Personal details

Personal details

First / given name	Harpreet
Second given name	
Third given name	
Surname/family name	Singh
Date of birth	21 December 2000
Preferred first/given name	Harpreet
Previous surname	
Country of birth	India
Legal nationality	Indian
Dual nationality	
Country of residence	India
Have you previously studied with us at the University of Bristol?	No

Contact details

Home address

Please provide your permanent residential address. If you have another address and would prefer for us to contact you at that address instead you have the opportunity to add a correspondence address in the next section.

Country	India
Postcode	148026
Address Line 1	Vpo Kakra, Bhawanigarh
Address Line 2	Sangrur, Punjab(148026), India
City	Bhawanigarh
County	India
Telephone	

If you would like us to send any postal correspondence to an address which is not your home address please enter an alternative address here. If you want us to send correspondence to your home address then please select No.

Do you want to add a correspondence address?	Yes
Country	India
Postcode	140306
Address Line 1	H4 323, Iiser, Mohali, Sec. 81
Address Line 2	Sas Nagar, Po Manauli(140306)
City	Sas Nagar
County	India
Telephone	

Agent

Agent details

Agency Name	
Email address	

Additional Documents

Please upload required documents as outlined in your admissions statement

Mode of study

How would like to study this programme? Full Time

Qualifications

Institution	Qualification	Type	Subject	Actual/predicted	Grade	Start date	End date
Indian Institute of Science Education & Research (IISER) Mohali	Other Qual	Academic Qualification	Mathematics	Predicted	8 CPI	01/Jan/2021	16/May/2025

If these qualifications have altered since your last application please note the changes in the free text box here.

English Language

Is English your first language?	No
What is your first language?	Punjabi
Did you study at school/university where you were taught in English?	Yes
For how many years?	10
Have you sat a relevant English language test?	Yes

TOEFL (internet-based)

Registration number	53G08C5F
Date of TOEFL test	09 November 2024
TOEFL reading score	24
TOEFL listening score	26
TOEFL speaking score	22
TOEFL writing score	21
TOEFL total score	93

IELTS (International English Language Testing System)

Test report form (TRF) number	
UKVI number (if applicable)	
Date of IELTS test	
IELTS listening score	
IELTS reading score	
IELTS writing score	
IELTS speaking score	
IELTS total score	

Pearson Test of English

Score report code	
Date of Pearson test	
Pearson listening score	
Pearson reading score	
Pearson speaking score	
Pearson writing score	
Pearson overall score	

Other English Language test

Name of course

Registration number
Date of test
Listening score
Writing score
Reading score
Total score

Experience

Current Employer

Employer name and address Indian Institute of Science Education and Research (IISER) Mohali, Sector 81, Knowledge City, PO Manauli, SAS Nagar, Punjab 140306, India.

Job title and main duties BS-MS Student. The program comprises 10 semesters. Since my 5th semester, I have majored in Mathematics with a minor in Data Science. From my 9th semester onward, I have been pursuing my MS thesis on Lorentzian polynomials and polytope algebra.

Full time/Part time Full time

Date of Appointment 01 January 2021

End date (if applicable) 16 May 2025

Previous employment 1

Employer name and address
Job title and main duties
Full time/Part time
Date of Appointment
End date (if applicable)

Previous employment 2

Employer name and address
Job title and main duties
Full time/Part time
Date of Appointment
End date (if applicable)

Previous employment 3

Employer name and address
Job title and main duties
Full time/Part time
Date of Appointment
End date (if applicable)

Other Experience

Do you have any other relevant work experience to support your application? No

Please provide details

Personal statement

Personal details

Do you have a personal statement to upload? No

Please type your personal statement in the box During my MS thesis, I was introduced to combinatorics. Since my university offered no dedicated courses in the subject, I pursued self-study, which deepened my interest. Combinatorics aligns with my way of thinking, where simple problems often reveal deeper insights and unexpected connections. I am fascinated by fundamental mathematical structures, like groups, topological spaces, matroids, and polynomials, which provide powerful tools for understanding various problems. I am always seeking such structures. I am eager to pursue a PhD at the University of Bristol under the guidance of Dr. Farhad Babaee, focusing on combinatorics and algebraic geometry. Coming from a background where education wasn't strongly emphasized and resources were modest, adjusting to IISER's academic environment was initially challenging. While this affected my grades at first, I gradually found my footing and developed a strong connection with mathematics. I believe my curiosity, determination, and persistence demonstrate my readiness for doctoral study. I would be grateful for the opportunity to contribute to this field under Dr. Babaee's guidance. I am currently writing my thesis, which builds on these ideas, and I may share it to support my application once completed.

