SRI SATHYA SAI INSTITUTE OF HIGHER LEARNING
PRASANTHI NILAYAM
सत्यं वद धर्मं चर

Admissions Prospectus

Doctoral Research Programmes

June 2020

The Underlying Philosophy

The Sai educational institutions have been established not merely to enable students to earn a living but to make them acquire good traits, lead ideal lives, and give them ethical, moral and spiritual strength. I have established them with a view to inculcate love and teach good qualities to students. They will learn here humility, discipline and faith.

I have established these institutions to impart spiritual education as a main component and worldly education as a secondary one. Education should enable one to cultivate good qualities, character and devotion. The teaching of the University curricula is only the means employed for the end, namely, spiritual uplift, self-discovery and social service through love and detachment.

This will be a Gurukula - a place where teachers and taught will grow together in love and wisdom - and like the ancient system of education, it will develop in its students a broad outlook and promote virtues and morals, which serve to foster noble ideals in society.

This Institute will be a temple of learning where youth are shaped into self-reliant, contented and enterprising heroes of action and self-sacrifice, for the purpose of serving humanity.

SRI SATHYA SAI BABA
Revered Founder Chancellor, SSSIHL

Education softens the heart. If the heart is hard, one cannot claim to be educated.

SRI SATHYA SAI BABA
Revered Founder Chancellor, SSSIHL

From the admissions office

Welcome to Sri Sathya Sai Institute of Higher Learning (SSSIHL).

This prospectus is for students interested in applying for doctoral research study at SSSIHL.

The first part introduces Sri Sathya Sai Institute of Higher Learning and its unique philosophy of education. It also includes current, key statistics regarding the University.

The second part will give a clear view on how to apply to the Ph.D. programmes of SSSIHL. This includes a step-by-step process, eligibility requirements (including Hostel guidelines unique to this University) and other application procedures in general.

The third part of the prospectus lists the department-wise information on available Areas of Research for June 2020 entry along with the available research infrastructure and admissions test syllabi.

Detailed information about the University can be found on our website, **sssihl.edu.in**

Good Luck and Sai Ram!

Admissions Office
Office of the Registrar, SSSIHL

Admissions Prospectus June 2020

Doctoral Research Programmes

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Sri Sathya Sai Values-based Integral Education

Sri Sathya Sai Institute of Higher Learning (Deemed to be University), Prasanthi Nilayam, Andhra Pradesh, India, is a visible manifestation of Bhagawan Sri Sathya Sai Baba's vision of education for human transformation.

Bhagawan Baba has designed the system of Sri Sathya Sai Values-based Integral Education in such a manner that between the time an 18-year old student joins the Institute and when she or he graduates (at the age of 21 or 23), there is a deep inner transformation that takes place. This concept is very unique at the university level.

The Institute hosts over 1400 undergraduate, postgraduate, professional and research students across four campuses:

For women students:

- Anantapur Campus at Anantapur, Andhra Pradesh

For men students:

- Prasanthi Nilayam Campus at Puttaparthi, Andhra Pradesh
- Brindavan Campus at Whitefield, Bangalore, Karnataka
- Muddenahalli Campus at Muddenahalli, Karnataka

Programmes offered include:

- Undergraduate: B.A., B.Com. (Hons.), B.Sc. (Hons.), B.B.A., B.P.A.
- Postgraduate: M.A., M.Sc.
- Professional: B.Ed., M.B.A., M.Tech.
- Research: Ph.D.

A Modern Gurukula

Sri Sathya Sai Institute of Higher Learning (SSSIHL) was founded to inculcate ethical and moral values in students. These ethics and morals form the undercurrent of every subject taught at the University. This helps students develop a wholesome and balanced personality, one where academic competence is supplemented with good character.

This holistic development of students can only be possible in an environment that encourages the development of the student's mind, body and spirit.

To facilitate this, the University has a compulsory residential policy for all students and doctoral research scholars. It is an essential ingredient for the University's Values-based Integral Education to achieve its objective of transformation. The environment is similar to the ancient Indian Gurukula system of education, in a modern context. Teachers and students live and grow together in an atmosphere of mutual trust and unity. This helps students develop a wholesome and balanced personality, one where academic competence is supplemented with good character.

Distinctive Features

Admissions

- Merit-based open admissions policy for all irrespective of income, religion or region
- Free education for all students

Residential Character

- Compulsory residential character enabling translation of lessons learnt into practical skills through experiential learning
- Spiritual ambience in an environment of discipline and love
- Teaching faculty, research scholars and students residing in the hostel
- Cultivation of the spirit of self-reliance, brotherhood and sacrifice through mentoring and personal example

Infrastructure

- Campuses set in spacious and peaceful surroundings
- Well equipped, modern science laboratories and cutting edge Research Instruments Facility
- Libraries across campuses with over 2,00,000 volumes
- Computer and Multimedia learning centres with ultra-high speed broadband internet connectivity
- International Centre for Sports and a cricket stadium

Academics & Research

- Over 95% examinations pass rate
- Favourable Student-Teacher Ratio
- Integrated five-year programmes combining undergraduate and postgraduate studies for a systematic and graduated learning process
- Interdisciplinary research for societal benefit
- Awareness Programmes and Moral Classes reinforcing human values

Integral Education

- Life lessons learnt through the message of the Revered Founder Chancellor, Bhagawan Sri Sathya Sai Baba
- Application of what is learned in daily life
- Integrating human values with secular knowledge
- Inculcating the spirit of self-reliance and service to society
- Synthesis of science and spirituality for societal benefit

The concept of integral education that SSSIHL imparts is willingly pursued by all teachers, staff and students.

The Process

The diagram on the right forms the basis of the system of Values-based Integral Education at SSSIHL.

The base is the concept of a modern Gurukula that sustains all relationships and activities at SSSIHL. It is responsible for creating and sustaining the congenial environment necessary for the teacher-student interaction to grow and develop.

Adherence to discipline and appropriate behaviour are the two important aspects that encompass all interactions.
The five human values of Truth, Right Conduct, Peace, Love and Non-violence form the undercurrent of all the dimensions of integral education.

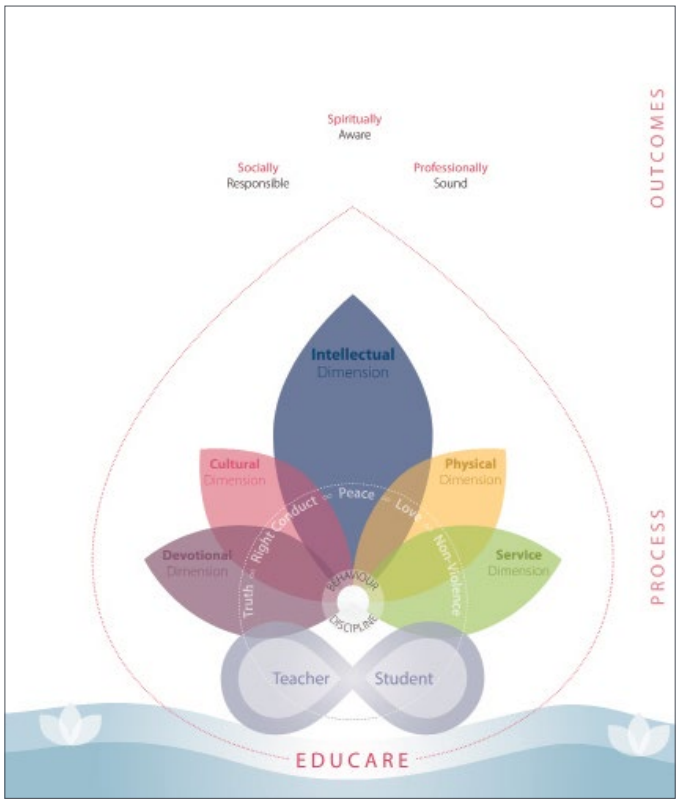
These dimensions are: Intellectual, Physical, Cultural, Devotional and Service. The key activities for each of these dimensions form the basis of most of the time that students spend at SSSIHL.

Bhagawan Baba purposefully designed the system of Integral Education so that while students spend 60% of their time on academics (intellectual capacities), they also spend 40% time on the development of other qualities.
(See page 8 for further details.)

