Somaiya center for Integrated Science Education and Research (SciSER)

Faculty of Science

Somaiya Vidyavihar University, Mumbai

Admission Manual

PhD Programme – Life Sciences

AY 2025-26 onwards

Visit for further Details : https://www.somaiya.edu/en/phd/

About Somaiya Vidyavihar University

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

We made this milestone after six decades of creating holistic teaching learning experience educational institutes of great repute. Somaiya Vidyavihar University has become a self finance – the first private University in Mumbai vide the Maharashtra Self-Financed Universities (Establishment and Regulation) Act 2013.

We have a dream to build and support a world-class institution, one that is proudly Indian, and excels in education, research and service. Somaiya Vidyavihar University will be a place where knowledge is preserved, disseminated, and new knowledge is created. It will be global in the reach of its ideas and universal in its service. Somaiya Vidyavihar University is a place where students and faculty can explore " Freedom of Possibilities" , pursue your passion and above all, find yourself.

Our History and Vision

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

The Somaiya Vidyavihar Complex was founded in 1959 by late Shri K.J. Somaiya (1902- 1999). Endowed with a sharp business acumen, a balanced perspective and a social bent of mind, Karamshibhai set up the Somaiya Trust in 1953 for furthering his dream of shaping young minds through quality education. For this purpose, he bought a large area of land at Ghatkopar, then considered to be distant, meagrely populated.

In six decades it has grown into a large educational complex with 34 institutions catering to diverse fields of education such as Humanities, Engineering, Education, Medicine, Management, Dharma Studies ,Pure Sciences and Commerce & Business Studies, with more than 39000+ Candidates and 3000+ Faculties and staff on a throbbing 50 acre campus.

Our Founder, Padmabhushan Shri K. J. Somaiya founded Somaiya Vidyavihar on 9th September 1959. He later founded the Girivanvasi Pragati Mandal, The K J Somaiya Medical Trust, Girivanvasi Education Trust and sister institutions to make great citizens of India and the World. In the words of Swami Vivekananda, "We want that education by which character is formed, strength of mind is increased, and the intellect expanded, and by which one can stand on one's own feet." We have now grown into a multi-disciplinary and multi-campus education institution with over 1500 faculty, and 38, 000 candidates.

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

1. Eligibility criteria for PhD Admission	
Subject to the conditions stipulated in the SVU Ph.D. Regulations, the following candidate are eligible to seek admission to the Ph.D. 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) or Pharma.D / Pharma.D. (Post Baccalaureate) 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 Ph.D. Programme but subject to completion of Master's degree before provisional admission to SVU Ph.D. 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 Ph.D. Programme
2. PhD Entrance Exam	
i.	MUST qualify a passing score of Ph.D. 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 Ph.D. 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. 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 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. Research and Teaching 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 publish 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. 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 Ph.D. Programme

Sr.No.	Steps
Ph.D. Pre-selection Phase	
1.	Advertisement / Call for SVU Ph.D. entrance exam on website /media handles
2.	Acceptance of the applications for Ph.D. entrance examination along with the applications processing fee
3.	Execution of Ph.D. entrance examination for all Ph.D. programmes
4.	One- on -one Interviews of candidates before an expert panel
5.	Display of selected candidates for provisional admission - Selection process complete
Provisional Admission Phase	
6.	Provisional admission and payment of fees in accounts/admin office of the colleges.

7.	Orientation and initiation of course work (1 year – 2 sem)
8.	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.
9.	ATKT examination for the semester I and II for unsuccessful candidates or for grade improvement
10.	Issue of mark sheets for course work of semester I and II
Allotments & Registrations	
11.	Allotment of the guide at individual college-level /department (within the first six months of provisional admission)
12.	Topic approval of the thesis work within 2-3 months after Qualifying course work examination
13.	Registration for Ph. D programme
PhD Phase	
14.	Appointment of Examiners and chairman from Research Committee
15.	Annual Progress Seminars (APS) and Intermediate Progress Seminar (IPS) for the academic year by Doctoral Advisory Committee (DAC)
Submission & defence	
16.	Approval of examiners to present pre-synopsis in one of the APS and IPS
17.	Presentation of pre-synopsis and its approval by the examiners
18.	Submission of thesis to COE office
19.	Sending the thesis to reviewers
20.	Receipt of reviews about thesis from the reviewers
21.	The final defence of the thesis
22.	Submission of the final corrected thesis after defence
23.	Issue of provisional Ph.D. certificate
24.	Issue of Ph.D. certificate
	The steps and the progress evaluation of Ph.D. students by the committee/examiners/experts will be as per the provisions of Ph.D. regulations

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

6. Fee Structure of Ph.D. 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	

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

Note:

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

8. Payment of fees schedule for Provisional admission and subsequent years of Ph.D. 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

There is a provision of ONLINE PAYMENT of college fees for student's' convenience 24x7 on or before the scheduled due date. Student 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 Ph.D. programme
(All Categories of Ph.D. 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 college 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 college	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 Ph.D. 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

Refer the below example for clarification of Ph.D. 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 college	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 verifications of documents, within 7 days, documents will be returned to students.

