



**SATHYABAMA**

INSTITUTE OF SCIENCE AND TECHNOLOGY  
(DEEMED TO BE UNIVERSITY)



**SATHYABAMA**  
ALL INDIA ONLINE ENTRANCE  
EXAMINATION - 2021  
**SAEEE-2021**

**All India Online Entrance Examination - 2021**  
for the following Undergraduate Programmes

**B.E. | B.TECH. | B.ARCH. | B.DES.**

Ranked among India's  
top 50 Universities for five consecutive years



**INFORMATION BROCHURE**

**SATHYABAMA**  
**ALL INDIA ONLINE ENTRANCE**  
**EXAMINATION – 2021**

**SAEEE – 2021**

**INFORMATION BROCHURE**

# CONTENTS

Sl. No.		Page No.
I.	INTRODUCTION	2
II.	ELIGIBILITY CRITERIA FOR ADMISSION	2
III.	ENTRANCE EXAMINATION & ADMISSION PROCEDURE	4
IV.	SCHOLARSHIPS	7
V.	IMPORTANT DATES FOR REMEMBER	7
VI.	QUESTION PAPER PATTERN AND MAXIMUM MARKS	7
VII.	SYLLABUS	9

## I. INTRODUCTION

Sathyabama Institute of Science and Technology aims to provide higher education with high quality teaching and research. The Institution has attained heights under the able guidance of Founder Chancellor **Col. Dr. JEPPIAAR, M.A., Ph.D.**, and dynamic leadership of chancellor **Dr. MARIAZEENA JOHNSON, B.E., M.B.A., M.Phil., Ph.D.**, well supported by President **Dr. MARIE JOHNSON, B.E., M.B.A., M.Phil., Ph.D.**, Vice Chancellor **Dr. T. SASIPRABA, M.E., Ph.D.** Institution offers 43 Under Graduate Programmes, 21 Post Graduate Programmes and Ph.D., Programmes in Engineering, Technology, Arts, Science and Management. Admission to Undergraduate Engineering, Technology, Architecture and B.Design Programmes are based on the Sathyabama All India Entrance Examination conducted, every year.

## II. ELIGIBILITY CRITERIA FOR ADMISSION

Candidates can choose any of the following programmes (refer page no.3) based on the eligibility criteria. Candidates should have passed the qualifying examination with first class/grade either in March/April 2020 or should be appearing for the same in March/April 2021. The candidate's date of birth should be on or after 1<sup>st</sup> January, 2001.

In addition to this, candidates should have passed the 10<sup>th</sup> class or Equivalent Examination in March/April 2018 or after, with minimum aggregate of 60% marks or "6.0" CGPA.

### NOTE:

**CANDIDATES PASSED IN COMPARTMENTAL CLASS / GRADE (OR) PASSED WITH ARREAR/S EITHER IN 10<sup>th</sup> CLASS OR IN 12<sup>th</sup> CLASS ARE NOT ELIGIBLE FOR ADMISSION.**

**NON RESIDENT INDIAN (NRI), DIPLOMA HOLDERS AND CANDIDATES OF FOREIGN ORIGIN NEED NOT APPEAR FOR THIS ENTRANCE EXAMINATION.**

**ELIGIBILITY CRITERIA**  
**UG PROGRAMMES IN ENGINEERING, ARCHITECTURE AND DESIGN**

PROGRAMME & SPECIALIZATION	DURATION	ELIGIBILITY CRITERIA
B.E - Aeronautical Engg.	<b>4 Years</b>	<p>A pass in the 10<sup>th</sup> class or Equivalent Examination with a minimum aggregate of 60% marks or “6.0” CGPA.</p> <p>Passed 10+2 examination with Physics / Mathematics / Chemistry / Computer Science / Electronics / Information Technology / Biology / Informatics Practices / Biotechnology / Technical Vocational Subject / Agriculture / Engineering Graphics / Business Studies / Entrepreneurship. (Any of the three)</p> <p>Obtained at least 45 % marks (40% marks in case of candidates belonging to reserved category) in the above subjects taken together</p>
B.E - Automobile Engg.		
B.E - Civil Engg.		
B.E - Computer Science and Engg.		
B.E - Computer Science and Engg with specialization in Artificial Intelligence		
B.E - Computer Science and Engg with specialization in Data Science		
B.E - Computer Science and Engg with specialization in Internet of Things		
B.E - Electrical and Electronics Engg.		
B.E - Electronics and Communication Engg.		
B.E – Electronics and Instrumentation Engg.		
B.E - Mechatronics		
B.E - Mechanical Engg.		
B.Tech - Chemical Engg.		
B.Tech - Information Technology		
B.Tech - Biomedical		
B.Tech - Biotechnology		
B.Design – Interior Design	<b>4 Years</b>	<p>A pass in 10+2/HSC obtained atleast 45% marks ( 40% in case of candidates belonging to Reserved category) in the qualifying Examination</p>
B.Arch- Bachelor of Architecture	<b>5 Years</b>	<p>A Pass in the 10+2/HSC/ICSE or Equivalent Examination with Mathematics , Physics and Chemistry with a minimum average of 50% marks in Mathematics , Physics and Chemistry.(45% in case of candidates belonging to Reserved Category) and valid NATA score National Aptitude Test in Architecture)</p> <p><b>Note:</b> For regular update about NATA Exam, please refer Council of architecture website.</p> <p>Candidate opting for this programme should appear for Mathematics, Physics and Chemistry in Sathyabama entrance examination.</p>

### III. ENTRANCE EXAMINATION AND ADMISSION PROCEDURE

#### 1. PRIMARY INFORMATION TO ALL CANDIDATES APPLYING FOR ENTRANCE EXAMINATION - 2021

- Candidates are required to ensure themselves that they possess the requisite eligibility criteria for admission into a programme before applying for entrance examination (refer eligibility criteria in page no.2)
- Based on 12<sup>th</sup> class syllabus (refer page no.9 for detailed syllabus), Entrance Examination will be conducted in Mathematics, Physics and Chemistry. All Candidates must appear for Mathematics, Physics and Chemistry.
- Entrance Examination will be conducted **only by Online mode**
- Permitting a candidate to appear for the entrance Examination - 2021 or counseling does not entitle the right for admission
- Candidates who have been offered provisional admission after counseling should submit the relevant original documents such as 10<sup>th</sup> and HSC Mark sheet, Transfer Certificate, etc. at the time of admission. If not, admission will stand cancelled
- After admission, at a later point of time if any discrepancy or malpractice is noticed in the submitted documents, the Candidate's admission will be cancelled by the institution without any further explanation

#### 2. ADMISSION PROCEDURE

The admission to **B.E /B.Tech. / B.Arch./ B. Des.** Programmes is done on the basis of the performance in the **All India B.E /B.Tech. / B.Arch./ B.Des. Entrance Examination 2021** conducted by Sathyabama Institute of Science and Technology, in online mode.