The Daily Routine

This is a crucial component of this process. Each student's day starts at 5:00 a.m., with a couple of hours spent in prayer, exercise and other vocational pursuits (such as practice sessions for music, band, traditional Indian music and the likes).

Classes commence at 9:00 a.m. After college ends at around 4:00 p.m., students move to the Mandir/Prayer hall for participation in congregational chanting (veda), devotional singing (bhajans) and other spiritual activities. These also include talks by eminent speakers on a variety of spiritual topics. Post dinner, students usually spend time on their studies.



Sri Sathya Sai Values-based Integral Education

The Outcome

The outcomes of the system of Values-based Integral Education at SSSIHL are threefold. It prepares all graduates to be:

- Spiritually aware
- Socially responsible and
- Professionally sound

It helps develop a strong character and positive qualities in students and nurtures virtues like adaptability, tolerance and sacrifice; shaping them into noble and responsible citizens.

I have established these institutions to impart spiritual education as a main component and worldly education as a secondary one. Education should enable one to cultivate good qualities, character and devotion. The teaching of the University curricula is only the means employed for the end, namely, spiritual uplift, self-discovery and social service through love and detachment.

Sri Sathya Sai Baba
Revered Founder Chancellor, SSSIHL

Why Research at SSSIHL?

SSSIHL Distinctive Features

- Favourable student-teacher ratio (8:1)
- Excellent academic and research facilities
- State-of-the-art Central Instruments Research Facility
- Campuses set amidst peaceful surroundings
- Inculcates in students the spirit of self-reliance and service to society
- Alumni who are highly accomplished - professionally and personally.

Free education for all students

Faculties & Departments

There are three academic faculties and nine departments at Sri Sathya Sai Institute of Higher Learning. Each faculty has a full-time dean and each department has a full-time head.

In the Faculty of Sciences, the thrust for research for societal benefit has led to interdisciplinary collaborations of SSSIHL with Sri Sathya Sai Institute of Higher Medical Sciences (SSSIHMS) and external agencies in several areas.

Research Growth

The research output at SSSIHL has seen a significant rise in the past few years. The number of doctoral research scholars has seen a tremendous increase in last four years. The five science departments, viz. Mathematics & Computer Science, Physics, Chemistry, Biosciences and Food & Nutritional Sciences are increasingly pursuing research collaborations with premier external Institutions such as IISc., IITs, Bayer College of Medicine (USA), etc.

In addition, collaborative research projects with Sri Sathya Sai Institute of Higher Medical Sciences (SSSIHMS) are testimonial to the rise in the quality of research at the University.

Needs-based Research

In line with the vision of the Revered Founder Chancellor, all research at SSSIHL ultimately leads to societal benefit. Thus, the topics for doctoral research across all departments are chosen with great diligence. In the present day world, the need of the hour is to integrate expertise from different departments to transform it into translational research or directed basic research.

Interdisciplinary Approach

Interdisciplinary research is indispensable for academic innovation. It brings together different minds, across various disciplines, and encourages emerging areas to converge and together make an impact on any programme.

In order to foster this ambiance for interdisciplinary research at the University, an Interdisciplinary Science Colloquium has been initiated (several years ago) to provide an opportunity for Doctoral Research Scholars and the Teaching Faculty — involving the departments of Physics, Chemistry, Biosciences and Food & Nutritional Sciences—to share their research experiences with fellow researchers.

This has facilitated the promotion and consolidation of their knowledge base. Besides, it has also proved to be an effective optimal method of sharing available resources for research.

The University has taken giant strides in this direction of interdisciplinary research by collaborating with top notch institutions, both within the country and abroad.

SSSIHL Statistics 2018/19

2:1
Student Computer Ratio

8:1
Student Teacher Ratio

23/29
States of India
Student Diversity

70
Doctoral Research Scholars

180
Visiting Faculty & Guest Lecturers

166
Research Publications

Examinations Pass Rates

92%
Undergraduate Programmes

98%
Postgraduate Programmes

₹ 15.62 crore
Expenditure on Equipment & Infrastructure

₹ 3.72 crore
Research & Teaching Grants

₹ 2.58 lakh
Expenditure per Student / per year

Central Research Instruments Facility (CRIF) and Central Research Laboratory (CRL)

SSSIHL Central Research Instruments Facility (CRIF), based at the Prasanthi Nilayam Campus and SSSIHL Central Research Laboratory (CRL), based at the Anantapur Campus for Women, are one of the few such facilities in the country (and the first of its kind in a rural location) that house advanced characterization/analytical tools to carry out translational research in various areas of science and technology such as physical, biological, chemical, materials science, food & nutritional sciences and computational and interdisciplinary areas.

The facilities, built with a funding of over ₹45 crore with the kind support of Sri Sathya Sai Central Trust, hosts a range of cutting-edge instruments and laboratories as listed on the opposite page. It has significantly strengthened the existing research facilities at SSSIHL by providing state-of-the-art infrastructural facilities under a single roof.

This will allow faculty and postgraduate and doctoral students at the Institute to accelerate their research work in all the major research areas of the Faculty of Sciences - Health, Energy and Environment. It will enable them to keep pace with the scientific developments taking place globally; and to publish their research findings in peer reviewed high impact journals; and through their concerted efforts to carry out research in cutting edge areas of Science and Technology and contribute to the needs of the society at large.

Full-time technical assistants with specific expertise operate and maintain the instruments and laboratories.

SSSIHL CRIF facilitates the strengthening of interdisciplinary health related research collaborations between SSSIHL and Sri Sathya Sai Institute of Higher Medical Sciences (SSSIHMS). Some of these include: Regenerative Medicine & Tissue Engineering, Rapid Detection of Endemic Diseases, Diabetic Retinopathy, Development of Cost Effective Multi-Modal Microscopes, SPCE-based Point of Care Devices, etc.

CORE FACILITIES

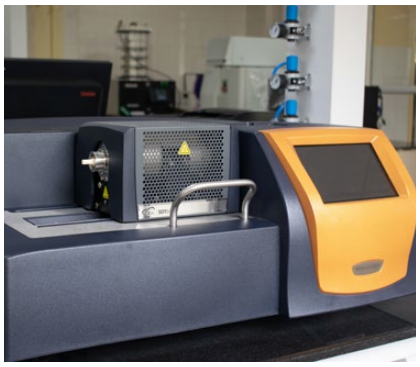
The following core facilities at CRIF and CRL are shared resources offering a range of services to the research community at SSSIHL:

- Femto Fab
- Electron Microscope Facility
- NMR & Mass Spectrometry Facilities
- Materials Characterization Facility
- Thermal and Optical Characterization Facilities
- Liquid Nitrogen Facility
- Central Utilities Facility
- Optical Imaging and Integration

LABORATORIES

In addition, CRIF hosts the following labs:

- Wet Chemistry Laboratories
- Functional Materials Laboratory
- Materials Synthesis Laboratory
- Water Research and Electrochemistry
- Bio-Safety Labs: Level 1 and Level 2
- Computational Science and Plasmonics



Eligibility

All applicants must meet the following eligibility criteria to qualify for admissions to the Ph.D. programme and appear for the SSSIHL Admissions Test & Interview in April 2020:

Age: All Ph.D. applicants must be under 30 years of age on 31 May 2020

Marital Status: The applicant should be unmarried

Compulsory Hostel stay: Selected candidates must reside in the hostel throughout their Ph.D. programme without exception

Academic Qualifications: Applicants **must have completed a Master's degree** correlating to the Ph.D. programme they are applying for (final year students must have appeared for their final exams by the time of the admissions tests) with minimum 60% marks (aggregate) or equivalent grade from SSSIHL or any other recognized university in the following disciplines:

