# Shambhavi Singh

4th Year Undergraduate
Department of Mathematics and Statistics

E-mail: shambhav@iitk.ac.in
Contact: +91-7754856783

## EDUCATION

**Indian Institute of Technology, Kanpur**   *2013-Present*
*B.S. in **Mathematics & Scientific Computing***

- Cumulative Performance Index (CPI) of **8.9** (on a scale of 10)

**Gyan Bharati School, Saket**
*All India Senior Secondary Certificate Examination (AISSCE)*   *2013*

- Scored **93.6%** marks in AISSCE

*All India Senior Certificate Examination (AISCE)*   *2011*

- Scored a CGPA of **9** (on a scale of 10) in AISCE

## MAJOR SCHOLASTIC ACHIEVEMENTS

- Selected by **MITACS** from among 10000 students for a Research Internship in Canada
- Selected for an 8-week **Research Internship** at ISI, Bangalore by the Indian Academy of Sciences in 2015
- Received **Academic Excellence Award** for distinctive performance in the term 2013-14 awarded to **top 7%** students in the institute
- Awarded **Outstanding Freshman** of the year 2013 by the Student Gymkhana, IIT Kanpur for all-round performance
- Secure **All India Rank 1995** amongst 126,749 students in **JEE Advanced** 2013
- Amongst **top 1%** out of 1.4 million students who appeared for **JEE Mains** 2013
- Awarded the **Inspire Scholarship** for securing rank under 10000 in JEE
- Awarded **Outstanding All Round Performance Award** for the years 2002, '03, '04 & '07 in Gyan Bharati School

## RESEARCH INTERESTS

Operator Theory, Functional Analysis, Topology

## KEY ACADEMIC PROJECTS

**COMPUTER AIDED CONVEX ANALYSIS**   *May 2016- Jul 2016*
**Mentor: Yves Lucet, University of British Columbia, Okanagan**

- Worked on the Computational Convex Analysis Toolbox of SciLab, in an attempt to expand the functions
- Used the pre-existing functions on the piecewise linear quadratic functions (plq) to create a user interface
- Designed User Interface to help eased graphical input of a PLQ function in one variable along with a brief overview of the different envelopes and duals of the function, such as Moreau Envelope, Legendre Fenchel Transform
- Incorporated Data Structure suggested in a previous thesis for storing Piecewise Linear Quadratic functions in 2 variables to attempt construction of a similar user interface in 2D

**ANALYTICAL APPROACH TO NUMBER THEORY**   *Jan 2016- Apr 2016*
**Mentor: Somnath Jha, Indian Institute of Technology, Kanpur**

- Reviewed literature on Analytical Number Theory by Tom M Apostol
- Studied elementary analytic functions and the the proof of the divergence of the sum of 1/p where p is a prime
- Covered Dirichlet's Theorem on Primes in an Arithmetic Progression using Dirichlet characters and L series near 1
- Discovered consequences of the same- such as the uniform distribution of primes in the classes of mod n
- Studied a few properties of the Riemann Zeta functions and Dirichlet L series to be used to prove the prime number theorem

**RESEARCH ON OPERATOR THEORY**                                             *May 2015- Jul 2015*
**Mentor: Professor B.V Rajarama Bhat, Indian Statistical Institute, Bangalore**

- Applied Spectral Theorem and Jordan Canonical Transformations to come up with an expression for the $n^{th}$ term of a recurrence relation.
- Covered cases in 2 and 3 term relations (for different eigenvalue cases)
- Generalized same-eigenvalue case for r term recurrence relation
- Discovered alternate ways to compute power of matrices (inverse of (I-tA) method)
- Reviewed literature on Integrators of matrices and proved nilpotency of an operator
- Attempted finding invariant subspaces of the given space for the operator

**SIMULTANEOUS TRIANGULARIZATION**                                          *Jul 2015- Nov 2015*
**Mentor: Dr. Sasmita Patnaik, Indian Institute of Technology, Kanpur**

- Conducted Literature Review on Simultaneously Triangularizable Operators, its consequences on Algebras and Radicals by thoroughly going through relevant Lemmas and Theorems
- Goal is to realize the applications of Simultaneous Triangularizability

