Somaiya School of Basic and Applied Sciences

Faculty of Science

Somaiya Vidyavihar University, Mumbai

Admission Manual

PhD Programme – SciSER

(Biology, Chemistry, Physics)

(Life Science, Chemical Sciences, Physical Sciences)

AY 2025-26 onwards

Visit for Further Details: https://sksc.somaiya.edu/en/phd

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Somaiya Vidyavihar University,
Mumbai

Somaiya Vidyavihar University, Mumbai

About Somaiya Vidyavihar University, Mumbai

On 26th August 2019, Somaiya Vidyavihar University, Mumbai became a reality !

After six decades of fostering a holistic teaching and learning experience and establishing reputed educational institutions, Somaiya Vidyavihar University, Mumbai, has achieved a significant milestone. It has become the first self-financed private university in Mumbai under the Maharashtra Self-Financed Universities (Establishment and Regulation) Act, 2013.

We aspire to build and support a world-class institution—one that is proudly Indian and excels in education, research, and service. Somaiya Vidyavihar University, Mumbai, will be a hub for preserving, disseminating, and creating knowledge. It will have a global impact through its ideas and a universal commitment to service. Here, students and faculty can embrace the "Freedom of Possibilities," pursue their passions, and, most importantly, discover themselves.

Our History and Vision

An all-round education must integrate Indian culture, values & morality into the curriculum.

Somaiya Vidyavihar was founded on September 9, 1959, by Padmabhushan Shri K.J. Somaiya (1902–1999), a visionary leader with sharp business acumen, a balanced perspective, and a deep commitment to social progress. His dream of shaping young minds through quality education led him to establish the Somaiya Trust in 1953, acquiring a vast expanse of land in Ghatkopar—then a sparsely populated area.

Driven by his passion for education and inclusivity, he later founded the Girivanvasi Pragati Mandal, the K.J. Somaiya Medical Trust, and the Girivanvasi Education Trust, along with several sister institutions, to provide greater access to learning and opportunity. Inspired by Swami Vivekananda's words, *"We want that education by which character is formed, strength of mind is increased, the intellect expanded, and by which one can stand on one's own feet,"* he dedicated his life to fostering knowledge and empowerment.

Over the past six decades, Somaiya Vidyavihar has grown into a thriving educational ecosystem with 34 institutions across diverse fields, including Humanities & Social Sciences, Engineering, Medicine, Management, Education, Dharma Studies, Pure Sciences, and Commerce & Business Studies. Today, with a vibrant 50-acre campus, it is home to over 39,000 students and 3,000 faculty and staff, continuing its legacy of excellence in education and innovation.

With PhD programmes in various faculties, we provide an innovative platform for research aspirants to make a niche of their own to impact society and life.

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About Somaiya School of Basic and Applied Sciences, SVU

The Somaiya School of Basic and Applied Sciences (SSBAS) is a newly established institution under the Faculty of Sciences at Somaiya Vidyavihar University, Mumbai. Initially it is a part of S.K. Somaiya College, SSBAS has grown into a center of academic and research excellence. With six departments, the school offers six undergraduate and eight postgraduate programs, along with a Doctor of Philosophy (Ph.D.) program in six disciplines. SSBAS is equipped with state-of-the-art research laboratories, advanced instrumentation, and cutting-edge software, fostering a seamless integration of science and technology research. The school has successfully secured ₹1 crore+ in research funding from various governmental agencies, reinforcing its commitment to advancing fundamental research for societal development.