- ✓ **Mathematics**: Any one of the following degrees: M.Sc. Mathematics / M.Sc. Statistics / M.Sc. Operations Research
- ✓ **Computer Science**: Any one of the following degrees: M.Sc. in Computer Science / M.Sc. in Information Technology / M.Sc. in Data Science and Computing / Master of Computer Applications / M.Sc. in Mathematics (with sufficient background in CS and programming) / M.Sc. Statistics (with programming skill) / M.Tech.in Computer Science / M.Tech. in Computer Science and Engineering / M.Tech. in Information Technology / M.Tech. in any branch of Science and Engineering with sufficient background in Data Structures, Algorithms and Programming
- ✓ **Physics / Photonics / Nuclear Physics**: Any one of the following degrees: M.Sc. in Physics / M.Sc. in Photonics / M.Sc. in Nuclear Physics
- ✓ **Materials Science**: Any one of the following degrees: M.Sc. in Physics / M.Sc. in Chemistry / M.Sc. in Photonics / M.Sc. in Materials Science / M.Sc. in Nanoscience and Nanotechnology / M.Tech. in Materials or Ceramic Engineering
- ✓ **Chemistry**: M.Sc. in any branch of Chemistry (Organic, Inorganic, Physical, Analytical and Biochemistry).
- ✓ **Biosciences**: Master's degree in any branch of Biological Sciences
- ✓ **Food and Nutritional Sciences**: Any one of the following degrees: M.Sc. in Food and Nutritional Sciences / M.Sc. in Food Science and Nutrition / M.Sc. in Clinical Nutrition & Dietetics / M.Sc. in Food Technology / M.Sc. in Agricultural Sciences / Horticulture, M.Sc. in Home Science / M. Tech. in Food Process Engineering
- ✓ **Management & Commerce**: M.B.A (with any specialization), M.Com., M.M.S.
- ✓ **Economics**: M.A. in Economics
- ✓ **English Language & Literature**: Masters degree in English Language & Literature, ELT, Linguistics, Comunicative English and Media Studies
- ✓ **Education**: Master in Education (M.Ed.)

SSSIHL direct Interview

Candidates who have qualified in the UGC CSIR (JRF) / UGC NET (JRF) / ICMR(JRF) / ICAR(JRF) National Examination, or those who have secured the minimum score in GATE / JEST as decided by the University every year need not appear for the Ph.D. Admissions Test of the Institute. They will however be required to appear for an evaluate test in English on 16 January 2020 at 11 a.m. and a subject viva / interview as per the schedule on page 15, to be considered for admission to the Ph.D. programme.

Areas of Research for 2020 entry: These are available on the individual Department pages.
The areas of research for women and men for the academic year 2020/21 are based on the current availability of research supervisors and resources at each of the campuses.

Information on hostel life

Given the compulsory residential nature of the system of Sri Sathya Sai Values-based Integral Education imparted at SSSIHL, a student's stay at the hostel becomes an important component of the holistic, character building education imparted at the University.

The hostel provides a conducive environment for the practice of inputs on values and spirituality received at the campus through community living and encourages experiential learning and blossoming of the human personality. The undercurrent of life at the hostel is discipline, self-regulation and well-mannered behaviour, epitomising the adage 'simple living and high thinking.'

The daily hostel routine includes prayer and meditation, games and sports, participation in social service and attending bhajans.

Doctoral Research Scholars—being the most senior students—are akin to junior teachers and need to be role models worthy of emulation by students. They therefore need to be impeccable in their behaviour as well as personal grooming and attire at all times. They are also expected to contribute to the functioning of the Hostel by either taking care of one or two students' rooms (as Room Teachers) or taking charge of a specific Self-Reliance department at the hostel.

IMPORTANT: Given the unique Gurukula system of Values-based Integral Education at the University—where students need to be reside full-time at the hostel during the entire period of their Ph.D. programme—only unmarried (bachelor/maiden) students will be admitted. **Engaged or married students need not apply.**

Any breach of this policy during the course of study will result in the admissions confirmation being revoked.

Additionally, since its inception in 1981, Sri Sathya Sai Institute of Higher Learning has gender-specific campuses. Accordingly, admissions (to all programmes) are campus-specific.

Application Process

Fill in the Application Form

There are two ways to get an application form:

In Person - Pick up the application form from the SSSIHL Admissions Office located in the Administrative Building at Prasanthi Nilayam. with a cash payment of Rs. **200**.

By Email - Apply by writing to **admissions@sssihl.edu.in** requesting for an application form with details of your **qualifying degree, age and marital status**. The application form will be emailed to you **if** you fulfill our eligibility criteria.

Applicants requesting the form via email must send in an **Indian Postal Order (IPO) or Demand Draft (DD) for Rs. 200**. The Bank draft should be drawn in favour of Sri Sathya Sai Institute of Higher Learning, payable at SBI, Prasanthi Nilayam/Puttaparthi.

Submit Application Form with Required Documents

Once you have filled in the application form - complete with signatures, photograph, contact information (including Email ID and mobile number), etc. you will have to make sure that you collate all the supporting documents that are requested and attach them with the form before posting the application to SSSIHL.

Please follow these four steps to ensure your application will be processed and not rejected:

1. Staple the filled application form with all supporting materials. Then, seal them in an A4-sized envelope.

2. Write the Application Number and the course for which you have applied on the envelope that you are posting.

3. Post the completed application so that it reaches the University BEFORE the submission deadline.

On average, allow one week for applications posted within South India and two weeks for the rest of India. Applications reaching after this date will be rejected.

4. It is desirable that all applications are posted either by Registered Post / Speed Post or via a reliable courier service to the address provided below. Should you opt for a courier service, it is advisable that you check with them if they have an office or delivery service at Puttaparthi, Andhra Pradesh. Two examples include: DTDC or Professional Couriers, both of whom have offices at Puttaparthi.

The postal address to use is:

The Admissions Office
Administrative Building
Sri Sathya Sai Institute of Higher Learning
Prasanthi Nilayam - 515 134
Dist. Anantapur
Andhra Pradesh

Tip: Application forms can also be submitted in person at the admissions office at the Administrative Building of SSSIHL, Prasanthi Nilayam.

APPLICATION DEADLINE
Sat, 21 March 2020

Final date for availability of application forms. Applications will not be available after this date.

SUBMISSION DEADLINE
Mon, 23 March 2020

Final date before which completed applications must reach the University.

Confirmation of Written Test Eligibility

Once we receive your application, it will be duly processed to make sure that you meet all the preliminary eligibility criteria and that all the supporting materials (including your application form) are in order.

If you meet the eligibility criteria, the University will send an **Admissions Entrance Test card (Hall ticket) to your email ID,** a print-out of which you produce when you come for the Admissions Entrance Test.

If you do not meet the eligibility criteria, you will be informed by the University that your application has been rejected.

The list of candidates called for the admissions test will be published on the University's website once the submissions deadline has passed.

Important: **Details regarding post-admission registration process, Pre-Ph.D. coursework, residency requirement, colloquium, submission of thesis etc., can be found from the academic regulations for the Ph.D. Programme on the University's website.**

Admissions Tests

Once the Admissions Office receives your application, and confirms your eligibility for the written test, you are required to travel to Prasanthi Nilayam, Andhra Pradesh to take the written test on the following dates:

Mon, 20 April 2020

9:00 to 11:00 a.m.
Ph.D. Admissions Test
in the relevant subject area
(75 marks)

11:00 a.m. to 12:00 noon
Evaluative Test in English
(50 marks)

Question Paper Pattern

Subject Test (75 Marks)

Part A: Multiple Choice Questions (30x1 = 30 marks)
Please NOTE that an incorrect response will attract negative marking.

Part B: Answer any 9 (out of the following) in about 150 words each (9x5 = 45 marks)

Evaluative Test in English (50 Marks)

Part A: Objective Questions (30x1 = 30 Marks)
Part B: Rewrite the following visual into a text of about 150 words (10 Marks)
Part C: Write a paragraph of about 150 words on your reasons for pursuing research, and India's need for original research contributions (10 Marks)

Model Test Papers

To help you better prepare for your Admissions Test, you can view model test papers on our website.

Admissions Interview

Candidates who are successful on the admissions test will be required to attend the admissions interview on the following dates:

Tue, 21 April 2020 **(Women)**
Wed, 22 April 2020 **(Men)**

Direct Interview

Candidates who have qualified in the UGC CSIR (JRF) / UGC NET (JRF) / ICMR (JRF) / ICAR (JRF) National Examination, or those who have secured the minimum score in GATE / JEST as decided by the University, are exempted from the Ph.D. Admissions Test of the Institute.

