary rise, Viscosity (Poiseuille's equation excluded) 6. Stoke's law 7. Terminal velocity 8. Streamline flow 9. equation of continuity 10. Bernoulli's theorem and its applications <ul style="list-style-type: none"> • Wave motion (plane waves only) <ol style="list-style-type: none"> 1. longitudinal waves 2. transverse waves 3. superposition of waves 4. Progressive waves and stationary waves 5. Vibration of strings and air column 6. Resonance 7. Beats 8. Speed of sound in gases 9. Doppler effect (in sound).
Thermal physics	<ul style="list-style-type: none"> • thermal expansion of solids, liquids, and gases • Calorimetry, latent heat • Heat conduction in one dimension • Elementary concepts of convection and radiation • Newton's law of cooling • Ideal gas laws • Specific heats (C_p and C_v for diatomic and monatomic gases) • Isothermal and adiabatic processes, bulk modulus of gases • Equivalence of heat and work • First law of thermodynamics and its applications (for ideal gases) • Blackbody radiation: absorptive powers and emissive powers • Wien's displacement law, Stefan's law.
Electricity and magnetism	<ul style="list-style-type: none"> • Coulomb's law <ol style="list-style-type: none"> 1. Electric field and potential 2. Electrical potential energy of a system of point charges and of electrical dipoles in a uniform electrostatic field 3. Electric field lines 4. Flux of electric field


	<ul style="list-style-type: none"> • Gauss's law and its application <ol style="list-style-type: none"> 1. to find Electric field due to an infinitely long straight wire 2. uniformly charged infinite plane sheet (3) uniformly charged thin spherical shell) • Capacitance <ol style="list-style-type: none"> 1. Parallel plate capacitor with and without dielectrics 2. Capacitors in series and parallel 3. Energy stored in a capacitor • Electric current <ol style="list-style-type: none"> 1. Ohm's law 2. Series and parallel arrangements of resistances and its numericals, cells 3. Kirchhoff's laws and its applications 4. Heating effect of current 5. Biot-Savart's law and Ampere's law • Magnetic field <ol style="list-style-type: none"> 1. Magnetic Field near a current-carrying straight wire (1) along the axis of a circular coil and (2) inside a long straight solenoid) 2. Force on a current-carrying wire and a moving charge in a uniform magnetic field 3. Magnetic moment of a current loop 4. Effects of a uniform magnetic field on a current loop 5. Moving coil galvanometer, voltmeter, ammeter and their conversions. Electromagnetic induction: Faraday's law, Lenz's law <ul style="list-style-type: none"> • Self and mutual inductance; LC, LR and RC circuits with a.c. and d.c. sources.
Optics	<ul style="list-style-type: none"> • Rectilinear propagation of light • Reflection and refraction at plane and spherical surfaces • Total internal reflection • Deviation and dispersion of light by a prism • Thin lenses • Combinations of mirrors and thin lenses • Magnification • Wave nature of light <ol style="list-style-type: none"> 1. Huygen's principle 2. interference (limited to Young's double-slit experiment)
Modern Physics	<ul style="list-style-type: none"> • Atomic nucleus; α, β and γ radiations • Law of radioactive decay • Decay constant; Half-life and mean life • Binding energy and its calculation • Fission and fusion processes • Energy calculation in these processes

	<ul style="list-style-type: none"> • Photoelectric effect • Bohr's theory of hydrogen-like atoms • Characteristic and continuous X-rays • Moseley's law • de Broglie wavelength of matter waves.
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JEE ADVANCED SYLLABUS 2020 (CHEMISTRY)