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1. **Eligibility criteria for PhD Admission**	
Subject to the conditions stipulated in the SVU PhD Regulations, the following candidate are eligible to seek admission to the PhD Programme	
1. Education Qualification	
i.	Master's degree (2 year or 1 year) or a professional degree declared equivalent to the Master's degree by the corresponding statutory regulatory body, with at least 55% marks in aggregate or its equivalent as per UGC regulations.
ii.	Candidate seeking admission after a 4-year/8-semester bachelor's degree programme (B.Tech / B.E, B.Pharma, MBBS or BDS or BAMS or BHMS or B.Sc (Honors) should have a minimum of 75% marks in aggregate or its equivalent as per UGC regulations
iii.	A person whose Master's dissertation has been evaluated and the viva-voce is pending may be admitted to the PhD Programme but subject to completion of Master's degree before provisional admission to SVU PhD Programmes.
iv.	Candidates possessing a Degree considered equivalent to Master's Degree of an Indian Institution, from a Foreign Educational Institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country for the purpose of assessing, accrediting or assuring quality and standards of educational institutions, shall be eligible for admission to PhD Programme
2. **PhD Entrance Exam**	
i.	MUST qualify a passing score of PhD Entrance Examination of SVU. This is a mandatory eligibility criteria for all candidates with exemptions mentioned in Point 2.(ii)
ii.	Exemption Criteria from SVU PhD Entrance Examination are: 1. Candidates who qualified in UGC - CSIR -NET-JRF/ ICMR-JRF / DBT-JRF (BET)/ INSPIRE/ GPAT/ICAR/JEST/ Qualified/valid GATE score in relevant branches /Prime Minister's Fellowships and those qualified in any of the UGC recognized national or state level eligibility tests with a valid fellowship/scholarship in the related subject. 2. Candidates with valid GMAT score for last 2 years (1st Jan 2020 to 31st Dec 2022), minimum GMAT score 350 3. Any candidates having 5 year of teaching/research experience and have published a research paper in SCOPUS; Web of science journal/published patents/grant received from government agencies will be exempted from appearing for the SVU PhD entrance exam but will be required to appear for an interview at the respective departments. The exemption criteria will be applicable ONLY when relevant document are uploaded during application submission. If relevant documents are not submitted , the candidate have to appear for Entrance exam.
Note: However, the candidates who fulfill the above criteria MUST fill the application form as per the schedule displayed on the website.	
3. Other Documents	

1. UG Degree or equivalent Mark List 2. UG Degree certificate 3. PG Degree or equivalent Mark List 4. PG Degree or equivalent certificate 5. AADHAR card 6. Degree equivalence / eligibility certificate – wherever is applicable 7. Transfer Certificate and /or Leaving Certificate 8. Migration certificate 9. Two colour passport size Photograph 10. If appearing the PG degree examination – bonafide certificate 11. If employed, then No Objection Certificate (NOC) from the employer – at the time of provisional admission
4. Important Links
UGC Notification 2022 (Link)

2. Categories of Ph D Students	
1.	Candidates with externally funded scholarships/Fellowships; (a full tuition fee waiver will be provided to candidates who join as JRF/SRF under government of INDIA research funded scheme)
2.	Candidates who work in funded projects within the University or in approved research centres which are collaborating with the University;
3.	Jointly guided PhD or Co-supervised PhD with International Universities;
4.	Teaching/work integrated research candidates who are the faculty/employees in pursuit of advancing their academic qualification, recommended by the Head of the Institution and the Academic Advisory Committee. This provision is for those candidates who shall take an undertaking that their routine responsibilities would be duly attended and under no circumstances compromised. The university shall reserve the rights to consider the registration of candidates who do not adhere to these guidelines;
5.	Teaching and Research Associates of the Somaiya Vidyavihar University.
6.	“Somaiya Vidyavihar University Research fellow under Chancellor’s Scholarships Programme”.
7.	“Any candidates having 5 year of teaching/research experience and have published research paper in SCOPUS; Web of science journal/published patents/grant received from government agencies will be excepted from appearing for the SVU PhD entrance exam but will be required to appear for an interview at the respective departments”
8.	A candidate is permitted to pursue studies on a part-time basis provided all the conditions stipulated in UGC 2022 regulations are fulfilled.