They will however be required to appear for the Admissions Interview.

Final Results & Reporting Dates

The final list of selected candidates for the SSSIHL Ph.D. programme will be published on SSSIHL's website **sssihl.edu.in** on:
Fri, 1 May 2020

The reporting date for selected candidates is: **Sun, 31 May 2020**

The Ph.D. programme commences on:
Mon, 1 June 2020

Admissions Confirmation

Provisional admission to the Doctoral Research programme stands confirmed subject to candidates satisfying the eligibility criteria and submission of original marks statement of all the examinations, degree certificate and other certificates as required by SSSIHL, within one month from the date of Admission, failing which, his/her admission will be cancelled.

Provisionally selected candidates will be examined for medical fitness by SSSIHL's Medical Officer.

Remuneration

Candidates successfully admitted to Doctoral Research Programme, and who have not qualified to receive a stipend/ scholarship/fellowship from UGC-JRF-NET, CSIR, UGC-BSR-Fellowships etc., shall be paid a research stipend of Rs. **8,000 per month** by Sri Sathya Sai Institute of Higher Learning.

CONTACT US

If you need further assistance please contact us either by email or telephone.

By Email
admissions@sssihl.edu.in
We will answer all email enquiries within two working days of receipt.

By Telephone
+91 9441 911 391 or
+91 8555 287239
Lines are open between 9am and 5pm, Monday to Saturday.

Mathematics & Computer Science

AREAS OF DOCTORAL RESEARCH
Available for 2020 entry

Applicants should enter a **maximum of three preferred areas of research** on the application form (in the order of preference) from the choices below.

For Women

- **Graph Theory** - Algorithms on interval graphs and circular graphs, domination problem, separation problems

For Men

Note: The three preferred areas of research chosen must be under **either** Mathematics **or** Computer Science

MATHEMATICS

- **Existential and Qualitative study of solutions of Nonlinear equations**: Qualitative study of Nonlinear paired and/or Coupled differential operators, various types of Functional Differential equations.
- **Epidemic Modelling**: Mathematical Models on spread of Dengue Fever based on sample data collected in the neighbourhood and also from health care institutions. The model also takes into account the behavior of the virus in the system.
- **Ecological Modelling**: Mathematical Models for additional food supply for predators to achieve the goal of pest control and ecological conservation.
- **Pseudo Differential Operators & Microlocal Analysis**: Pseudo-Differential Operators, Fourier Integral Operators, Global Analysis, Symplectic Geometry and Time-Frequency Analysis; Study of hyperbolic partial differential equations - their solvability, regularity and propagation of singularities; Microlocal analysis of satellite and medical imaging, especially SAR and CT imaging.
- **Mathematical Aspects of Image Processing**: Early detection of cardiac abnormalities and determining the fluid-tissue interaction from CT images using techniques of calculus of variations and functional analysis.
- **Mathematical Analysis**
- **Isogeny Based Cryptography Modelling**
- **Study of Curvatures of Manifold with applications to machine learning**

COMPUTER SCIENCE

- **Computer Vision and Machine Learning**: Face Recognition (FR) with particular emphasis on age invariant face recognition (AIFR) and kinship verification; automatic segmentation and detection of stones in case of Renal CT Images, automatic detection of different types of lesions that include micro-aneurysms, hemorrhages, exudates, etc.
- **Deep Learning**: Ease of training, scaling and resilience against adversarial attacks with regard to the recent and emerging DL architectures.
- **Blockchain**: To build immutable data storage and management platform in Big Data environment using Scalable Blockchain with high throughput. Study on issues of Interoperability, Fraud Free financial transactions, Comprehensive Health Insurance Management systems, Governance.
- **HPC, Big Data & AI powered solutions for problems in Actuarial Science**: To develop a framework for Fraud Detection and Prevention; Dynamic ERM Dashboard using Actuarial and ERM techniques.
- **IoT for Health Care**: To provide healthcare and wellness centers for optimizing resources with automated workflows.
- **Semi Supervised Clustering**: Use of partially labeled data along with some prior information for clustering text, image and video data.
- **Sports and Medical video/Image Analysis**

ACTUARIAL SCIENCE

- **Data Driven Fraud Detection and Prevention Models** using actuarial and data science techniques
- **Actuarial Techniques** for Building innovative Enterprise Dashboard with predictive capabilities
- **Blockchain Applications** in Health insurance product design and pricing
- **Actuarial Pricing** of Crop Insurance Revenue Protection products targeted to benefit farmers in India
- **Actuarial Investigations** into Impact Analysis of climate change on general insurance product pricing

Infrastructure

The Department of Mathematics & Computer Science (DMACS) is equipped with a good library for books, monographs and access to journals in various domains of interest in Mathematics and Computer Science.

Computing facility in DMACS supports the kind of research work in the area of Computer Vision, ML & DL, Security, HPC etc. Computing facility includes a three-node cluster, Four High end computing Nodes with Nvidia K40, TitanX and Intel MIC. The lab is also equipped for embedded processing with ARM processors and Jetson TK100. A Hadoop cluster is in place for developing applications in Hadoop and SPARK platform. The Lab for Cybersecurity is equipped with server and necessary hardware to set up Honeypots for detecting and recognizing malware. Besides this the DMACS has access to a number of supercomputing facilities in USA.

ADMISSIONS TEST SYLLABUS

Candidates seeking a Ph.D. in Mathematics

Linear Algebra: Finite dimensional vector spaces, Linear transformations and their matrix representations, rank, systems of linear equations, eigenvalues and eigenvectors, minimal polynomial, Cayley-Hamilton Theorem, diagonalization, Hermitian, Finite dimensional inner product spaces, Gram-Schmidt orthonormalization process, self-adjoint operators.

Complex Analysis: Analytic functions, conformal mappings, bilinear transformations, complex integration, Cauchy's integral theorem and formula, Liouville's theorem, maximum modulus principle, Zeros and singularities, Taylor and Laurent's series, Residue theorem.

Real Analysis: Sequences and series of functions, uniform convergence, power series, Fourier series, functions of several variables, maxima, minima; Riemann integration, multiple integrals, line, surface and volume integrals, theorems of Green, Stokes and Gauss; metric spaces, compactness, completeness, Weierstrass approximation theorem; Lebesgue measure, measurable functions; Lebesgue integral.

Ordinary Differential Equations: First order ordinary differential equations, existence and uniqueness theorems for initial value problems, systems of linear first order ordinary differential equations, linear ordinary differential equations of higher order with constant coefficients; linear second order ordinary differential equations with variable coefficients; method of Laplace transforms for solving ordinary differential equations, series solutions (power series, Frobenius method); Legendre and Bessel functions and their orthogonal properties.

Algebra: Groups, subgroups, normal subgroups, quotient groups and homomorphism theorems, automorphisms; cyclic groups and permutation groups; Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domains, Principle ideal domains, Euclidean domains, polynomial rings and irreducibility criteria.

Functional Analysis: Normed linear spaces, Banach spaces, Hahn-Banach extension theorem, open mapping and closed graph theorems, principle of uniform boundedness; Inner-product spaces, Hilbert spaces, orthonormal bases, Riesz representation theorem, bounded linear operators.

Numerical Analysis: Numerical solution of algebraic and transcendental equations; fixed point iteration; interpolation; error of polynomial interpolation; numerical differentiation; numerical integration; numerical solution of systems of linear equations: direct methods; iterative methods; numerical solution of ordinary differential equations and initial value problems.

Partial Differential Equations: Linear and quasilinear first order partial differential equations, method of characteristics; second order linear equations in two variables and their classification; Cauchy, Dirichlet and Neumann problems; solutions of Laplace, wave in two dimensional Cartesian coordinates, Separation of variables method for solving wave and diffusion equations in one space variable; Fourier transform method based solutions for the above equations.

Topology: Basic concepts of topology, bases, subbases, subspace topology, order topology, product topology, connectedness, compactness, countability and separation axioms, Urysohn's Lemma.

Graph Theory: Connectivity; spanning trees; Cut vertices & edges; covering; matching; independent sets; Colouring; Isomorphism; Depth first search and breadth first search.