1. Physical Chemistry
2. Inorganic Chemistry
3. Organic Chemistry

PHYSICAL CHEMISTRY

Topics	Sub Topics
General Topics 	<ul style="list-style-type: none"> • Concept of atoms and molecules • Dalton's atomic theory • Mole concept • Chemical formulae • Balanced chemical equations • Calculations/ Numericals based on mole concept which can involve common oxidation-reduction, neutralisation reaction and displacement reactions • Concentration in terms of mole fraction • molarity, molality and normality.
Gaseous and liquid states	
	<ul style="list-style-type: none"> • Bohr model, spectrum of hydrogen atom, quantum numbers • Wave-particle duality, de Broglie hypothesis • Uncertainty principle • Qualitative quantum:- mechanical picture of hydrogen atom, shapes of s orbital, p orbital and d orbitals • Electronic configurations of elements (till atomic number 36) • Aufbau principle • Pauli's exclusion principle and Hund's rule • Orbital overlap and covalent bond • Hybridisation involving s, p and d orbitals only • Orbital energy diagrams for homonuclear diatomic species • Hydrogen bond • Polarity in molecules, dipole moment (qualitative aspects only)

Useful Links

	<ul style="list-style-type: none"> VSEPR model and shapes of molecules (linear, triangular, angular square planar, pyramidal, square pyramidal, trigonal bipyramidal, tetrahedral and octahedral).
Energetics	<ul style="list-style-type: none"> First law of thermodynamics Internal energy work and heat pressure-volume work Enthalpy Hess's law Heat of reaction, fusion and vapourization Second law of thermodynamics Entropy Free energy Criterion of spontaneity.
Chemical Equilibrium	<ul style="list-style-type: none"> Law of mass action Equilibrium constant Le Chatelier's principle (effect of temperature, concentration and pressure) Significance of ΔG and ΔG^0 in chemical equilibrium Solubility product common ion effect pH and buffer solutions Acids and bases (Bronsted and Lewis concepts) Hydrolysis of salts.
Electrochemistry	<ul style="list-style-type: none"> Electrochemical cells and cell reactions Standard electrode potentials Nernst equation and its relation to ΔG Electrochemical series emf of galvanic cells Faraday's laws of electrolysis Electrolytic conductance, specific conductance, equivalent and molar conductivity, Kohlrausch's law Concentration cells
Chemical kinetics	<ul style="list-style-type: none"> Rates of chemical reactions Order of reactions Rate constant First order reactions Temperature dependence of rate constant (Arrhenius equation).
Solid state	<ul style="list-style-type: none"> Classification of solid state, crystalline state, seven crystal systems (cell parameters a, b, c, α, β, γ)

	<ul style="list-style-type: none"> close packed structure of solids (cubic), packing in bcc, fcc and hcp lattices Nearest neighbours, ionic radii, point defects, simple ionic compounds.
Solutions	<ul style="list-style-type: none"> Raoult's law Molecular weight determination from lowering of vapour pressure depression of freezing point, elevation of boiling point.
Surface chemistry	<ul style="list-style-type: none"> Elementary concepts of adsorption (excluding adsorption isotherms) Colloids: types, methods of preparation and general properties Elementary ideas of surfactants, emulsions, and micelles (only definitions and examples).
Nuclear chemistry	<ul style="list-style-type: none"> Radioactivity: isotopes and isobars Properties of α, β and γ rays Kinetics of radioactive decay (excluding decay series), carbon dating Stability of nuclei with respect to proton-neutron ratio Brief discussion on fusion and fission reactions.

INORGANIC CHEMISTRY

Topics	Sub Topics
Topics	Sub Topics
Isolation/preparation and properties of the following non-metals	<ul style="list-style-type: none"> Boron, nitrogen, phosphorus, silicon, oxygen, sulphur and halogens Properties of allotropes of carbon (diamond and graphite), phosphorus and sulphur.
Preparation and properties of the following compounds	<ul style="list-style-type: none"> Oxides, hydroxides, peroxides, carbonates, bicarbonates, and chlorides sulphates of sodium, magnesium, potassium and calcium Boron: diborane, boric acid, and borax Aluminium: alumina, aluminium chloride, and alums Carbon: oxides and oxyacid (carbonic acid) Silicon: silicones, silicates, and silicon carbide Nitrogen: oxides, oxyacids, and ammonia