3. Overview of Steps involved in PhD Programme	
Sr. No.	Steps
PhD Pre-selection Phase	
1.	Advertisement / Call for SVU PhD entrance exam on website /media handles

2.	Acceptance of the applications for PhD entrance examination along with the applications processing fee

3.	Execution of PhD entrance examination for all PhD programmes
4.	Declaration of PhD entrance examination results
5.	Selection process - Display of list of eligible shortlisted candidates for interview
6.	One- on -one Interviews of shortlisted candidates before an expert panel
7.	Display of selected candidates for provisional admission - Selection process complete
Provisional Admission Phase	
8.	Provisional admission and payment of fees in accounts/admin office of the constituent unit of Somaiya Vidyavihar University, Mumbai.
9.	Orientation and initiation of course work (1 year – 2 semesters)
10.	First semester encompasses research methodology & publication ethics along with subject specific topic. Second semester majorly focus on building research , technical & soft skills. It includes research activities, lab rotation and research proposal drafting & presentation and its evaluation.
11.	ATKT examination for the semester I and II for unsuccessful candidates or for grade improvement
12.	Issue of mark sheets for course work of semester I and II
Allotments & Registrations	
13.	Allotment of the guide at individual constituent unit-level /department (within the first six months of provisional admission)
14.	Topic approval of the thesis work within 2-3 months after Qualifying course work examination
15.	Registration for PhD programme
PhD Phase	
16.	Appointment of Examiners and chairman from Research Committee
17.	Annual Progress Seminars (APS) and Intermediate Progress Seminar (IPS) for the academic year by Doctoral Advisory Committee (DAC)
Submission & defence	
18.	Approval of examiners to present pre-synopsis in one of the APS and IPS
19.	Presentation of pre-synopsis and its approval by the examiners
20.	Submission of thesis to COE office
21.	Sending the thesis to reviewers
22.	Receipt of reviews about thesis from the reviewers
23.	The final defense of the thesis
24.	Submission of the final corrected thesis after defense

25.	Issue of provisional PhD certificate
26.	Issue of PhD certificate
	The steps and the progress evaluation of PhD students by the committee/examiners/experts will be as per the provisions of PhD regulations

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4. Pattern and syllabus of SVU PhD Entrance Examination
Paper-1 Qualitative Test – 40 marks a) Essay Writing – 20 marks b) Comprehension – 20 marks (50% choice in selecting questions in paper I)
Paper – 2 Subject Specific Test – 60 marks a) Multiple Choice Questions – 20 marks (Attempt 20 out of 30 questions) b) Subjective Questions – 40 marks (with 50% Choice)

5. About Course Work
The course work will be for one academic year (two semesters) and out of which the first semester will be full time. It is expected that during the first semester, the student will report to the college/department/section/laboratory for attending the sessions as per Timetable. The student will have to complete a total of 14 credits (semester I) + 5 credits (semester II) = total 19 credits with CGPI as per the PhD regulations to become eligible for the registration to PhD programme.

6. Fee Structure of PhD Program
(This is common across disciplines, all categories of students)

Particulars	@Total Fees per annum (₹)	
	First Year	Second Year Onwards
Tuition Fee	30,000/-	30,000/-
Development Fee	10,000/-	10,000/-
Examination Fee	10,000/-	10,000/-
Caution money Deposit (Refundable)	1,000/-	-----
Library Deposit (Refundable)	2,000/-	-----
Total (₹)	53,000/-	50,000/-
@ If paid provisional admission fee then should be deducted from total fee		
Link for fees payment (Fees will be accepted via online payment gateway only and in no case, it can be paid using any other type of mode of payment and to any office/person)	https://myaccount.somaiya.edu/#/login	

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7. Registration, Synopsis & Ph D Thesis Submission Fees	
Particulars	Amount
Registration fees	5000
Approval of Synopsis of PhD Thesis Topic	5000
PhD Thesis Submission	10000
Total	20,000/-

Note:

1. Registration fees to be paid by the PhD scholars before submitting the application for Registration for Ph D.
2. Synopsis PhD Thesis Submission fees to be paid by the PhD scholars before submission of synopsis.