The candidates will be shortlisted and called for Counseling based on their performance in the entrance examination 2021. On the day of counseling the branch of study will be allotted depending on the availability of seat and provisional admission order will be issued on the same day after collecting counseling fee of Rs.50,000/-.

**ALLOTMENT OF BRANCH ONCE MADE DURING THE COUNSELLING IS FINAL AND CANNOT BE CHANGED UNDER ANY CIRCUMSTANCES.**

#### 3. PROCEDURE TO APPLY B.E /B.Tech. / B.Arch./ B.Des. ENTRANCE EXAMINATION 2021

##### APPLICATION FORM - ONLINE MODE

Candidates should use only online submission of application, which is available at [www.sathyabama.ac.in](http://www.sathyabama.ac.in). Candidates opting for online submission should fill the application, and verify that all the details are entered. After the verification of the details, online payment of Rs.650/- should be made either by using Net Banking Facility / Credit Card/Debit Card or

offline payment (only by Indian bank challan mode) at any one of the INDIAN BANK branches.

The candidates who have submitted the application through online mode need not send any printed forms/account statement/ bank or institution challan copy etc., unless otherwise requested by authorities. But they should note the application number, login user name and password for future reference (application number must be required to track their application and to book the slot for online mode examination). Applications without the fee payment will not be considered.

#### **4. ENTRANCE EXAMINATION- 2021 INSTRUCTIONS**

Entrance Examination 2021 will be conducted through Online Mode only. The Online Mode Examination will be conducted in the first week of May, 2021.

##### **a. TRACK YOUR ENTRANCE EXAMINATION 2021 APPLICATION**

- After submission of application by online, candidates can track his/her application through our website [www.sathyabama.ac.in](http://www.sathyabama.ac.in)
- A Candidate can track his/her application form by entering the application number
- E-mail may be sent to [entranceexam2021@sathyabama.ac.in](mailto:entranceexam2021@sathyabama.ac.in) for any assistance to track the application by mentioning the application number, candidate name, father's name, mobile number and date of birth of the candidate

##### **b. ENTRANCE EXAMINATION DATE & TIME**

**SUBMISSION OF ENTRANCE EXAMINATION APPLICATION FORM ALONE IS NOT SUFFICIENT TO APPEAR FOR THE EXAMINATION. THE CANDIDATE SHOULD VISIT SATHYABAMA WEBSITE AND CHECK THE EMAIL FOR FREQUENT UPDATES.**

##### **c. ONLINE MODE EXAMINATION**

**The details of Online Examination, i.e., Duration, Maximum marks, etc., will be informed to all the candidates at least one month before the exact date/s of Examination.**

#### **5. INFORMATION TO CANDIDATES BY SMS & E-MAIL AT DIFFERENT STAGES OF ENTRANCE EXAMINATION AND ADMISSION PROCESS**

**Through mobile and e-mail:** All candidates will be updated with information regarding Entrance Examination-2021, through SMS and e- mail. Please ensure that correct mobile number and e-mail ID are provided in the online application.

#### **6. RESULTS OF THE ENTRANCE EXAMINATION-2021**

- The Entrance Examination results will be published on [www.sathyabama.ac.in](http://www.sathyabama.ac.in)
- As the examination is in online mode and evaluated with care, there is no provision for revaluation or re- totaling. No correspondence in this regard will be entertained, further

## **7. COUNSELLING PROCEDURE AND ADMISSION**

- The date/time for counseling will be published in our website [www.sathyabama.ac.in](http://www.sathyabama.ac.in) after the publication of results. Candidates can attend the Counselling either through online or attend in person as per the counseling schedule. Details regarding counseling venue, dates and fee will be mentioned in the counseling call letter
- Change of date/time of counseling is generally not permissible. If a candidate does not personally appear for counseling on the date and time specified, his/her seat shall be allocated to the succeeding candidate in the order of merit

## **8. REQUIRED DOCUMENTS IN ORIGINAL TO BE SUBMITTED DURING COUNSELLING (IN PERSON)**

- The candidate should produce the following documents in original along with one set of photocopies while reporting for counseling. Candidates will not be allowed to participate in the counseling process without these documents
  - Counseling call letter
  - Sathyabama Entrance Examination-2021 Hall Ticket
  - NATA score card (for B.Arch only)
  - Secondary school (Class X) mark sheet
  - HSC Mark sheet (Class XII) or Intermediate college Mark Sheet

If a candidate fails to produce any of these documents, he/she will not be considered for counseling

- Five colour passport size photographs of the candidate and parents

(CANDIDATE WHO SECURE THE ADMISSION THROUGH ONLINE COUNSELING MODE NEED TO SUBMIT THE ABOVE MENTIONED DOCUMENTS IN THE INSTITUTION AFTER THE COMMENCEMENT OF CLASSES)

- The branch of study will be allotted as per the marks secured in the Entrance Examination and availability of seats on that particular date at the counseling. After the allotment of branch of study, provisional admission letter will be issued to the candidate. Last date for the submission of remaining fee, submission of original certificates and other admission procedure will be mentioned in the admission offer letter
- Allotment of branch once made is final and cannot be changed under any circumstances
- A candidate should make a decision before the payment of the fee, whether he/she should join the programme based on the branch allotted to him/her at the time of counselling
- The candidates called for counselling will have to pay the counseling fee of Rs. 50,000/- (after the selection of the programme / branch that is available at the time of counseling) by means of Demand Draft drawn in favour of “Sathyabama Institute of Science and Technology”, payable at Chennai

- A candidate can also attend the counseling through online to select the preferred branch of Course and make the online payment of counseling fees
- A candidate's admission will be confirmed only after the payment of remaining tuition and other fee, such as Hostel Fee (if applicable) etc.
- On the day of counseling if the opted branch is not available, the candidate need not pay the counseling fee. Counseling fee paid once will not be refunded under any circumstances

#### IV. SCHOLARSHIPS

Dr. JEPPIAAR REMIBAI SCHOLARSHIP is offered to students who secure the top three positions in their semester examinations. A Student if consistently maintains top rank in eight consecutive semesters is eligible for a **MAXIMUM SCHOLARSHIP**.