## RELEVANT COURSES

| | |
|---|---|
| Linear Algebra and Differential calculus | Topics in Topology (Knot Theory) (#) |
| Abstract Algebra | Hyperbolic Geometry (#) |
| Algebra-II | |
| | Ordinary Differential Equations |
| Introduction to Mathematical Analysis | Partial Differential Equations (#) |
| Real Analysis | Several Variable Calculus and Differential Geometry |
| Complex Analysis | |
| Analysis-II | Introduction to Computing |
| Functional Analysis (*) | Data Structures and Algorithms |
| Operator Theory (#) | Mathematical Logic |
| Introduction to Fourier Series (*) | Theory of Computation (*) |
| | |
| Topology | Probability and Statistics |
| Algebraic Topology (*) | Principles of Numerical Computations |

*# - Courses to be done next semester * - Ongoing Courses*

## TECHNICAL SKILLS

- **Programming Languages**: C, C++, HTML
- **Other Tools**: LaTeX, SciLab
- **Miscellaneous Software**: Adobe Photoshop, Adobe Premier Pro, NI Massive, Ableton Live
- **Operating Systems**: Windows

## OTHER KEY PROJECTS

**FIRST-AID GUIDE APPLICATION FOR WINDOWS 8 PLATFORM**                       *Jan 2014*
**Microsoft Code.Fun.Do '14**

- Led a team of **6 members** and designed an **app** informing the user of information, symptoms and concerned first-aid for several ailments using **C# programming** in
- Included **search feature for quick access.** Awarded c**ertificate of appreciation** for designing the app

**LIBRARY BOOKS DATABASE**                                                  *2013-14*
**Gyan Bharati School**

- Designed a programme that created a database for storing the books in a library and displayed their status (Issued/Available)  using C++ in a team of 4

## EXTRA-CURRICULAR ACTIVITIES

### Sports
- Achievements
    - Won **Gold Medal with a new record** in 4*100m relay in Inter IIT Sports Meet 2014
    - Won **Silver medal** in 4*400m relay in Inter IIT Sports Meet 2014
    - Won **Bronze Medal** in 800m in Udghosh 2014, the inter-college sports festival of IIT Kanpur
    - Won **Gold Medals** in 4*100m relay and 4*400m relay in Udghosh 2014 as well as Udghosh 2015
    - Secured **First position in Duathlon** in 2014
- Contributor to the **IIT Kanpur Sports Blog**

### Active member of the Music Club:
- **1st Runners-up** in '**Junoon**' during Antaragni '16- a competition held among eastern music bands of the country
- Participated and helped in conduction **Musical Extravaganza** '14 (Feb and Nov), '15 (Mar and Oct), '16(Mar and Oct) and **Acoustic Night** '15 and '16 (Jan)- events organized by the Music Club every year
- Performed songs along with other club members during **Orientation Programme** of the 2014 and 2015 batch, **Founder's day,** 35th Reunion (Class of 1980) and National Holidays (Republic Day and Independence Day)
- Represented IIT Kanpur in '**Unplugged**' during Antaragni '14 & '15- an acoustic music competition among colleges
- Used software like Massive and Ableton to synthesize sounds on the computer

### Technical Events
- Competed in **IOPC** during Tekhkriti '14 against international teams & secured a position in the **top 200**
- Designed a **Windows 8 app** in **Code.Fun.Do** '14 organized by Microsoft. Awarded a **certificate of appreciation**

## POSITIONS OF RESPONSIBILITY

### Vice-Captain, Girl's Athletics Team                                              *2014-2016*
- Responsible for managing a team of 40+ members
- Assisted the organization of Athletics events in Udghosh'13 & '14- the inter college sports festival of IIT Kanpur
- Won overall championship (Men) and (Women) in Udghosh '13 & '14 and Inter-IIT '13 & '14

### Coordinator, Music Club                                              *2015-2016*
- Responsible for managing the finances of the club and assisting smooth functioning of club
- Helped organize workshops for beginners to learn music
- Conducted Musical Extravaganzas and helped smooth conduction of Music Events in Antaragni

### Academic Mentor (Introduction to Computing)                                              *2014-2015*
- Assigned the responsibility of tutoring academically deficient students by the Counselling Service, IIT Kanpur
- Organized sessions for students to clear their doubts in the assigned subject (Fundamentals of computing)
- Ensured access to study material for students by regularly providing sources and previous years' material

## ACADEMIC REFERENCES

Dr. Yves Lucet  
Professor  
Computer Science  
UBC Okanagan  
yves.lucet@ubc.ca

Dr. Sasmita Patnaik  
Assistant Professor  
Department of Mathematics and Statistics  
Indian Institute of Technology Kanpur  
sasmita@iitk.ac.in