Candidates seeking a Ph.D. in Computer Science

Set Theory & Algebra: Sets; Relations; Functions; Partial Orders, Groups, Boolean Algebra.

Linear Algebra: Algebra of matrices, determinants, systems of linear equations, Linear Transforms, Eigen values and Eigen vectors.

Probability: Conditional Probability; Mean, Median, Mode and Standard Deviation; Random Variables; Distributions.

Graph Theory: Connectivity; spanning trees; Cut vertices & edges; covering; matching; independent sets; Colouring; Isomorphism; Depth first search and breadth first search.

Computer Organization and Architecture: Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface (Interrupt and DMA mode), Instruction pipelining, Instruction level parallelism - hardware and software techniques (e.g., dynamic scheduling, superscalar, static and dynamic branch prediction, VLIW, loop unrolling), Cache and main memory, multi-level caches, Cache consistency, snoopy protocols, Secondary storage.

Programming and Data Structures: Functions, Recursion, Parameter passing; Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Heaps, O-O Programming Concepts: Class, object, instantiation. Inheritance, polymorphism and overloading.

Algorithms: Greedy algorithms, dynamic programming, divide-and-conquer, network flow, Notions of space and time complexity, Asymptotic analysis: Big Oh, Little oh, Theta, Worst case and average case analysis, Polynomial time algorithms, NP-algorithms, NP-hardness and NP-completeness.

Relational Database Design and SQL: E-R diagrams and their transformation to relational design, normalization-INF, 2NF, 3NF, BCNF and 4NF. Limitations of 4NF and BCNF. Good working knowledge in SQL.

Computer Networks: Network fundamentals: LAN, MAN, WAN, Wireless Networks. Reference Models: The OSI model, TCP/IP model. Data Communication: Channel capacity. Internet working: Switch/Hub, Bridge, Router, Gateways, Tunnelling, Fragmentation, Routing algorithms, Sliding window protocols, Three-way handshake, Congestion control.

System Software and Compilers: Assemblers-2-pass and single-pass. Macros and macroprocessors. Loading, linking, relocation, program relocatability. Phases of compilation process. Lexical analysis. Context free grammars. Parsing and parse trees. Representation of parse (derivation) trees as rightmost and leftmost derivations. Bottom up parsers-shift-reduce, operator precedence, and LR.

Operating Systems (with Case Study of Unix): Main functions of operating systems. Multi Programnming, multiprocessing, and multitasking. Memory Management: Virtual memory, paging, fragmentation. Concurrent Processing: Mutual exclusion. Critical regions, lock and unlock. Scheduling: CPU scheduling, I/O scheduling, Resource scheduling. Deadlock and scheduling algorithms. Banker's algorithm for deadlock handling.

Candidates seeking a Ph.D. in Actuarial Science

Numerical Analysis: Numerical solution of algebraic and transcendental equations; fixed point iteration; interpolation; numerical differentiation; numerical integration; numerical solution of systems of linear equations: direct methods; iterative methods; numerical solution of ordinary differential equations and initial value problems.

Partial Differential Equations: Linear and quasilinear first order partial differential equations, method of characteristics; second order linear equations in two variables and their classification;

Set Theory & Linear Algebra: Sets; Relations; Functions; Partial Orders, Groups, Boolean Algebra, Algebra of matrices, determinants, systems of linear equations, Linear Transforms, Eigen values and Eigen vectors.

Probability and Statistics: Conditional Probability; Mean, Median, Mode and Standard Deviation; Random Variables; Distributions; Exploratory Data Analysis, Statistical Inference; confidence intervals; Hypothesis testing; Regression Theory and applications; ANOVA

Applied Statistics: Bayesian statistics; Loss Models; Poisson Process; Time Series; Stochastic Processes; Survival Models, Fundamentals Machine Learning

Physics

AREAS OF DOCTORAL RESEARCH
Available for 2020 entry

Applicants should enter a **maximum of three preferred areas of research** on the application form (in the order of preference) from the choices below.

For Women

- **Material Science:** Synthesis of ferroelectric materials for solar cell applications
- **Material Science:** Synthesis and characterization of novel ferroelectric materials for solar cell applications

For Men

- **Glasses, Glass-Ceramics, and Soft Materials:** Glasses are amorphous materials which does not possess long range structural order and find wide range of applications in various fields. Glass-ceramics are partially crystallized glasses that have combination of properties to that of crystal and glass. Our research is focused on understanding their structure-property correlations and developing new glasses and glass-ceramics for sensor and biomedical applications. Soft materials are intermediate to solids and liquids which are made by dispersing colloidal particles, polymers etc., in suitable solvents. They are highly deformable to small applied mechanical fields. Our research on soft materials is focused on understanding the effect of external fields such as electric field on rheological behaviour of complex fluids towards developing smart materials.
- **Piezotronic Device:** Fabrication of novel Pieozelectric (Ultrasonics) materials for Biomedical and Defense applications
- **Nonlinear Optical Spectroscopy and Devices**:
  a) Fabricating and testing Nanomaterials/NanoCarbons for nonlinear optical applications
  b) Fabricating Electro-optic modulators with novel functional materials
- **Applied Optics & Spectroscopy**:
  a) Optical and Vibrational spectroscopy for inspecting Phase transformation and structure property correlation of technological important materials supllemented with Computational modelling of Materials property
  b) Biophotonics- Building Portable Optical and Imaging device for Clinical Pathological and Agricultural applications- It involves Computational Design evolution and developing laboratory prototye for validation
- **Nuclear Spectroscopy and level structure studies:** To investigate the nuclear structures of doubly odd nuclei in the deformed region both- rare earth and heavy actinides, by employing semi-empirical models and experimental methods. The research will investigate the low lying level structures of some of the nuclei thereby studying the as yet unidentified isomeric states in these nuclei.
- **Smart materials for energy and sensors:**
  a)Fabrication and characterization of solid-electolytes for Li/Na-ion batteries
  b) Fabrication and study of Lead-free piezoelectric materials for green energy harvesting and sensor application
- **Femtosecond laser Nano-Micro structuring of Glasses:** Femtosecond laser micromachining of doped glasses for controlled nanostrucutring/ microstructuring for Photonic applications
- **Medical Nucler Imaging GAMMA CAMERA**
- **Computational Physics**

Infrastructure

With the support of funded projects from various funding agencies like UGC, MHRD, DST, DAE-BRNS, DRDO and along with the support from our parent organization, Sri Sathya Sai Central Trust, the Department of Physics houses state-of-the-art facilities, including:

Nd:YAG Laser with Harmonics generators, Sources and Detectors; Fusion splicer, High Bandwidth Digital Oscilloscope, Optical Energy/Power meters, UV-Visible spectrophotometer; Planetary Ball Mill, Harman system for Thermoelectric Figure of Merit measurement, Modular Raman Spectrometer; Spin coating unit for Thin Films Fabrication, Solvo/Hydrothermal Reactor, High Temperature Furnaces and Ovens; Radiation survey meters, Scintillation detectors, Semi-conductor detectors HPGe and Si(Li), NIM - Nuclear Instrumentation Modules, Turbo-molecular pump.

The above facilities are in addition to the Central facilities available at SSSIHL Central Research Instruments Facility (CRIF).

ADMISSIONS TEST SYLLABUS

Candidates with a Masters (M.Sc.) degree in Physics, Photonics and Nuclear Physics

Mathematical Methods of Physics
Vector algebra and vector calculus; Linear algebra, matrices, eigenvalues and eigenvectors; ordinary differential equations of first & second order; Fourier transforms; Elements of complex analysis.

Electromagnetism
Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; Electromagnetic waves in free space.

Quantum Mechanics
Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box, harmonic oscillator, etc.). Commutator and Heisenberg uncertainty principle; orbital angular momentum, angular momentum algebra, spin, addition of angular momenta; Hydrogen atom;

Thermodynamic and Statistical Physics
Laws of thermodynamics and their consequences. Thermodynamic potentials, Maxwell relations, chemical potential, phase space, micro- and macro-states. Micro-canonical, canonical and grand-canonical ensembles and partition functions;

Electronics
Pn Junction diodes, transistors, Operational amplifiers and their applications. Digital Electronics: Logic Gates, Flip flops and applications.