About Research Center

Somaiya Centre for Integrated Science Education and Research (*Sci*SER), at Somaiya Vidyavihar University, Mumbai, is envisaged as a center dedicated to the promotion of an integrated approach to education, research, and training in science, in collaboration with all the relevant departments of the Faculty of Sciences. It offers a five-year's full time BS-MS programme as its flagship programme. This programme offers a platform for creating a culture of collaboration in interdisciplinary areas of science with well-equipped shared facilities and infrastructure, with opportunities for developing research projects, with external collaboration and funding avenues. It is also creating Centers of Excellence in specialised areas of science, equipped with appropriate research tools and having application to frontier research areas across multiple disciplines. The vision of the Centre is to equip students with distinctive skill sets with holistic, integrated knowledge in sciences. The center has faculty with vast experience in research (in India and abroad) and teaching in the fields of Physics, Chemistry, and Life Sciences.

Doctoral programme in Life Sciences at Somaiya Centre for Integrated Science Education and Research (*Sci*SER), Somaiya Vidyavihar University offers a unique opportunity for research scholars to carry out research work at the organism level using zebrafish as a model organism. The scholar will use different molecular biology and classical biology approaches to better understand molecular mechanisms involved in developmental and regeneration processes that result in the formation of tissues and organs. The tools commonly used in the research group involve: understanding gene expression studies by using approaches like *in situ* hybridization and quantitative PCR (qRT-PCR), gene function analysis by knockout strategy using CRISPR-Cas9, immune histology and other histological approaches. The researcher will have an amazing opportunity to interact with other Faculty members of the Center and other Institutes who are involved in active research in frontier areas. The researcher will be given ample exposure to present the work at National and international platforms and will be encouraged to attend conferences, workshops and seminars.

Eligibility at UG/PG Degree	
Branch of study at UG (Minimum score of first class)	BSc in Life Sciences/Biological sciences B.Sc./ B.Tech in Biotechnology, Bioinformatics, MBBS
Branch of study at PG	MSc in Life Sciences/ Biological Sciences including Biotechnology, environmental sciences and MTech Biotechnology

Syllabus for Entrance Examination

UNIT 1. MOLECULES AND THEIR INTERACTION RELAVENT 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) Stabilizing 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 behaviour by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.
b) Cell signalling - Hormones and their receptors, cell surface receptor, signalling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signalling pathways, bacterial and plant two- component systems, light signalling in plants, bacterial chemotaxis, and quorum sensing
c) Cellular communication - Regulation of haematopoiesis, 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 cell- mediated 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.
f) Programmed cell death, aging, and senescence

UNIT 5. SYSTEM PHYSIOLOGY - PLANT

a) Photosynthesis - Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms.

b) Respiration and photorespiration – Citric acid cycle; plant mitochondrial electron transport and ATP synthesis.
c) Nitrogen metabolism - Nitrate and ammonium assimilation; amino acid biosynthesis.
d) Plant hormones – Biosynthesis, storage, breakdown, and transport.
e) Solute transport and photo assimilate translocation – uptake, transport and translocation of water, ions, solutes, and macromolecules from soil, through cells, across membranes, through xylem and phloem, transpiration.
f) Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.
g) Stress physiology - Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature, and salt) stresses.

UNIT 6. SYSTEM PHYSIOLOGY - ANIMAL

a) Blood and circulation - Blood corpuscles, hemopoiesis 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 7. INHERITANCE BIOLOGY

a) Mendelian principles : Dominance, segregation, independent assortment.
b) Concept of gene : Allele, multiple alleles, pseudo allele, 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
j) Structural and numerical alterations of chromosomes : Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

UNIT 8. ECOLOGICAL PRINCIPLES

a) The Environment: Physical environment; biotic environment; biotic and abiotic interactions.
b) Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.
c) Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection);
d) Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.
e) Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.
f) Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.
g) 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).
h) Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.
i) Applied Ecology: Environmental pollution; global environmental change; biodiversity status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.
j) Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).
k) Organisms of conservation concern: Rare, endangered species. Conservation strategies

UNIT 9. 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 10. METHODS IN BIOLOGY

a) Molecular Biology and Recombinant DNA methods:
   i. Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods.
   ii. Analysis of RNA, DNA and proteins by one- and two-dimensional gel electrophoresis, Isoelectric focusing gels.
   iii. Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems. Expression of recombinant proteins using bacterial, animal and plant vectors.
   iv. Isolation of specific nucleic acid sequences
   v. Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors.
   vi. In vitro mutagenesis and deletion techniques, genes knock out bacterial and eukaryotic organisms.
   vii. Protein sequencing methods, detection of post translation modification of proteins. DNA sequencing methods and strategies for genome sequencing.
   viii. Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array-based techniques
   ix. 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, flow cytometry 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) Radiolabelling 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.
e) Microscopic techniques - Visualization 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 freeze- fracture methods for EM, image processing methods in microscopy.
f) Electrophysiological methods - Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT.
g) 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 behaviour, habitat characterization: ground and remote sensing method.