8. Payment of fees schedule for Provisional admission and subsequent years of PhD programme

Program Academic Year	Particulars	Amount in Rupees (₹)	Payment Schedule
First Year	Total fee	53,000/-	Within eight days from the date of receiving the offer letter
Second Year and Onwards	Total fee	50,000/-	Within first week from the commencement of the new Academic Year
Link for fees payment (Fees will be accepted via online payment only and in no case it can be paid using any other mode of payment and to any office/person)		https://myaccount.somaiya.edu/#/login	
Note: Students have to pay the full fees of the program per year till the submission of the thesis			

9. Guidelines to make fee payment in Online Mode

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There is a provision of ONLINE PAYMENT of college fees for student's convenience 24x7 on or before the scheduled due date. Students will get notification from the institute in three ways.

1) SMS
2) Email
3) Notification on myaccount.somaiya.edu portal

In the notification there will be a link to make the payment. You just need to click on the link and follow below simple steps to make the payment.

STEP 1: Link will take you to myaccount.somaiya.edu portal. Use Somaiya SVV Net ID and password to login. Want to know more about myaccount.somaiya.edu click on https://somaiya.edu/media/pdf/SVVNetID_and_EmaiI%20id.pdf

STEP 2: Login, select 'instalments' and click on "Pay Now".

STEP 3: System will redirect to Online Payment Gateway. Fill in the required information and follow payment options to complete the payment cycle.

STEP 4: After the successful payment, the payment receipt will be available at student's MyAccount portal

10. Admission Cancellation policy of PhD programme

(All Categories of PhD Students)

If the candidate has accepted the allotted seat by paying the fees and later chooses/decides to withdraw from the programme of study, then cancellation option is available at his/her MyAccount login.

The School shall follow the below system for deduction of fees against the cancellation request for the candidate.

Sr. No.	Point of time when the application for admission cancellation is received by the school	Applicable Deduction
1	15 days or more before the date of commencement of academic term	Rs 5,000/-
2	Less than 15 days before the date of commencement of the academic term	10% of total fees
3	Less than 15 days from the date of commencement of the academic term	20% of total fees
4	On or beyond the 15th day but within six weeks from the date of commencement of the academic term	50% of total fees
5	More than six weeks from the date of commencement of the academic term	100% of total fees

Note:

- Total Fees for the program per year is Rs. 50,000/- for All Categories of PhD Students
- Tentative date of commencement of every academic term will be announced on website.

Typical Sample example for further illustration to know about cancellation charges with reference to the date of commencement of term

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Refer the below example for clarification of PhD admission cancellation policy

Assume that the academic term commences from 15th July of a particular academic year. Based on this assumption, following table illustrates important dates of cancellation policy:

Illustration:

Sr. No.	**Point of time when an application for admission cancellation is received by school**	**Applicable Deduction**

1	Cancellation on or before 30th June (up to 11.59pm)	Rs 5,000/-
2	Any time from 1st July to 14th July (up to 11.59pm)	10% of total fees
3	Any time from 15th July to 28th July (up to 11.59pm)	20% of total fees
4	Any time from 29th July to 25th August (up to 11.59pm)	50% of total fees
5	After 25th August	100% of total fees

11. Process of getting documents submitted return
After verification of documents, within 7 days, documents will be returned to students.