For more details regarding Scholarship offered for meritorious students, please visit our Webpage: admission/ Scholarship files Sathyabama.ac.in/news/scholarship.pdf.

#### V. IMPORTANT DATES TO REMEMBER

Issue of application forms	<b>22-01-2021</b>
Last date for submitting the filled in application forms through Online mode	<b>Will be announced</b>
Online mode Examination	<b>Will be announced</b>
Declaration of Results and commencement of Counseling	<b>Will be announced</b>

#### VI. QUESTION PAPER PATTERN AND MAXIMUM MARKS

The Question paper is divided into three parts.

- 25% Questions from Physics
- 25% Questions from Chemistry
- 50% Questions from Mathematics

Sample questions are available at [www.sathyabama.ac.in](http://www.sathyabama.ac.in)

**EACH QUESTION CARRIES ONE MARK AND  
NO NEGATIVE MARKS FOR WRONG ANSWERS**



**IMPORTANT INFORMATION**

- We do not have any agent or middle men or broker for our admissions
- Entrance Examination application fee (Rs.650/-) will not be refunded under any circumstances
- Candidates are requested to enter and shade the correct mobile number properly in datasheet
- Results/Counseling call letter should be only downloaded from our website and will not be sent by post
- Candidates are advised to check the SMS, e-mail frequently for any regular updates
- Candidates are advised to visit [www.sathyabama.ac.in](http://www.sathyabama.ac.in) for regular updates regarding Entrance Examination -2021
- All the candidates must appear for Physics, Chemistry and Mathematics in the Entrance Examination
- For any assistance, candidate can send an e-mail to [entranceexam2021@sathyabama.ac.in](mailto:entranceexam2021@sathyabama.ac.in) by clearly mentioning their application number, name of the candidate, father's/guardian's name, mobile number, date of birth
- Contact 044 - 24502436, 044 - 24500600, 9940058263, 9940168007, 9940069538 (between 8.00 A.M and 4.00 P.M except public holidays) and Toll Free No. 18004231770 for any query regarding entrance examination
- All candidates who have submitted application for entrance examination are requested to note their application number. Application number is requested to track their application and to book the slot for online mode examination

**VII. SYLLABUS****PHYSICS****UNIT 1: PHYSICS AND MEASUREMENT**

Physics, technology and society, S I units, Fundamental and derived units. Least count, accuracy and precision of measuring instruments, Errors in measurement, Significant figures. Dimensions of Physical quantities, dimensional analysis and its applications.

**UNIT 2: KINEMATICS**

Frame of reference. Motion in a straight line: Position time graph, speed and velocity. Uniform and non uniform motion, average speed and instantaneous velocity Uniformly accelerated motion, velocity-time, position-time graphs, relations for uniformly accelerated motion. Scalars and Vectors, Vector addition and Subtraction, Zero Vector, Scalar and Vector products, Unit Vector, Resolution of a Vector. Relative Velocity, Motion in a plane, Projectile Motion, Uniform Circular Motion.

**UNIT 3: LAWS OF MOTION**

Force and Inertia, Newton's First Law of motion; Momentum, Newton's Second Law of motion; Impulse; Newton's Third Law of motion. Law of conservation of linear momentum and its applications, Equilibrium of concurrent forces. Static and Kinetic friction, laws of friction, rolling friction. Dynamics of uniform circular motion: Centripetal force and its applications.

**UNIT 4: WORK, ENERGY AND POWER**

Work done by a constant force and a variable force; kinetic and potential energies, work energy theorem, power. Potential energy of a spring, conservation of mechanical energy, conservative and non conservative forces; Elastic and inelastic collisions in one and two dimensions.

**UNIT 5: ROTATIONAL MOTION**

Centre of mass of a two-particle system, Centre of mass of a rigid body; Basic concepts of rotational motion; Moment of a force, torque, angular momentum, conservation of angular momentum and its applications; moment of inertia, radius of gyration. Values of moments of inertia for simple geometrical objects, parallel and perpendicular axes theorems and their applications. Rigid body rotation, equations of rotational motion.

**UNIT 6: GRAVITATION**

The universal law of gravitation. Acceleration due to gravity and its variation with altitude and depth. Kepler's laws of planetary motion. Gravitational potential energy; gravitational potential. Escape velocity. Orbital velocity of a satellite. Geo-stationary satellites.

**UNIT 7: PROPERTIES OF SOLIDS AND LIQUIDS**

Elastic behaviour, Stress-strain relationship, Hooke's Law, Young's modulus, bulk modulus, modulus of rigidity. Pressure due to a fluid column; Pascal's law and its applications. Viscosity, Stokes' law, terminal velocity, streamline and turbulent flow, Reynolds number. Bernoulli's

principle and its applications. Surface energy and surface tension, angle of contact, application of surface tension - drops, bubbles and capillary rise. Heat, temperature, thermal expansion; specific heat capacity, calorimetry; change of state, latent heat. Heat transfer-conduction, convection and radiation, Newton's law of cooling.

### **UNIT 8: THERMODYNAMICS**

Thermal equilibrium, zeroth law of thermodynamics, concept of temperature. Heat, work and internal energy. First law of thermodynamics. Second law of thermodynamics: reversible and irreversible processes. Carnot engine and its efficiency.

### **UNIT 9: KINETIC THEORY OF GASES**

Equation of state of a perfect gas, work done on compressing a gas. Kinetic theory of gases - assumptions, concept of pressure. Kinetic energy and temperature: rms speed of gas molecules; Degrees of freedom, Law of equipartition of energy, applications to specific heat capacities of gases; Mean free path, Avogadro's number.