	<ul style="list-style-type: none"> Phosphorus: oxides, oxyacids (phosphoric acid, phosphorous acid) and phosphine Oxygen: ozone and hydrogen peroxide Sulphur: hydrogen sulphide, oxides, sulphurous acid, sulphuric acid and sodium thiosulphate Halogens: hydrohalic acids, oxyacids and of chlorine, bleaching powder Xenon fluorides.
Transition elements (3d series)	<ul style="list-style-type: none"> Definition of 3d Series, its general characteristics oxidation states and their stabilities colour (excluding the details of electronic transitions) calculation of spin-only magnetic moment Coordination compounds nomenclature of mononuclear coordination compounds cis-trans and ionisation isomerisms Geometries and hybridization of mononuclear coordination compounds (linear, tetrahedral, square planar and octahedral).
4. Preparation and properties of the following compounds	<ul style="list-style-type: none"> Oxides and chlorides of tin and lead Chlorides, oxides and sulphates of Fe^{2+}, Cu^{2+} and Zn^{2+} Potassium permanganate, potassium dichromate, silver oxide, silver nitrate, silver thiosulphate
5. Ores and minerals	<ul style="list-style-type: none"> Commonly occurring minerals and ores of iron, copper, aluminium, zinc, tin, lead, magnesium, and silver.
6. Extractive metallurgy	<ul style="list-style-type: none"> Chemical principles and reactions only (industrial details excluded) Carbon reduction method (iron and tin) Self reduction method (copper and lead) Electrolytic reduction method (magnesium and aluminium) Cyanide process (silver and gold).
Principles of qualitative analysis	<ul style="list-style-type: none"> Groups I to V (only Ag^+, Hg_2^{2+}, Cu^{2+}, Pb^{2+}, Bi^{3+}, Fe^{3+}, Cr^{3+}, Al^{3+}, Ca^{2+}, Ba^{2+}, Zn^{2+}, Mn^{2+} and Mg^{2+}) Nitrate

- halides (excluding fluoride)
- sulphate and sulphide.

ORGANIC CHEMISTRY

Topic	Sub Topic
Basic Concepts	<ul style="list-style-type: none"> • Hybridisation of carbon • σ and π-bonds • Shapes of simple organic molecules • Structural and geometrical isomerism • Optical isomerism of compounds that contains up to two asymmetric centres (R,S and E,Z nomenclature excluded) • IUPAC nomenclature of simple organic compounds (only hydrocarbons, bi-functional and mono-functional compounds) • Conformations of ethane and butane (Newman projections) • Resonance and hyperconjugation • Keto-enol tautomerism • Determination of empirical formula and molecular formulae of simple compounds (only combustion method) • Definition of Hydrogen Bonds and their effects on physical properties of carboxylic acids and alcohols • Inductive effects and resonance effects on basicity and acidity of organic acids and bases • Polarity and inductive effects in alkyl halides • Reactive intermediates (produced during homolytic bond and heterolytic bond cleavage) • Formation, structure and stability of carbanions, carbocations and free radicals.
Preparation, properties and reactions of alkanes	<ul style="list-style-type: none"> • Homologous series • physical properties of alkanes (boiling points, melting points and density) • Combustion and halogenation of alkanes • Preparation of alkanes by decarboxylation reactions and Wurtz reaction.
Preparation, properties and reactions of alkenes and alkynes	<ul style="list-style-type: none"> • Physical properties of alkynes and alkenes (boiling points, density and dipole moments) • Acidity of alkynes • Acid catalysed hydration of alkynes and alkenes (excluding the stereochemistry of addition and elimination) • Reactions of alkenes with KMnO_4 and ozone