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Somaiya School of Basic and Applied Sciences Faculty of Science

Somaiya center for Integrated Science Education and Research (*Sci*SER)

About Research Center

Somaiya Centre for Integrated Science education and research at Somaiya Vidyavihar University, Mumbai offering a five year's full time BS-MS course. The vision is to equip students with distinctive skill sets with holistic, integrated knowledge in sciences based on the application of mathematical and statistical tools. Foster critical thinking stimulates logical decision-making and innovation, with rigorous research-based project work. Aim to cultivate entrepreneurial abilities, teamwork, leadership, and resilience. and to nurture human values, ethics, and life skills, including communication. SciSER is emerging as a Research and Learning centre which offers a unique Ph.D. Programme in Integrated Sciences, with streams in Physical, Chemical and Biological Sciences. The details of these will appear soon in the SciSER website.

Highlights:

- ✔ Unique research-oriented program
- ✔ Research collaboration with research institutes/Govt agencies/Industries (eg., BARC/IIT/NCL/TIFR/IISER/SCTIMST etc)
- ✔ Facilitate visits to national research laboratories, and participation in national and international conferences, on-campus or at other reputed national institutes. Opportunities to directly interact with internationally reputed scientists.
- ✔ Faculties who have proven track record as research scientists who published in peer reviewed international journals

Eligibility at UG/PG Degree for PhD in Life Science/Biological Sciences

Branch of study at UG	Any branch of Engineering /Science or Medicine
Branch of study at PG	Life Sciences Biotechnology Microbiology Biochemistry Environmental Sciences Zoology
Eligibility at UG/PG Degree for PhD in Chemistry/chemical sciences	
Branch of study at UG	Any branch of Engineering /Science or Medicine
Branch of study at PG	Any branches of Chemistry Polymer Science Earth science Provided completed a course in Chemistry at UG level.
Eligibility at UG/PG Degree for PhD in Physical Sciences	
Branch of study at UG	Any branch of Engineering /Science or Medicine
Branch of study at PG	Physical/Chemical/Mathematical/Engineering Sciences

Syllabus for Entrance Examination in *Sci*SER Physical Sciences

Upcoming entrance Examinations for the SciSER/Physics Ph.D. programme will have element basic interdisciplinary knowledge at the B.Sc. level in the Indian universities and the test include core subject knowledge above BSc level.

For the current year, those who wish to opt the SciSER PhD programme will have to qua through an interview process if qualified in any of the Basic Science/Engineering branch entra examination conducted by SVU.

(*Those who have secured a First class or equivalent in the qualifying De (B.Tech/MSc/MTech/or equivalent) or passed any of the national/international examination comparable standards may be exempted from the entrance examination complying with guidelines of mandatory bodies as the case may be. Candidates who are keenly intereste pursuing a Ph.D. programme in integrated sciences with focus on any of its three major strea viz, Physical/Chemical/biological Sciences are advised to write to the *Sci*SER faculty mem

and discuss their interest and we may be able to guide you through the process)

Core Subject Syllabus for the Entrance Test (based on Joint Entrance Screening test by m Institutions in India)

Mathematical Methods

Vector algebra and vector calculus, tensors, curvilinear coordinate systems, linear algebra;
Linear differential equations, elements of Sturm–Liouville theory;
Special functions; Complex analysis; Fourier series and Fourier transforms, Laplace transform

Elementary properties of discrete groups; Elements of probability theory, error analysis.

Classical Mechanics

Newton's laws, conservation of energy and momentum, collisions; generalized coordina principle of least action,
Lagrangian and Hamiltonian formulations of mechanics;
Symmetry and conservation laws; central force problem, Kepler problem; Small oscillations normal modes; special relativity in classical mechanics.

Electromagnetism & Optics

Electrostatics and magnetostatics, boundary value problems, multipole expansion;
Fields in conducting, dielectric, diamagnetic and paramagnetic media; Faraday's law and t varying fields; displacement current;

Maxwell's equations; energy and momentum of electromagnetic fields; Propagation of p electromagnetic waves, reflection, refraction; Electromagnetic waves in dispersive and conduc media; diffraction, interference, polarization.