### **UNIT 10 : OSCILLATIONS AND WAVES**

Periodic motion - period, frequency, displacement as a function of time. Periodic functions. Simple Harmonic Motion (S.H.M.) and its equation; phase; oscillations of a spring - restoring force and force constant; energy in S.H.M. - kinetic and potential energies; Simple pendulum - derivation of expression for its time period; Free, forced and damped oscillations, resonance. Wave motion. Longitudinal and transverse waves, speed of a wave. Displacement relation for a progressive wave. Principle of superposition of waves, reflection of waves, Standing waves in strings and organ pipes, fundamental mode and harmonics, Beats, Doppler effect in sound

### **UNIT 11 : ELECTROSTATICS**

Electric charges: Conservation of charge, Coulomb's law-forces between two point charges, forces between multiple charges; superposition principle and continuous charge distribution. Electric field: Electric field due to a point charge, Electric field lines, Electric dipole, Electric field due to a dipole, Torque on a dipole in a uniform electric field. Electric flux, Gauss's law and its applications to find field due to infinitely long uniformly charged straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell. Electric potential and its calculation for a point charge, electric dipole and system of charges; Equipotential surfaces, Electrical potential energy of a system of two point charges in an electrostatic field. Conductors and insulators, Dielectrics and electric polarization, capacitor, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, Energy stored in a capacitor.

### **UNIT 12 : CURRENT ELECTRICITY**

Electric current, Drift velocity, Ohm's law, Electrical resistance, Resistances of different materials, V-I characteristics of Ohmic and nonohmic conductors, Electrical energy and power, Electrical resistivity, Colour code for resistors; Series and parallel combinations of resistors; Temperature dependence of resistance. Electric Cell and its Internal resistance, potential difference and emf of a cell, combination of cells in series and in parallel. Kirchhoff's laws and their applications. Wheatstone bridge, Metre bridge. Potentiometer - principle and its Applications.

**UNIT 13: MAGNETIC EFFECTS OF CURRENT AND MAGNETISM**

Biot - Savart law and its application to current carrying circular loop. Ampere's law and its applications to infinitely long current carrying straight wire and solenoid. Force on a moving charge in uniform magnetic and electric fields. Cyclotron. Force on a current-carrying conductor in a uniform magnetic field. Force between two parallel current-carrying conductors-definition of ampere. Torque experienced by a current loop in uniform magnetic field; Moving coil galvanometer, its current sensitivity and conversion to ammeter and voltmeter. Current loop as a magnetic dipole and its magnetic dipole moment. Bar magnet as an equivalent solenoid, magnetic field lines; Earth's magnetic field and magnetic elements. Para-, dia- and ferro- magnetic substances. Magnetic susceptibility and permeability, Hysteresis, Electromagnets and permanent magnets.

**UNIT 14 : ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENTS**

Electromagnetic induction; Faraday's law, induced emf and current; Lenz's Law, Eddy currents. Self and mutual inductance. Alternating currents, peak and rms value of alternating current/voltage; reactance and impedance; LCR series circuit, resonance; Quality factor, power in AC circuits, wattless current. AC generator and transformer.

**UNIT 15 : ELECTROMAGNETIC WAVES**

Electromagnetic waves and their characteristics. Transverse nature of electromagnetic waves. Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, Xrays, gamma rays). Applications of e.m. waves.

**UNIT 16 : OPTICS**

Reflection and refraction of light at plane and spherical surfaces, mirror formula, Total internal reflection and its applications, Deviation and Dispersion of light by a prism, Lens Formula, Magnification, Power of a Lens, Combination of thin lenses in contact, Microscope and Astronomical Telescope (reflecting and refracting) and their magnifying powers. Wave optics: wave front and Huygens' principle, Laws of reflection and refraction using Huygen's principle. Interference, Young's double slit experiment and expression for fringe width, coherent sources and sustained interference of light. Diffraction due to a single slit, width of central maximum. Resolving power of microscopes and astronomical telescopes, Polarisation, plane polarized light; Brewster's law, uses of plane polarized light and Polaroids.

**UNIT 17 : DUAL NATURE OF MATTER AND RADIATION**

Dual nature of radiation. Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation; particle nature of light. Matter waves-wave nature of particle, de Broglie relation. Davisson- Germer experiment.

**UNIT 18 : ATOMS AND NUCLEI**

Alpha-particle scattering experiment; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum. Composition and size of nucleus, atomic masses, isotopes, isobars; isotones. Radio activity alpha, beta and gamma particles/rays and their properties; radioactive decay law. Mass- energy relation, mass defect; binding energy per nucleon and its variation with mass

number, nuclear fission and fusion.

### **UNIT 19 : ELECTRONIC DEVICES**

Semiconductors; semiconductor diode: I-V characteristics in forward and reverse bias; diode as a rectifier; I-V characteristics of LED, photodiode, solar cell and Zener diode; Zener diode as a voltage regulator. Junction transistor, transistor action, characteristics of a transistor; transistor as an amplifier (common emitter configuration) and oscillator. Logic gates (OR, AND, NOT, NAND and NOR). Transistor as a switch.

### **UNIT 20 : COMMUNICATION SYSTEMS**

Propagation of electromagnetic waves in the atmosphere; Sky and space wave propagation, Need for modulation, Amplitude and Frequency Modulation, Bandwidth of signals, Bandwidth of Transmission medium, Basic Elements of a Communication System (Block Diagram only).

## **CHEMISTRY**

### **UNIT 1: SOME BASIC CONCEPTS IN CHEMISTRY**

Matter and its nature, Dalton's atomic theory; Concept of atom, molecule, element and compound; Physical quantities and their measurements in Chemistry, precision and accuracy, significant figures, S.I. Units, dimensional analysis; Laws of chemical combination; Atomic and molecular masses, mole concept, molar mass, percentage composition, empirical and molecular formulae; Chemical equations and stoichiometry.

### **UNIT 2: STATES OF MATTER**

Classification of matter into solid, liquid and gaseous states.