Atomic & Molecular Physics
LS & JJ coupling schemes. Zeeman effect, Born-Oppenheimer approximation. Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Lasers: spontaneous and stimulated emission, population inversion; laser characteristics;

Solid State Physics
Bravais lattices. Reciprocal lattice. X-ray diffraction and the structure factor, bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power; band theory of solids: metals, insulators and semiconductors; magnetism- dia, para, ferro and ferri-magnetism; dielectric and ferroelectric properties.

Nuclear Physics
Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, Evidence of shell structure, single-particle shell model, elementary ideas of alpha, beta and gamma decays and their selection rules.

Candidates with an M.Sc. in Physics, Chemistry, Materials Science, Nanoscience & Nanotechnology, or an M.Tech. in Materials Science & Engineering, Materials & Metallurgical Engineering, Nanotechnology, Materials or Ceramic Engineering

Mathematical Methods
Differentiation, integration, differential equations, vectors, matrices and determinants, eigenvalues and eigenvectors, complex numbers;

Quantum Mechanics
Wave-particle duality, Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box, harmonic oscillator, etc.);

Solid State Physics
Crystal symmetry, indices of planes, close packing in solids, types of crystal structures, coordination, radius ratios concepts, X-ray diffraction technique, indexing of diffraction patterns; Defects in Solids: Point defects, dislocations (edge and screw) Burgers vector- grain boundaries; Physical properties of materials - specific heat, thermal conductivity, electrical conductivity, dia, para, ferro and ferri-magnetism; dielectric behavior – piezo and ferro-electric materials, elements of band theory, semiconductors, Hall effect, optical properties. Mechanical properties, elements of elastic and plastic behavior of materials, stress-strain relations;

Thermodynamics
Thermodynamic potentials, Maxwell relations, chemical potential, phase rule, phase diagrams, solid solution, lever rule; iron-carbon phase diagram, solidification, phase transformation, recrystallization, diffusion, mechanisms of diffusion;

Spectroscopic Techniques
UV-Vis, IR and Raman Spectroscopy; Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules.

Synthesis of Materials
Soft chemistry routes: solvothermal/hydrothermal method, sol-gel method; methods of preparing single crystals; physical and chemical vapor deposition.

Chemistry

AREAS OF DOCTORAL RESEARCH
Available for 2020 entry

Applicants should enter a **maximum of three preferred areas of research** on the application form (in the order of preference) from the choices below.

For Women

> **Waste Water Technology**

> **Environmental Analytical Chemistry**

Water treatment: Fluoride sensors and defluoridation of water using novel adsorbents
Remediation techniques for metal ion contamination
Design and development of functionalized Graphene oxide for oil speed removal and organic dye removal

For MEN

> **Physical and Analytical Chemistry**

Fluoride sensor and defluoridation of water with novel hydroxyapatite composites.
Ultrafast Spectroscopic Studies of Organic Semiconductors and other Organic fluorophores

> **Inorganic and Materials Chemistry**

Bio-processing and Renewable energy - biofuels, carbon dots, supercapacitors
Biomaterials - bone composites and bone glue
Fabrication of Organic Light Emitting Diodes and Organic Solar Cells

> **Theoretical and Computational chemistry**

Computer Aided Drug Design (CADD) - Molecular modelling, DFT calculations
Computational Material science and computational analytical chemistry
Theoretical study of organic reactions, reaction intermediates / transition state and reaction mechanisms using computational methods

> **Organic and Bioorganic Chemistry**

Natural Products - Identification of Bio-active secondary metabolites
Semi-Synthesis of Medicinally active compounds.
Synthetic Organic Chemistry Synthesis of Organic Compounds with potential Non-linear Optical properties and Pharmacological activity (Pharmacological activities include anti-cancer, antimalarial, anti-inflammatory and anti-bacterial activities); Drug design

> **Environmental Analytical Chemistry**

Metal ion sensing using novel chromophores
Remediation techniques for metal contamination

Air pollutants in Bengaluru and its impact on health

Infrastructure

Gas Chromatography- Mass Spectrometer (GC-MS),
Gas Chromatography with ECD detector (GC-ECD for pesticide residue analysis),
High-Pressure Liquid Chromatography system (with DAD and RI Detectors),
Microwave Reactor,
Uv-Vis Spectrophotometers
FT-IR Spectrometer with ATR
Fluorescence Spectrophotometer
Atomic Absorption Spectrometer
Ion Chromatography System
Differential Scanning Calorimeter (DSC),
Electrochemical Workstation (potentiostat/galvanostat)
Flash Chromatography System.

Wet labs are equipped with minor equipment required for carrying out research work.

ADMISSIONS TEST SYLLABUS

Analytical Chemistry
Instrumental: UV-visible spectrophotometry, NMR and ESR spectroscopy, mass spectrometry. Chromatography including GC and HPLC.
Spectroscopy: Applications of UV-visible, IR, NMR and Mass spectrometry in the structural determination of organic molecules.

Physical Chemistry
Quantum chemistry: Postulates of quantum mechanics, application of Schrodinger's equation to the particle in a one dimensional box, rigid rotator, harmonic oscillator; Group theory: symmetry elements and operations, classification of molecules into different point groups; Statistical thermodynamics, thermodynamic functions in terms of the partition functions; Electrochemistry: Debye-Huckel Onsager equation (derivation), Butler-Volmer equation (derivation);

Chemical Kinetics: CTST, unimolecular gas phase reactions, complex reactions; Fast reaction kinetics: relaxation method and flash photolysis; Langmuir and BET adsorption isotherms; Electrical double layer and zeta potential.

Inorganic Chemistry

Chemical periodicity; Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory); Concepts of acids and bases: Hard-Soft acid base concept, Non-aqueous solvents; Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds; Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms; Organometallic compounds: synthesis, bonding and structure, and reactivity; Organometallics in homogeneous catalysis;.

Solid State: Crystal systems and lattices, Miller planes, crystal packing, crystal defects, Bragg's law, ionic crystals, band theory of metals and semiconductors.

Organic Chemistry

Stereochemistry: Chirality of organic molecules with chiral centers and determination of their absolute configurations. Geometrical isomerism.

Reaction Mechanisms: Basic mechanistic concepts - Nucleophilic and electrophilic substitution reactions (both aromatic and aliphatic). Addition reactions to carbon-carbon and carbon-heteroatom (N, O) multiple bonds. Elimination reactions. Reactive intermediates - carbocations, carbanions, carbenes, arynes and free radicals. Molecular rearrangements involving electron deficient atoms.

Organic Synthesis: Synthesis, reactions, mechanisms and selectivity involving the following classes of compounds - alkanes, alkenes, alkynes, arenes, alcohols, phenols, aldehydes, ketones, carboxylic acids, esters, nitriles, halides, nitro compounds, amines and amides. Uses of Mg, and Li based reagents in organic synthesis. Michael addition reaction.

Pericyclic Reactions: Electrocyclic, cycloaddition and sigmatropic reactions.

Heterocyclic Compounds: Structure, preparation, properties and reactions of furan, pyrrole, thiophene and pyridine, indole, quinoline and isoquinoline.

Note: Questions will cover areas in different branches like M.Sc. (Inorganic Chemistry), M.Sc. (Physical Chemistry), M.Sc. (Organic Chemistry) and M.Sc. (Analytical Chemistry)

Biosciences

AREAS OF DOCTORAL RESEARCH
Available for 2020 entry

Applicants should enter a **maximum of three preferred areas of research** on the application form (in the order of preference) from the choices below.

For Women

- **Neurodegenerative Diseases**: Understanding molecular mechanisms associated with inherited neurodegenerative diseases and possible prevention measures.
- **Obesity and Diabetes**: Studying key biochemical pathways to understand obesity associated metabolic abnormalities.
- **Substrate specificity of Enzymes**: To investigate and possibly identify key amino acid residues of specific study enzymes responsible for their dual specificity.