Quantum Mechanics

Uncertainty principle; Schrodinger equation; central potentials, hydrogen atom;
Orbital and spin angular momenta, addition of angular momenta;
Matrix formulation of quantum theory, unitary transformations, Hermitian operators;Variati principle, time independent perturbation theory, time dependent perturbation theory

Thermodynamics & Statistical Physics

Laws of thermodynamics, work and heat, thermodynamic potentials; Elements of kinetic the Maxwell's relations;
Statistical ensembles; partition function; classical ideal gas, harmonic oscillators;

Classical and quantum statistics; Fermi and Bose gases; black body radiation; statistics paramagnetism

Electronics

Basics of semiconductor; p-n junctions, diodes, transistors;
LCR circuits, rectifiers, amplifiers, active filters and oscillators;
basics of OPAMPs and their applications; basics of digital electronics.

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Syllabus for Entrance Examination in Biological Science/LifeScience (CSIR-NET/SET Syllabus)

Unit 1: MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY

A. Structure of atoms, molecules and chemical bonds. B Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins). C. Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). D Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties). E. Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers. F. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes G. Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds). H. Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA). I. Stability of proteins and nucleic acids. J. Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins**.**

Unit 2. CELLULAR ORGANIZATION A) Membrane structure and function (Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport,electrical properties of membranes). B) Structural organization and function of intracellular organelles (Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility). C) Organization of genes and chromosomes (Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons). D) Cell division and cell cycle (Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle). E) Microbial Physiology (Growth yield and characteristics, strategies of cell division, stress response)

Unit 3. FUNDAMENTAL PROCESSES A) DNA replication, repair and recombination (Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination). B) RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of

RNA, RNA transport). C) Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins). D) Control of gene expression at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing).

Unit 4. Cell communication and cell signaling A) Host parasite interaction Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells. B) Cell signaling Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant twocomponent systems, light signaling in plants, bacterial chemotaxis and quorum sensing. C) Cellular communication Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. D) Cancer Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth. E) Innate and adaptive immune system Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules. generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cellmediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines.

Unit 5. DEVELOPMENTAL BIOLOGY A) Basic concepts of development : Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development B) Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination. C) Morphogenesis and organogenesis in animals : Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, amphibia and chick; organogenesis – vulva formation in Caenorhabditis elegans, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic

development- larval formation, metamorphosis; environmental regulation of normal development; sex determination. D) Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum E) Programmed cell death, aging and senescence

Unit 6. SYSTEM PHYSIOLOGY - PLANT A. Photosynthesis - Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways. B. Respiration and photorespiration – Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway. C. Nitrogen metabolism - Nitrate and ammonium assimilation; amino acid biosynthesis. D. Plant hormones – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. E. Sensory photobiology - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks. F. Solute transport and photoassimilate translocation – uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates. G. Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles. H. Stress physiology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

Unit 7. SYSTEM PHYSIOLOGY - ANIMAL A. Blood and circulation - Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis. B. Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above. C. Respiratory system - Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration. D. Nervous system - Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. E. Sense organs - Vision, hearing and tactile response. F. Excretory system - Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance. G. Thermoregulation - Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization. H. Stress and adaptation I. Digestive system - Digestion, absorption, energy balance, BMR. J. Endocrinology and reproduction - Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation

Unit 8. INHERITANCE BIOLOGY A) Mendelian principles : Dominance, segregation, independent assortment. B) Concept of gene : Allele, multiple alleles, pseudoallele, complementation tests C) Extensions of Mendelian principles : Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity,

phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters. D) Gene mapping methods : Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. E) Extra chromosomal inheritance : Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. F) Microbial genetics : Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes. G) Human genetics : Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. H) Quantitative genetics : Polygenic inheritance, heritability and its measurements, QTL mapping. I) Mutation : Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. J) Structural and numerical alterations of chromosomes : Deletion, duplication, inversion, translocation, ploidy and their genetic implications. K) Recombination : Homologous and non-homologous recombination including transposition.