#### **Gaseous State:**

Measurable properties of gases; Gas laws - Boyle's law, Charles's law, Graham's law of diffusion, Avogadro's law, Dalton's law of partial pressure; Concept of Absolute scale of temperature; Ideal gas equation; Kinetic theory of gases (only postulates); Concept of average, root mean square and most probable velocities; Real gases, deviation from Ideal behaviour, compressibility factor, van der Waals equation, liquefaction of gases, critical constants.

#### **Liquid State:**

Properties of liquids - vapour pressure, viscosity and surface tension and effect of temperature on them (qualitative treatment only).

#### **Solid State:**

Classification of solids: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea); Bragg's Law and its applications; Unit cell and lattices, packing in solids (fcc, bcc and hcp lattices), voids, calculations involving unit cell parameters, imperfection in solids; Electrical, magnetic and dielectric properties.

### **UNIT 3 :ATOMIC STRUCTURE**

Discovery of sub-atomic particles (electron, proton and neutron); Thomson and Rutherford atomic models and their limitations; Nature of electromagnetic radiation, photoelectric effect;

Spectrum of hydrogen atom, Bohr model of hydrogen atom - its postulates, derivation of the relations for energy of the electron and radii of the different orbits, limitations of Bohr's model; Dual nature of matter, de-Broglie's relationship, Heisenberg uncertainty principle. Elementary ideas of quantum mechanics, quantum mechanical model of atom, its important features, and concept of atomic orbitals as one electron wave functions; Variation of and with  $r$  for 1s and 2s orbitals; various quantum numbers (principal, angular momentum and magnetic quantum numbers) and their significance; shapes of s, p and d - orbitals, electron spin and spin quantum number; Rules for filling electrons in orbitals aufbau principle, Pauli's exclusion principle and Hund's rule, electronic configuration of elements, extra stability of half-filled and completely filled orbitals.

#### UNIT 4: CHEMICAL BONDING AND MOLECULAR STRUCTURE

Kossel - Lewis approach to chemical bond formation, concept of ionic and covalent bonds.

**Ionic Bonding:** Formation of ionic bonds, factors affecting the formation of ionic bonds; calculation of lattice enthalpy.

**Covalent Bonding:** Concept of electronegativity, Fajan's rule, dipole moment; Valence Shell Electron Pair Repulsion (VSEPR) theory and shapes of simple molecules.

**Quantum mechanical approach to covalent bonding:**

Valence bond theory - Its important features, concept of hybridization involving s, p and d orbitals; Resonance.

**Molecular Orbital Theory** - Its important features, LCAOs, types of molecular orbitals (bonding, antibonding), sigma and pi-bonds, molecular orbital electronic configurations of homonuclear diatomic molecules, concept of bond order, bond length and bond energy. Elementary idea of metallic bonding. Hydrogen bonding and its applications.

#### UNIT 5 : CHEMICAL THERMODYNAMICS

Fundamentals of thermodynamics: System and surroundings, extensive and intensive properties, state functions, types of processes.

**First law of thermodynamics** - Concept of work, heat internal energy and enthalpy, heat capacity, molar heat capacity; Hess's law of constant heat summation; Enthalpies of bond dissociation, combustion, formation, atomization, sublimation, phase transition, hydration, ionization and solution.

**Second law of thermodynamics;** Spontaneity of processes;  $\Delta S$  of the universe and  $\Delta G$  of the system as criteria for spontaneity,  $\Delta G^\circ$  (Standard Gibbs energy change) and equilibrium constant.

#### UNIT 6 : SOLUTIONS

Different methods for expressing concentration of solution - molality, molarity, mole fraction, percentage (by volume and mass both), vapour pressure of solutions and Raoult's Law Ideal and non-ideal solutions, vapour pressure - composition, plots for ideal and non-ideal solutions; Colligative properties of dilute solutions - relative lowering of vapour pressure, depression of freezing point, elevation of boiling point and osmotic pressure; Determination of molecular mass using colligative properties; Abnormal value of molar mass, van't Hoff factor and its significance.

**UNIT 7: EQUILIBRIUM**

Meaning of equilibrium, concept of dynamic equilibrium.

**Equilibria involving physical processes:** Solid -liquid, liquid - gas and solid gas equilibria, Henry's law, general characteristics of equilibrium involving physical processes.

**Equilibria involving chemical processes:** Law of chemical equilibrium, equilibrium constants ( $K_p$  and  $K_c$ ) and their significance, significance of  $\Delta G$  and  $\Delta G^\circ$  in chemical equilibria, factors affecting equilibrium concentration, pressure, temperature, effect of catalyst; Le Chatelier's principle.

**Ionic equilibrium:** Weak and strong electrolytes, ionization of electrolytes, various concepts of acids and bases (Arrhenius, Br instead - Lowry and Lewis) and their ionization, acid - base equilibria (including multistage ionization) and ionization constants, ionization of water, pH scale, common ion effect, hydrolysis of salts and pH of their solutions, solubility of sparingly soluble salts and solubility products, buffer solutions.

**UNIT 8 : REDOX REACTIONS AND ELECTROCHEMISTRY**

Electronic concepts of oxidation and reduction, redox reactions, oxidation number, rules for assigning oxidation number, balancing of redox reactions. Electrolytic and metallic conduction, conductance in electrolytic solutions, specific and molar conductivities and their variation with concentration: Kohlrausch's law and its applications. Electrochemical cells - Electrolytic and Galvanic cells, different types of electrodes, electrode potentials including standard electrode potential, half - cell and cell reactions, emf of a Galvanic cell and its measurement; Nernst equation and its applications; Relationship between cell potential and Gibbs' energy change; Dry cell and lead accumulator; Fuel cells; Corrosion and its prevention.

**UNIT 9 : CHEMICAL KINETICS**

Rate of a chemical reaction, factors affecting the rate of reactions: concentration, temperature, pressure and catalyst; elementary and complex reactions, order and molecularity of reactions, rate law, rate constant and its units, differential and integral forms of zero and first order reactions, their characteristics and half - lives, effect of temperature on rate of reactions Arrhenius theory, activation energy and its calculation, collision theory of bimolecular gaseous reactions (no derivation).