For Men

- **Disease Biology (Glaucoma and Rheumatology:** Clinical and animal model-based studies to gain insights into signaling pathways leading to onset of Glaucoma and Rheumatic diseases.
- **Protein Structure and Function**: Structural and functional characterization of novel proteins employing wet lab experimentation and computational techniques.
- **Secondary Metabolites and Fungal Biotechnology**: 1) Biogenic synthesis of metal and metal oxide nanoparticles from endemic micro fungi; and its applications;
  2) Mycoremediation, decolourisation and detoxification of significant dyes and pollutants; 3) Study of the waste water microbes for waste water treatment and their potential use in medical applications.
- **Microbial Genomics and Antibiotic Resistance**: Understanding mechanisms involved in the emergence of antimicrobial resistance among clinically isolated bacterial pathogens.

Infrastructure

In addition to the common facilities at the Central Research Instruments Facility (CRIF), the department hosts the following facilities/ laboratories for research:

Mycology and Plant pathology; Plant tissue culture; Animal cell culture; Wastewater analysis; Structural biology; Antimicrobial resistance lab, Bioinformatics.

Research equipment housed in the department include:

PCR Thermal cycler, Real time PCR, UV-VIS Spectrophotometers, Ultracentrifuge, UV-Vis, fluorescence and Fourier Transform Infra-Red (FTIR) spectrophotometers, Multimode microplate reader, Chemi-doc documentation system, Fast Protein Liquid Chromatography (FPLC), Nanodrop, Qubit, Nikon fluorescence microscope, Hypoxia incubator, CO2 incubators, Luminometer, FACS analyzer, Biosafety cabinets (Class II-A2), Lyophilizer, Ultra deep freezers (-150°C and -80°C), Incubators, Humidity chambers, Orbital shakers, and Ice flaker.

ADMISSIONS TEST SYLLABUS

Molecular Cell Biology
Organization of prokaryotic and eukaryotic cells, Cell wall and membrane, Major cell organelles, Membrane transport, Cell junctions, Cell adhesion and Extra-cellular matrix, Cellular communication and signalling pathways, Cell cycle and Cell division, Cell death.

Molecular Biology and Genetic Engineering
Genome organization in prokaryotes and eukaryotes, DNA replication, Transcription, Protein synthesis, Regulation of gene expression in prokaryotes and eukaryotes, DNA repair and damage, Oncogenes and cancer, Molecular cloning strategies, Transgenic plants and animals, Gene therapy.

Biological Chemistry
Structure, function and metabolism of carbohydrates, proteins, lipids and nucleic acids, Enzyme kinetics and regulation of enzyme activity, Electron transport chain and oxidative phosphorylation.

Immunology
Cells and organs of immune system, Antigens, Structure and function of immunoglobulins, Major Histocompatibility Complexes, Humoral immune response, Cell mediated immunity, Hypersensitive reactions, Autoimmunity.

Developmental Biology
Gametogenesis, Fertilization, Cleavage - Blastulation, Gastrulation and Neurulation, Proximate tissue interactions, Genetics of axis specification in Drosophila, Stem cells and their applications.

Microbiology
Bacterial structure and function, Bacterial growth and metabolism, Microbial Recombination, Conjugation, Transformation, Transduction and Transposition, Structure of viruses, Viral replication strategies.

Physiology
Plant: Overview of photosynthesis and respiration, Mineral nutrition and water uptake, Plant hormones

Animal: Respiratory system, Circulatory system, Excretory system, Nervous system, Endocrine system, Muscle physiology.

Genetics
Mendelian genetics, Pedigree analysis, Hardy-Weinberg law, Human pedigree analysis and patterns of autosomal and sex-linked inheritance, Variations in chromosome structure and number

Biotechnology
Applications of fungi in biotechnology, Plant tissue culture and micropropagation, Production of secondary metabolites from microbes and plants, Biomineralization, Biotechnological approaches for pollution control, Intellectual Property Rights and patenting of biological materials.

Biostatistics
Measures of central tendency, Measures of dispersion, Statistical hypothesis testing, Analysis of variance, Chi-square analysis, Correlation analysis.

Food & Nutritional Sciences

AREAS OF DOCTORAL RESEARCH
Available for 2020 entry

Applicants should enter a **maximum of three preferred areas of research** on the application form (in the order of preference) from the choices below.

FOR WOMEN

- **Functional foods for diabetes and bone health**
- **Nutritional epidemiology**
- **Women health and child nutrition**
- **Metabolite profiling of novel and indigenous food crops**
- **Ayurvedic nutrition and ayurceuticals**
- **Fruit and vegetable processing and preservation**
- **Postharvest and bio-based packaging technology**
- **Development of functional dairy products**
- **Food choice and consumer behaviour**
- **Food chemistry: Nutritional profiling of food materials**
- **Value added millet-based technologies**
- **Food Material Science**
- **Food Safety**

The Department a offers a Ph.D. program covering basic and applied areas in Nutrition, Food Science and Food Technology with an interdisciplinary approach.

The programme provides adequate framework for preparing researchers and professionals in their areas of specialization. It will train researchers to understand the interrelationship between food and nutrition, and health and disease and help identify and solve problems of public health importance in human nutrition. It will also assist in carrying out research projects in the basic scientific field as well as innovative technological development of improved food processes and products.

Infrastructure

The department is equipped with the following laboratories to undertake a wide range of analysis and research activities:

Community Nutrition Laboratory,
Experimental and Clinical Nutrition Laboratory,
Food Chemistry Laboratory,
Food Processing and Technology Laboratories,
Food Quality Control and Food Microbiology Laboratory,
Food Science and Culinary Science Laboratory,
Nutritional Biochemistry and Human Physiology Laboratory.

Major Research equipment includes:
Bench Top High Speed Centrifuge,
Blood Analyzer,
Brookefield Viscometer,
Double Beam UV-Vis Spectrophotometer,
Kjeltron - Automated Protein Digestion and Distillation Unit,
Lovibond Tintometer,
Lyophilizer,
Orion Fluoride Tracer,
Solar Drier,
Soxtron - Automated Fat Extracting Equipment,
Thermo Scientific Varioskan Lux (Multi-functional mode reader),
Water Activity Meter.

ADMISSIONS TEST SYLLABUS

Nutrition and Dietetics
Functions, requirements, deficiency and excesses of different nutrients. Impact of good nutrition on the outcome of pregnancy. Meal pattern and nutritional requirements of different age groups in the life cycle. Diet during pregnancy and lactation. Breast feeding vs. artificial feeding. Nutritional problems of pre-schoolers. Meaning, purpose and principle of therapeutic diet. Diet for under nutrition and anaemia. Etiology, pathology, metabolic changes, clinical manifestations and dietary management of the following diseases: gastritis, constipation, diarrhoea, liver and gall bladder disorders, renal disorders, cardiovascular disorders, metabolic disorders - obesity, gout, diabetes mellitus, and inborn errors of metabolism.

Public Nutrition
Nutrition, immunity and infection – mechanism of interaction, agent, host environment in disease occurrence, meaning of epidemiology. Meaning of community, community nutrition, vital statistics. Assessment of nutritional status. Malnutrition – causes, measures to combat malnutrition: different intervention programs. General idea of nutrition education, program planning, nutrition surveillance and monitoring.

Food Science and Chemistry
Basic concepts in food science. Principles of food processing and preservation. Preservation techniques- Thermal and non-thermal. Properties and changes during processing of carbohydrates, proteins and fats. Food flavours and pigments. Colloids and emulsions.

Food Safety and Quality
Principles of food safety and hygiene. Food adulteration, food contamination and food borne diseases. International and national food standards & laws. Quality control - HACCP. Sensory evaluation and product development. Food Packaging - Types and properties of packaging materials and methods of packaging of foods. Techniques of food analysis.

Nutritional Biochemistry and Physiology
Structure and functions of DNA & RNA, DNA replication and transcription, protein synthesis. Fatty acid metabolism, Cholesterol biosynthesis and its regulation. Energy metabolism - Concept and regulation, components of energy balance. Metabolism of carbohydrates and its regulation. Digestive system, composition, functions and secretion of digestive juices, Digestion and absorption of different nutrients. Role of liver, gall bladder, pancreas with reference to digestion and absorption, neuroendocrine control of hunger, appetite and obesity. Phytochemicals in the prevention and treatment of diseases.