	<ul style="list-style-type: none"> • Reduction of alkenes and alkynes • Preparation of alkenes and alkynes by elimination reactions • Electrophilic addition reactions of alkenes with HOX, H₂O X₂, and HX(X=halogen) • Addition reactions of alkynes • Metal acetylides.
Reactions of benzene	<ul style="list-style-type: none"> • Structure and aromaticity <ol style="list-style-type: none"> 1. Electrophilic substitution reactions <ul style="list-style-type: none"> • Halogenation • Nitration • sulphonation 2. Friedel-Crafts alkylation and acylation 3. Effect of p-, o- and m- directing groups(in monosubstituted benzenes)
Phenols	<ul style="list-style-type: none"> • Acidity • electrophilic substitution reactions (nitration, sulphonation and halogenation) • Reimer-Tieman reaction • Kolbe reaction.
Characteristic reactions of the following (including those which have been mentioned above)	<ol style="list-style-type: none"> 1. Alkyl halides <ul style="list-style-type: none"> • rearrangement reactions of alkyl carbocation • Grignard reactions • nucleophilic substitution reactions 2. Alcohols <ul style="list-style-type: none"> • Esterification • dehydration and oxidation • reaction with sodium • phosphorus halides • ZnCl₂/concentrated HCl • conversion of alcohols into aldehydes and ketones 3. Ethers <ul style="list-style-type: none"> • Preparation by Williamson's Synthesis 4. Aldehydes and Ketones <ul style="list-style-type: none"> • Oxidation

	<ul style="list-style-type: none"> • Reduction • oxime and hydrazone formation • aldol condensation • Perkin reaction • Cannizzaro reaction • haloform reaction • nucleophilic addition reactions (Grignard addition) <p>5. Carboxylic acids</p> <ul style="list-style-type: none"> • formation of esters • acid chlorides and amides • ester hydrolysis <p>6. Amines</p> <ul style="list-style-type: none"> • basicity of substituted anilines and aliphatic amines • preparation from nitro compounds • reaction with nitrous acid • azo coupling reaction of diazonium salts (aromatic amines) • Sandmeyer and related reactions of diazonium salts • carbylamine reaction <p>7. Haloarenes</p> <ul style="list-style-type: none"> • nucleophilic aromatic substitution in haloarenes • substituted haloarenes (excluding C₆H₅ substitution and Benzyne mechanism).
Carbohydrates	<ul style="list-style-type: none"> • Classification <p>1. mono-saccharides and di-saccharides (glucose and sucrose)</p> <ul style="list-style-type: none"> • Oxidation, reduction • glycoside formation • hydrolysis of sucrose
Amino acids and peptides	<ul style="list-style-type: none"> • General structure (only primary structure for peptides) and its physical properties
Properties and uses of some important polymers	<ul style="list-style-type: none"> • Natural rubber • Cellulose

	<ul style="list-style-type: none"> Nylon Teflon PVC
Practical organic chemistry	<ul style="list-style-type: none"> Detection of elements (halogens, N, S) Detection and identification of the following functional groups <ol style="list-style-type: none"> hydroxyl (alcoholic and phenolic) carbonyl (aldehyde and ketone) carboxyl, amino and nitro Separating mono-functional compounds from binary mixtures by using chemical method

JEE ADVANCED SYLLABUS 2020 (MATHEMATICS)

Topics	Sub Topics
Algebra	<ol style="list-style-type: none"> Algebra of complex numbers <ul style="list-style-type: none"> addition, multiplication, conjugation of vectors polar representation of vectors properties of modulus and principal argument triangle inequality cube roots of unity, geometric interpretations. Quadratic equations with real coefficients <ul style="list-style-type: none"> relations between roots and coefficients formation of quadratic equations with given roots symmetric functions of roots Sequence and Series <ul style="list-style-type: none"> Arithmetic progressions Geometric progressions Harmonic progressions Arithmetic mean Geometric mean Harmonic mean sums of finite arithmetic and geometric progressions infinite geometric series sums of squares of the first n natural numbers cubes of the first n natural numbers Logarithms