**UNIT-10 : SURFACE CHEMISTRY**

**Adsorption-** Physisorption and chemisorption and their characteristics, factors affecting adsorption of gases on solids - Freundlich and Langmuir adsorption isotherms, desorption from solutions.

**Catalysis** - Homogeneous and heterogeneous, activity and selectivity of solid catalysts, enzyme catalysis and its mechanism.

**Colloidal state** - distinction among true solutions, colloids and suspensions, classification of colloids - lyophilic, lyophobic; multi molecular, macromolecular and associated colloids (micelles), preparation and properties of colloids - Tyndall effect, Brownian movement, electrophoresis, dialysis, coagulation and flocculation; Emulsions and their characteristics.

**INORGANIC CHEMISTRY****UNIT 11 : CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES**

Modern periodic law and present form of the periodic table, s, p, d and f block elements, periodic trends in properties of elements atomic and ionic radii, ionization enthalpy, electron gain enthalpy, valence, oxidation states and chemical reactivity.

**UNIT 12 : GENERAL PRINCIPLES AND PROCESSES OF ISOLATION OF METALS**

Modes of occurrence of elements in nature, minerals, ores; Steps involved in the extraction of metals - concentration, reduction (chemical and electrolytic methods) and refining with special reference to the extraction of Al, Cu, Zn and Fe; Thermodynamic and electrochemical principles involved in the extraction of metals.

**UNIT 13 : HYDROGEN**

Position of hydrogen in periodic table, isotopes, preparation, properties and uses of hydrogen; Physical and chemical properties of water and heavy water; Structure, preparation, reactions and uses of hydrogen peroxide; Classification of hydrides - ionic, covalent and interstitial; Hydrogen as a fuel.

**UNIT 14 : S - BLOCK ELEMENTS (ALKALI AND ALKALINE EARTH METALS)**

Group - 1 and 2 Elements General introduction, electronic configuration and general trends in physical and chemical properties of elements, anomalous properties of the first element of each group, diagonal relationships. Preparation and properties of some important compounds - sodium carbonate, sodium chloride, sodium hydroxide and sodium hydrogen carbonate; Industrial uses of lime, limestone, Plaster of Paris and cement; Biological significance of Na, K, Mg and Ca.

**UNIT 15 : P - BLOCK ELEMENTS - Group - 13 to Group 18 Elements**

General Introduction: Electronic configuration and general trends in physical and chemical properties of elements across the periods and down the groups; unique behaviour of the first element in each group.

**Groupwise study of the p block elements**

**Group 13** - Preparation, properties and uses of boron and aluminium; Structure, properties and uses of borax, boric acid, diborane, boron trifluoride, aluminium chloride and alums.

**Group 14** - Tendency for catenation; Structure, properties and uses of allotropes and oxides of carbon, silicon tetrachloride, silicates, zeolites and silicones.

**Group 15** - Properties and uses of nitrogen and phosphorus; Allotropic forms of phosphorus; Preparation, properties, structure and uses of ammonia, nitric acid, phosphine and phosphorus halides, (PCl<sub>3</sub>, PCl<sub>5</sub>); Structures of oxides and oxoacids of nitrogen and phosphorus.

**Group 16** - Preparation, properties, structures and uses of dioxygen and ozone; Allotropic forms of sulphur; Preparation, properties, structures and uses of sulphur dioxide, sulphuric acid (including its industrial preparation); Structures of oxoacids of sulphur.



**Group 17** - Preparation, properties and uses of chlorine and hydrochloric acid; Trends in the acidic nature of hydrogen halides; Structures of Interhalogen compounds and oxides and oxoacids of halogens.

**Group 18** - Occurrence and uses of noble gases; Structures of fluorides and oxides of xenon.

### **UNIT 16 : d- and f –BLOCK ELEMENTS**

**Transition Elements** - General introduction, electronic configuration, occurrence and characteristics, general trends in properties of the first row transition elements – physical properties, ionization enthalpy, oxidation states, atomic radii, colour, catalytic behaviour, magnetic properties, complex formation, interstitial compounds, alloy formation; Preparation, properties and uses of  $K_2Cr_2O_7$  and  $KMnO_4$ .

**Inner Transition Elements** - Lanthanoids - Electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction. Actinoids - Electronic configuration and oxidation states.

### **UNIT 17 : CO-ORDINATION COMPOUNDS**

Introduction to co-ordination compounds, Werner's theory; ligands, co-ordination number, denticity, chelation; IUPAC nomenclature of mononuclear coordination compounds, isomerism; Bonding-Valence bond approach and basic ideas of Crystal field theory, colour and magnetic properties; Importance of coordination compounds (in qualitative analysis, extraction of metals and in biological systems).

### **UNIT 18 : ENVIRONMENTAL CHEMISTRY**

Environmental pollution - Atmospheric, water and soil.

Atmospheric pollution - Tropospheric and Stratospheric

Tropospheric pollutants Gaseous pollutants: Oxides of carbon, nitrogen and sulphur, hydrocarbons; their sources, harmful effects and prevention; Green house effect and Global warming; Acid rain;

Particulate pollutants: Smoke, dust, smog, fumes, mist; their sources, harmful effects and prevention.

Stratospheric pollution- Formation and breakdown of ozone, depletion of ozone layer - its mechanism and effects.

Water Pollution - Major pollutants such as, pathogens, organic wastes and chemical pollutants; their harmful effects and prevention.

Soil pollution - Major pollutants such as: Pesticides (insecticides, herbicides and fungicides), their harmful effects and prevention. Strategies to control environmental pollution.

### **ORGANIC CHEMISTRY**

#### **UNIT 19 : PURIFICATION AND CHARACTERISATION OF ORGANIC COMPOUNDS**

Purification - Crystallization, sublimation, distillation, differential extraction and chromatography - principles and their applications.

Qualitative analysis - Detection of nitrogen, sulphur, phosphorus and halogens. Quantitative analysis (basic principles only) - Estimation of carbon, hydrogen, nitrogen, halogens, sulphur,

phosphorus. Calculations of empirical formulae and molecular formulae; Numerical problems in organic quantitative analysis.