Recent concepts in Nutrition and Food Science
Nutrigenomics; Neutraceuticals; Functional foods; Probiotics & prebiotics; Genetically modified foods; Organic foods; Biopolymers for packaging; Bio based preservation methods; Salt, sugar & fat substitutes.

Management & Commerce

AREAS OF DOCTORAL RESEARCH
Available for 2020 entry

Applicants should enter a **maximum of three preferred areas of research** on the application form (in the order of preference) from the choices below.

FOR WOMEN

- **Spirituality at the workplace**
- **Values based Management**
- **Gender in Business**
- **Rural Management**
- **Human Resources Management**

ADMISSIONS TEST SYLLABUS

Self-Development
Self: Self-Concept, Personality, Values & Emotions, Behaviour, Transactional Analysis, Assertiveness Training; Conflict - Inter Personal Conflict Management.

Values-Based Management
Planning, Organising, Controlling, Change Management and Innovation, Motivation Theories and Indian Insights to Motivation

Marketing Management
Core marketing concepts, Consumer Buying Behaviour, Market Segmentation, Digital Marketing, Product Life Cycle Strategies, Innovation and New Product development, Marketing Services, Pricing, Marketing Channels, Marketing Communication process.

Financial Management
The goal of financial management, Decisions in financial management, Time value of money and Valuation of securities, Investment decisions- Capital Budgeting, Calculating average return and risk, Efficient market hypothesis and its forms, Capital structure and cost of capital, Short term financing decisions.

Statistics for Business Management
Descriptive statistics, Probability and Decision Theory, Probability Distributions, Inferential statistics, Analysis of Variance, Non-Parametric Methods, Simple Correlation and Regression.

Human Resource Management
Changing nature of Human Resource Management, Human Resource Planning, Job Analysis and Job Design, Selection and Recruitment, Training and Development, Performance Appraisal, Compensation Management, Quality of Work Life.

Management Accounting
Analysis of financial statements, Cash flow statement, Cost Volume Profit analysis and decision making, Budgets and Budgetary control, Standard costing.

Services Operations Management
Operations strategy and Competitiveness, Service Quality, Demand forecasting, Managing Capacity and Demand, Managing Waiting Lines, Inventory Management, Supply chain management.

Management Science
Linear Programming Problems - Formulation of Linear Programming Problems, Graphical solutions, Simplex Algorithm, Industrial Applications of LPP, Transportation and Assignment models, Network Analysis using PERT and CPM.

Economics

AREAS OF DOCTORAL RESEARCH
Available for 2020 entry

Applicants should enter a **maximum of three preferred areas of research** on the application form (in the order of preference) from the choices below.

FOR WOMEN

- **Financial Inclusion**
- **Women Empowerment**

FOR MEN

- **Macroeconometric Modelling**
- **Modeling Financial Economics**
- **Macroeconomics**
- **International Economics and Finance**
- **Monetary Economics**
- **Financial Inclusion**

ADMISSIONS TEST SYLLABUS

Microeconomics
Consumer theory and Behaviour, Theory of Production and Cost, Market Structures, perfect and imperfect markets, Elements of Welfare Economics, General equilibrium.

Macroeconomics
Measurement of National Income, Classical theory of Employment, Income, Expenditure Model -Money and Goods market, Consumption and Investment, Business cycles, Macroeconomic Dynamics, Policy Implications.

Quantitative Methods
Sets and Functions, Differential Calculus of one variable and several variables, Economic applications of derivatives, Optimization, with and without constraints, Difference and differential equations of first order, Matrices, Operations on matrices, inverse of a matrix- probability, expectation and variance, Probability distributions, Binomial, Poisson, Normal.

Development Economics
Economic Growth and Economic Development, Theories of Economic Growth and Development Neoclassical and endogenous growth models, Inclusive Growth, Human Development, Rural Development.

Public Economics and Fiscal Policy
Public Finance, Principles of Taxation and Resource Allocation, Public Expenditure -Fiscal Functions and Theory of Public goods Fiscal Policy and the Budget, Federal Finance in India, Cost, Benefit Analysis

Indian Economy
Structure of the Indian Economy, Agriculture, Industrial and Tertiary Sectors, Role of government, Services and Trade, New Economic Policy, Contemporary Issues, Future Scenario.

Econometrics
Elements of statistical Inference, Theory of Estimation (OLS and MLE), Testing of Hypothesis (t, Chi square and F tests) - Multiple regression models, Multicollinearity, Heteroscedasticity, Autocorrelation, Dummy variables.

Financial Economics
Introduction to Financial system, Financial Markets and Institutions, Finance and Economic Development, Financial Reforms in India, Investment Environment, Risk Management.

International Economics and Finance
International trade theory, Economic integration, Balance of Payments, Exchange rates and Foreign exchange markets, International monetary system.

English Language & Literature

AREAS OF DOCTORAL RESEARCH
Available for 2020 entry

Applicants should enter a **maximum of three preferred areas of research** on the application form (in the order of preference) from the choices below.

FOR WOMEN

Literary Studies

- **Modern and Postmodern British Literature**
- **Postcolonial Studies**
- **Indian Writing in English**
- **American Literature**
- **Witness Literature**
- **Comparative Literature**
- **European Classics**

Language Studies

- **ELT- English Language Teaching**
- **Media Writing**
- **ICT in TESoL (Use of technology in Teaching of English as a Second Language)**
- **Language Laboratories**

The Department of English Language and Literature at SSSIHL is committed to achieving excellence in research, and employs eclectic methods to both analyse and synthesise. With its creative, supportive and collaborative research ambience, the scholars in the department are encouraged to generate fresh ideas which are debated and ratified.

Research in both language and literature offer new modules and fresh perspectives that contribute notably to the fund of knowledge. The department uses the literary text as a pretext to unravel the deeper mysteries and meanings of the human condition and predicament; and relates 'art experiences' to 'life experiences'. It also helps draw from the exercise, valuable moral lessons that would help the scholars to become morally empowered individuals.

While the literary researches bring in fresh perspectives, the language researches give value-addition to the existing practices. Weekly departmental colloquia, very regular interactions between scholars and supervisors, and insistence on quality research enhances the academic climate which promotes worthwhile research.

ADMISSIONS TEST SYLLABUS

Ph.D. in English Literature*
British Literature: Chaucer until the Twentieth Century: Prose, Poetry, Drama, Novel
Commonwealth Literature, Indian Writing in English, American Literature, Literary Criticism, Comparative Literature.

Ph.D. in English Language*
Linguistics and Phonetics, Modern English Grammar, English for the Media, Teaching of English as a Second Language.

* Based on the Syllabus for M.A. in English Language & Literature at SSSIHL.

Education

AREAS OF DOCTORAL RESEARCH
Available for 2020 entry

Applicants should enter on the application form their choices from the two options below (in the order of preference).

FOR WOMEN

Literary Studies

- **Pedagogy and Assessment**
- **Technology in/for Education**

ADMISSIONS TEST SYLLABUS

Pedagogy and Assessment
Methods & Techniques of teaching- Principles and maxims of teaching - NCF-2005- Bloom's Taxonomy of Educational objectives (revised)- organising teaching: memory level (Herbartian model), understanding level (Morrison teaching model) Reflective
Models of Teaching- Principles and Maxims of teaching and learning
Assessment for learning and Assessment of learning – Types of Assessment (placement, formative, summative, diagnostic)
Relation between objectives and outcomes- Assessment of cognitive, affective and psychomotor domains of learning
feedback devices – types- criteria- guidance as a feedback - qualitative and quantitative tools.
standardization of a tool- Item Analysis - characterstics of a good measuring instrument

Technology in/for Education
Educational Technology as a discipline- Technology of Education & Technology in Education, concept of IT, ICT, Applications of Educational Technology in formal, ODL & inclusive education.
Overview of Behaviorist, cognitive and Constructivist theories and their implications to Instructional design
Communication – ICT& Instructional technology -plagiarism- constructivism- 5 E's of constructivism
Applications of Computers in Education- CAI,CAL,CBT,CML, OER
e-learning- approaches to e-learning – Blended learning- M-learning
NMEICT - use of ICT in Evaluation.

Who is a Ph.D.?

A Ph.D. is one who helps others through his research and develops the country. This is the true objective of doing a Ph.D.

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