Unit 9. DIVERSITY OF LIFE FORMS: A. Principles & methods of taxonomy: Concepts of species and hierarchical taxa, biological nomenclature, classical & quantititative methods of taxonomy of plants, animals and microorganisms. B. Levels of structural organization: Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems. Comparative anatomy, adaptive radiation, adaptive modifications. C. Outline classification of plants, animals & microorganisms: Important criteria used for classification in each taxon. Classification of plants, animals and microorganisms. Evolutionary relationships among taxa. D. Natural history of Indian subcontinent: Major habitat types of the subcontinent, geographic origins and migrations of species. Common Indian mammals, birds. Seasonality and phenology of the subcontinent. E. Organisms of health & agricultural importance: Common parasites and pathogens of humans, domestic animals and crops. F. Organisms of conservation concern: Rare, endangered species. Conservation strategies.

Unit10. ECOLOGICAL PRINCIPLES The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations. Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax. Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India. Applied Ecology: Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on

conservation/management strategy (Project Tiger, Biosphere reserves).

Unit 11. EVOLUTION AND BEHAVIOUR A. Emergence of evolutionary thoughts Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis. B. Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiement of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism. C. Paleontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo. D. Molecular Evolution: Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence. E. The Mechanisms: Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution. F. Brain, Behavior and Evolution: Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks; Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.

Unit 12. APPLIED BIOLOGY: A. Microbial fermentation and production of small and macro molecules. B. Application of immunological principles, vaccines, diagnostics. Tissue and cell culture methods for plants and animals. C. Transgenic animals and plants, molecular approaches to diagnosis and strain identification. D. Genomics and its application to health and agriculture, including gene therapy. E. Bioresource and uses of biodiversity. F. Breeding in plants and animals, including marker – assisted selection G. Bioremediation and phytoremediation H. Biosensors

Unit 13. METHODS IN BIOLOGY A. Molecular Biology and Recombinant DNA methods: Isolation and purification of RNA , DNA (genomic and plasmid) and proteins, different separation methods. Analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, Isoelectric focusing gels. Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems. Expression of recombinant proteins using bacterial, animal and plant vectors. Isolation of specific nucleic acid sequences Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors. In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms. Protein sequencing methods, detection of post translation modification of proteins. DNA sequencing methods, strategies for genome sequencing. Methods for analysis of gene expression at RNA and protein level, large scale expression,

such as micro array based techniques Isolation, separation and analysis of carbohydrate and lipid molecules RFLP, RAPD and AFLP techniques B. Histochemical and Immunotechniques Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, fluocytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH. C Biophysical Method: Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy Molecular structure determination using X-ray diffraction and NMR, Molecular analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods. D Statisitcal Methods: Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance; Regression and Correlation; t-test; Analysis of variance; X2 test;; Basic introduction to Muetrovariate statistics, etc. E. Radiolabeling techniques: Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines. F. Microscopic techniques: Visulization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freezefracture methods for EM, image processing methods in microscopy. G. Electrophysiological methods: Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT . H. Methods in field biology: Methods of estimating population density of animals and plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behavior, habitat characterization: ground and remote sensing methods

Syllabus for Entrance Examination in chemistry/chemical Science

Inorganic Chemistry

1. Chemical periodicity
2. Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory).
3. Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.
4. Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds.
5. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.
6. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications.
7. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis.

8. Cages and metal clusters.
9. Analytical chemistry- separation, spectroscopic, electro- and thermoanalytical methods.
10. Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine.
11. Characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-vis, NQR, MS, electron spectroscopy and microscopic techniques.
12. Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

Physical Chemistry:

1. Basic principles of quantum mechanics: Postulates; operator algebra; exactly- solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunneling.
2. Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.
3. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.
4. Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated π-electron systems.
5. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.
6. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; basic principles of magnetic resonance.
7. Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.
8. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities – calculations for model systems.
9. Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye-Huckel theory; electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.
10. Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.
11. Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis.
12. Solid state: Crystal structures; Bragg's law and applications; band structure of solids.
13. Polymer chemistry: Molar masses; kinetics of polymerization.
14. Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