## **UNIT 20 : SOME BASIC PRINCIPLES OF ORGANIC CHEMISTRY**

Tetravalency of carbon; Shapes of simple molecules - hybridization (s and p); Classification of organic compounds based on functional groups: - C = C - , - C h C - and those containing halogens, oxygen, nitrogen and sulphur; Homologous series; Isomerism - structural and stereoisomerism.

Nomenclature (Trivial and IUPAC) : Covalent bond fission - Homolytic and heterolytic: free radicals, carbocations and carbanions; stability of carbocations and free radicals, electrophiles and nucleophiles. Electronic displacement in a covalent bond- Inductive effect, electromeric effect, resonance and hyperconjugation. Common types of organic reactions - Substitution, addition, elimination and arrangement.

## **UNIT 21 : HYDROCARBONS**

Classification, isomerism, IUPAC nomenclature, general methods of preparation, properties and reactions.

Alkanes - Conformations: Sawhorse and Newman projections (of ethane); Mechanism of halogenations of alkanes.

Alkenes - Geometrical isomerism; Mechanism of electrophilic addition: addition of hydrogen, halogens, water, hydrogen halides (Markownikoff's and peroxide effect); Ozonolysis, oxidation, and polymerization.

Alkynes - Acidic character; Addition of hydrogen, halogens, water and hydrogen halides; Polymerization.

Aromatic hydrocarbons - Nomenclature, benzene - structure and aromaticity; Mechanism of electrophilic substitution: halogenation, nitration, Friedel Craft's alkylation and acylation, directive influence of functional group in mono-substituted benzene.

## **UNIT 22 : ORGANIC COMPOUNDS CONTAINING HALOGENS**

General methods of preparation, properties and reactions; Nature of C-X bond; Mechanisms of substitution reactions. Uses; Environmental effects of chloroform, iodoform, freons and DDT.

## **UNIT 23 : ORGANIC COMPOUNDS CONTAINING OXYGEN**

General methods of preparation, properties, reactions and uses. ALCOHOLS, PHENOLS AND ETHERS

Alcohols: Identification of primary, secondary and tertiary alcohols; mechanism of dehydration.

Phenols: Acidic nature, electrophilic substitution reactions: halogenation, nitration and sulphonation, Reimer - Tiemann reaction.

Ethers: Structure.

Aldehyde and Ketones: Nature of carbonyl group; Nucleophilic addition to >C=O group, relative reactivities of aldehydes and ketones; Important reactions such as Nucleophilic addition reactions (addition of HCN, NH<sub>3</sub> and its derivatives), Grignard reagent; oxidation; reduction (Wolff Kishner and Clemmensen); acidity of  $\alpha$  - hydrogen, aldol condensation, Cannizzaro reaction, Haloform reaction; Chemical tests to distinguish between aldehydes and Ketones.

CARBOXYLIC ACIDS : Acidic strength and factors affecting it.

**UNIT 24 : ORGANIC COMPOUNDS CONTAINING NITROGEN**

General methods of preparation, properties, reactions and uses. Amines: Nomenclature, classification, structure, basic character and identification of primary, secondary and tertiary amines and their basic character. Diazonium Salts: Importance in synthetic organic chemistry.

**UNIT 25 : POLYMERS**

General introduction and classification of polymers, general methods of polymerization-addition and condensation, copolymerization; Natural and synthetic rubber and vulcanization; some important polymers with emphasis on their monomers and uses - polythene, nylon, polyester and bakelite.

**UNIT 26 : BIOMOLECULES**

General introduction and importance of biomolecules.

**CARBOHYDRATES** - Classification: aldoses and ketoses; monosaccharides (glucose and fructose), constituent monosaccharides of oligosaccharides (sucrose, lactose, maltose) and polysaccharides (starch, cellulose, glycogen).

**PROTEINS** - Elementary Idea of \_ - amino acids, peptide bond, polypeptides; Proteins: primary, secondary, tertiary and quaternary structure (qualitative idea only), denaturation of proteins, enzymes.

**VITAMINS** - Classification and functions.

**NUCLEIC ACIDS** - Chemical constitution of DNA and RNA. Biological functions of nucleic acids.

**UNIT 27 : CHEMISTRY IN EVERYDAY LIFE**

Chemicals in medicines - Analgesics, tranquilizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamins – their meaning and common examples. Chemicals in food - Preservatives, artificial sweetening agents - common examples. Cleansing agents - Soaps and detergents, cleansing action.

**UNIT 28 : PRINCIPLES RELATED TO PRACTICAL CHEMISTRY**

- Detection of extra elements (N,S, halogens) in organic compounds; Detection of the following functional groups: hydroxyl (alcoholic and phenolic), carbonyl (aldehyde and ketone), carboxyl and amino groups in organic compounds

- Chemistry involved in the preparation of the following: Inorganic compounds: Mohr's salt, potash alum. Organic compounds: Acetanilide, p-nitroacetanilide, aniline yellow, iodoform

- Chemistry involved in the titrimetric exercises - Acids bases and the use of indicators, oxalic-acid vs  $\text{KMnO}_4$ , Mohr's salt vs  $\text{KMnO}_4$

- Chemical principles involved in the qualitative salt analysis:

• Cations -  $\text{Pb}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Al}^{3+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{NH}_4^+$ . Anions-  $\text{CO}_3^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{SO}_4^{2-}$ ,  $\text{NO}_2^-$ ,  $\text{NO}_3^-$ ,  $\text{Cl}^-$ ,  $\text{Br}$ ,  $\text{I}$

• (Insoluble salts excluded)

• Chemical principles involved in the following experiments:

- Enthalpy of solution of  $\text{CuSO}_4$
- Enthalpy of neutralization of strong acid and strong base.
- Preparation of lyophilic and lyophobic sols.
- Kinetic study of reaction of iodide ion with hydrogen peroxide at room temperature.

## **MATHEMATICS**

### **UNIT 1 : SETS, RELATIONS AND FUNCTIONS**

Sets and their representation; Union, Intersection and Complement of sets and their algebraic properties; Power set; Relation, Types of relations, Equivalence relations, functions; one-one, into and onto functions, composition of functions.