	<ul style="list-style-type: none"> properties <p>5. Permutations and combinations</p> <p>6. binomial theorem for a positive integral index</p> <ul style="list-style-type: none"> properties of binomial coefficients.
Matrices	<ul style="list-style-type: none"> Matrices as a rectangular array of real numbers equality of matrices <p>1. Operation on Matrices</p> <ul style="list-style-type: none"> Addition and subtraction of matrices Multiplication of matrices(by scalar) Matrix Multiplication <p>2. Transpose of a matrix</p> <p>3. Determinant of a square matrix(Up to Order of 3)</p> <p>4. inverse of a square matrix(Up to Order of 3)</p> <p>5. properties of matrix operations</p> <p>6. diagonal, symmetric and skew-symmetric matrices and their properties</p> <p>7. solutions of simultaneous linear equations in two variables</p> <ul style="list-style-type: none"> solutions of simultaneous linear equations in three variables.
Probability	<p>1. Addition and multiplication rules of probability</p> <p>2. conditional probability</p> <p>3. Bayes Theorem</p> <p>4. independence of events</p> <p>5. computation of probability (using permutations and combinations)</p>
Trigonometry	<p>1. Trigonometric functions</p> <p>2. Periodicity and graphs</p> <p>3. addition and subtraction formulae</p> <p>4. formulae involving multiple and sub-multiple angles</p> <p>5. general solution of trigonometric equations</p> <p>6. Relations between sides and angles of a triangle</p> <p>7. sine rule, cosine rule and half-angle formula</p> <p>8. area of a triangle(trigonometric formulae), inverse trigonometric functions (only principal value).</p>

Analytical geometry	<ol style="list-style-type: none"> 1. Two dimensions <ul style="list-style-type: none"> • Cartesian coordinates • distance between two points • section formulae • shift of origin 2. Equation of a straight line in various forms <ul style="list-style-type: none"> • angle between two lines • distance of a point from a line • lines through the point of intersection of given two lines • To find the equation of the bisector of the angle(angle between two lines) • concurrency of lines 3. Triangles <ul style="list-style-type: none"> • Centroid of a triangle • Orthocentre of a triangle • incentre of a triangle • circumcentre of a triangle 4. Circle <ul style="list-style-type: none"> • Equation of a circle in various forms • equations of tangent, normal and chord • Parametric equations of a circle • intersection of a circle with a straight line • Intersection of a circle with a circle • equation of a circle passing through the points of intersection of two circles and those of a circle and a straight line 5. Parabola, Ellipse and Hyperbola <ul style="list-style-type: none"> • Equations of a parabola in standard form • Equation ellipse and hyperbola in standard form • foci, directrices and eccentricity • parametric equations • equations of tangent and normal • Locus problems 6. Three dimensions <ul style="list-style-type: none"> • Direction cosines and direction ratios • equation of a straight line in space • equation of a plane • distance of a point from a plane
Differential calculus	<ul style="list-style-type: none"> • Real valued functions of a real variable • into, onto and one-to-one functions

	<ul style="list-style-type: none"> Sum, difference, product and quotient of two functions Composite functions, absolute value, trigonometric, polynomial, rational, exponential and logarithmic functions Limit and continuity of a function <ol style="list-style-type: none"> limit and continuity of the sum, product, difference and quotient of two functions L'Hospital rule of evaluation of limits of functions Even and odd functions inverse of a function Continuity of composite functions intermediate value property of continuous functions. Derivative of a function <ol style="list-style-type: none"> <ol style="list-style-type: none"> Derivative of the sum, product difference and quotient of two functions chain rule derivatives of polynomial, rational, trigonometric inverse trigonometric exponential and logarithmic functions Derivatives of implicit functions derivatives up to order two geometrical interpretation of the derivative <ul style="list-style-type: none"> tangents and normals increasing and decreasing functions maximum and minimum values of a function Rolle's theorem Lagrange's mean value theorem
Integral calculus	<ul style="list-style-type: none"> Integration(the inverse process of differentiation) <ol style="list-style-type: none"> indefinite integrals of standard function definite integrals and their properties fundamental theorem of integral calculus Integration by parts Integration by the methods of substitution Integration by partial fractions Application of definite integrals Determination of areas involving simple curves(Using definite integration) Formation of ordinary differential equations Solution of homogeneous differential equations separation of variables method linear first order differential equations.
Vectors	<ul style="list-style-type: none"> Addition of vectors, scalar multiplication dot and cross products scalar triple products and their geometrical interpretations