Organic Chemistry

1. IUPAC nomenclature of organic molecules including regio- and stereoisomers.
2. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.
3. Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions.
4. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes.
5. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.
6. Common named reactions and rearrangements – applications in organic synthesis.
7. Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Chemo, regio and stereoselective transformations.
8. Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups.
9. Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst controlled reactions; determination of enantiomeric and diastereomeric excess; enantio-discrimination. Resolution – optical and kinetic.
10. Pericyclic reactions – electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.
11. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).
12. Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.
13. Structure determination of organic compounds by IR, UV-Vis, 1 H & 13 C NMR and Mass spectroscopic techniques.

Interdisciplinary topics

1. Chemistry in nanoscience and technology.
2. Catalysis and green chemistry.
3. Medicinal chemistry.
4. Supramolecular chemistry.
5. Environmental chemistry

Syllabus for Entrance Examination in SciSER Physical Sciences

Upcoming entrance Examinations for the SciSER/Physics Ph.D. programme will have elements of basic interdisciplinary knowledge at the B.Sc. level in the Indian universities and the test will include core subject knowledge above BSc level.

For the current year, those who wish to opt the SciSER PhD programme will have to qualify through an interview process if qualified in any of the Basic Science/Engineering Branch entrance exam conducted by SVU.

Those who have secured a First class or equivalent in the qualifying Degree (B.Tech/MSc/MTech/or equivalent) or passed any of the national/international examinations of comparable standards may be exempted from the entrance examination complying with the guidelines of mandatory bodies as the case may be. Candidates who are keenly interested in pursuing a Ph.D. programme in integrated sciences with focus on any of its three major streams, viz, Physical/Chemical/biological Sciences are advised to write to the SciSER faculty members and discuss their interest

Core Subject Syllabus for the Entrance Test (based on Joint Entrance Screening test by major Institutions in India)

Mathematical Methods

Vector algebra and vector calculus, tensors, curvilinear coordinate systems, linear algebra;
Linear differential equations, elements of Sturm–Liouville theory;
Special functions; Complex analysis; Fourier series and Fourier transforms, Laplace transforms;

Elementary properties of discrete groups; Elements of probability theory, error analysis.

Classical Mechanics

Newton's laws, conservation of energy and momentum, collisions; generalized coordinates, principle of least action,
Lagrangian and Hamiltonian formulations of mechanics;
Symmetry and conservation laws; central force problem, Kepler problem; Small oscillations and normal modes; special relativity in classical mechanics.

Electromagnetism & Optics

Electrostatics and magnetostatics, boundary value problems, multipole expansion;
Fields in conducting, dielectric, diamagnetic and paramagnetic media; Faraday's law and time varying fields; displacement current;

Maxwell's equations; energy and momentum of electromagnetic fields; Propagation of plane electromagnetic waves, reflection, refraction; Electromagnetic waves in dispersive and conducting media; diffraction, interference, polarization.

Quantum Mechanics

Uncertainty principle; Schrodinger equation; central potentials, hydrogen atom;
Orbital and spin angular momenta, addition of angular momenta;
Matrix formulation of quantum theory, unitary transformations, Hermitian operators;

Variational principle, time independent perturbation theory, time dependent perturbation theory.

Thermodynamics & Statistical Physics
Laws of thermodynamics, work and heat, thermodynamic potentials; Elements of kinetic theory; Maxwell's relations;
Statistical ensembles; partition function; classical ideal gas, harmonic oscillators;
Classical and quantum statistics; Fermi and Bose gases; black body radiation; statistics of paramagnetism
Electronics
Basics of semiconductor; p-n junctions, diodes, transistors;
LCR circuits, rectifiers, amplifiers, active filters and oscillators;
basics of OPAMPs and their applications; basics of digital electronics.

Details of PhD Coordinator

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