### **UNIT 2 : COMPLEX NUMBERS AND QUADRATIC EQUATIONS**

Complex numbers as ordered pairs of reals, Representation of complex numbers in the form  $a+ib$  and their representation in a plane, Argand diagram, Algebra of complex numbers, Modulus and Argument (or Amplitude) of a complex number, square root of a complex number, triangle inequality, Quadratic equations in real and complex number system and their solutions. Relation between roots and co- efficient, nature of roots, formation of quadratic equations with given roots.

### **UNIT 3 : MATRICES AND DETERMINANTS**

Matrices, Algebra of matrices, Types of matrices, Determinants and matrices of order two and three. Properties of determinants, Evaluation of determinants, Area of triangles using determinants. Adjoint and evaluation of inverse of a square matrix using determinants and elementary transformations, Test of consistency and solution of simultaneous linear equations in two or three variables using determinants and matrices.

### **UNIT 4 : PERMUTATIONS AND COMBINATIONS**

Fundamental principle of counting, permutation as an arrangement and combination as selection, Meaning of  $P(n,r)$  and  $C(n,r)$ , simple applications.

### **UNIT 5 : MATHEMATICAL INDUCTION**

Principle of Mathematical Induction and its simple applications.

### **UNIT 6 : BINOMIAL THEOREM AND ITS SIMPLE APPLICATIONS**

Binomial theorem for a positive integral index, general term and middle term, properties of Binomial coefficients and simple applications.

**UNIT 7 : SEQUENCES AND SERIES**

Arithmetic and Geometric progressions, insertion of arithmetic, geometric means between two given numbers. Relation between A.M. and G.M. Sum upto n terms of special series:  $S_n$ ,  $S_{n^2}$ ,  $S_{n^3}$ . Arithmetic Geometric regression.

**UNIT 8 : LIMIT, CONTINUITY AND DIFFERENTIABILITY**

Real - valued functions, algebra of functions, polynomials, rational, trigonometric, logarithmic and exponential functions, inverse functions. Graphs of simple functions. Limits, continuity and differentiability. Differentiation of the sum, difference, product and quotient of two functions. Differentiation of trigonometric, inverse trigonometric, logarithmic, exponential, composite and implicit functions; derivatives of order upto two. Rolle's and Lagrange's Mean Value Theorems. Applications of derivatives: Rate of change of quantities, monotonic – increasing and decreasing functions, Maxima and Minima of functions of one variable, Tangents and Normals.

**UNIT 9 : INTEGRAL CALCULUS**

Integral as an anti - derivative. Fundamental integrals involving algebraic, trigonometric, exponential and logarithmic functions. Integration by substitution, by parts and by partial fractions. Integration using trigonometric identities.

**Evaluation of simple integrals of the type**

$$\int \frac{dx}{x^2 \pm a^2}, \int \frac{dx}{\sqrt{x^2 \pm a^2}}, \int \frac{dx}{a^2 - x^2}, \int \frac{dx}{\sqrt{a^2 - x^2}}, \int \frac{dx}{ax^2 + bx + c},$$

$$\int \frac{dx}{\sqrt{ax^2 + bx + c}}, \int \frac{(px+q)dx}{ax^2 + bx + c}, \int \frac{(px+q)dx}{\sqrt{ax^2 + bx + c}}$$

$$\int \sqrt{a^2 \pm x^2} dx \quad \int \sqrt{x^2 - a^2} dx$$

Integral as limit of a sum. Fundamental Theorem of Calculus. Properties of definite integrals. Evaluation of definite integrals, determining areas of the regions bounded by simple curves in standard form.

**UNIT 10 : DIFFERENTIAL EQUATIONS**

Ordinary differential equations, their order and degree. Formation of differential equations. Solution of differential equations by the method of separation of variables, solution of homogeneous and linear differential equations of the type:

$$\frac{dy}{dx} + p(x)y = q(x)$$

**UNIT 11: CO-ORDINATE GEOMETRY**

Cartesian system of rectangular co-ordinates in a plane, distance formula, section formula, locus and its equation, translation of axes, slope of a line, parallel and perpendicular lines, intercepts of a line on the coordinate axes.

Straight lines - Various forms of equations of a line, intersection of lines, angles between two lines, conditions for concurrence of three lines, distance of a point from a line, equations of internal and external bisectors of angles between two lines, coordinates of centroid, orthocentre and circumcentre of a triangle, equation of family of lines passing through the point of intersection of two lines.

Circles, conic sections Standard form of equation of a circle, general form of the equation of a

circle, its radius and centre, equation of a circle when the end points of a diameter are given, points of intersection of a line and a circle with the centre at the origin and condition for a line to be tangent to a circle, equation of the tangent. Sections of cones, equations of conic sections (parabola, ellipse and hyperbola) in standard forms, condition for  $y = mx + c$  to be a tangent and point (s) of tangency.

### **UNIT 12: THREE DIMENSIONAL GEOMETRY**

Coordinates of a point in space, distance between two points, section formula, direction ratios and direction cosines, angle between two intersecting lines. Skew lines, the shortest distance between them and its equation. Equations of a line and a plane in different forms, intersection of a line and a plane, coplanar lines.

### **UNIT 13: VECTOR ALGEBRA**

Vectors and scalars, addition of vectors, components of a vector in two dimensions and three dimensional space, scalar and vector products, scalar and vector triple product.

### **UNIT 14: STATISTICS AND PROBABILITY**

Measures of Dispersion: Calculation of mean, median, mode of grouped and ungrouped data. Calculation of standard deviation, variance and mean deviation for grouped and ungrouped data. Probability: Probability of an event, addition and multiplication theorems of probability, Baye's theorem, probability distribution of a random variate, Bernoulli trials and Binomial distribution.

### **UNIT 15: TRIGONOMETRY**

Trigonometrical identities and equations. Trigonometrical functions. Inverse trigonometrical functions and their properties. Heights and Distances.

### **UNIT 16: MATHEMATICAL REASONING:**

Statements, logical operations AND, OR, IMPLIES, IMPLIED BY, IF AND ONLY IF. Understanding of Tautology, Contradiction, Converse and Contra positive



# **SATHYABAMA**

**INSTITUTE OF SCIENCE AND TECHNOLOGY  
(DEEMED TO BE UNIVERSITY)**

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