Research proposal

Research proposal

Proposed supervisor 1 Dr. Farhad Babaee

Proposed supervisor 1

Proposed project title (max 150 chars) Combinatorial Algebraic Geometry

Passport and visa

Visa required

Do you require a visa to study in the UK? Yes

Please fill out your passport details below. If you are unable to provide these at the current time you will have another opportunity to upload your passport after you submit the form. If you do not provide us with this information we will be unable to issue you with your confirmation of acceptance number and you will be unable to obtain a visa.

Passport details

Passport number B7373264

Further details

Have you previously studied in the UK? No

What was the highest level of study in the UK?

Please confirm the total length of your UK study in years

Referees

Referee 1

Do you have a reference to upload? No

Type of reference Academic

Referee title Dr

Forename Vaibhav

Surname Vaish

Position Assistant Professor

Institution/Company Indian Institute of Science Education & Research (IISER) Mohali

Email address vaibhav@iisermohali.ac.in

Country India

Referee 2

Do you have a second reference to upload? No

Type of reference Academic

Referee title Dr

Forename Tanusree

Surname Khandai

Position Assistant Professor

Institution/Company Indian Institute of Science Education & Research (IISER) Mohali

Email address tanusree@iisermohali.ac.in

Country India

Funding

Funding 1

What is your likely source of funding? University of Bristol scholarship

Please give the name of your scholarship or Studentship

Please specify

Percentage from this source 100

Is this funding already secured? No

Funding 2

What is your likely source of funding?

Please give the name of your scholarship or Studentship

Please specify

Percentage from this source

Is this funding already secured?

Funding 3

What is your likely source of funding?

Please give the name of your scholarship or Studentship

Please specify

Percentage from this source

Is this funding already secured?

Other funding

I would like to be considered for other funding opportunities Yes

Documents

Document type	File name
Application form PDF (anonymised)	Anon 2802854~01~01.pdf
Research proposal	Research_satement.pdf
Passports and visas	Passport.pdf
Curriculum vitae	Cv.pdf
Language qualification	TOEFL_Score_Report_0625673.pdf
Transcript	Harpreet_singh_Acadmic_transcript.pdf

By ticking the checkbox below and submitting your completed online application form, you acknowledge the University of Bristol will use the information provided from time to time, along with any further information about you the University may hold, for the purposes set out in the University's full Data Protection Statement. Applicants applying to the collaborative programmes of doctoral training should also read the Data Protection Statement for collaborative programmes of doctoral training.

The information that you provided on your application form will be used for the following purposes:

- To enable your application for entry to be considered and allow our Admissions Advisors, where applicable, to assist you through the application process;
- To enable the University to compile statistics, or to assist other organisations to do so. No statistical information will be published that would identify you personally;
- To enable the University to initiate your student record should you be offered a place at the University.

All applicants should note that the University reserves the right to make without notice changes in regulations, courses, fees etc at any time before or after a candidate's admission. Admission to the University is subject to the requirement that the candidate will comply with the University's registration procedure and will duly observe the Charter, Statutes, Ordinances and Regulations from time to time in force.

By ticking the checkbox below and submitting your completed online application form, you are confirming that the information given in this form is true, complete and accurate and that no information requested or other material information has been omitted. You are also confirming that you have read the Data Protection Statement and you confirm the statement below.

I can confirm that the information I have provided is true, complete and accurate. I accept that the information given in my application will be stored and processed by the University of Bristol, in accordance with the *UK General Data Protection Regulation and Data Protection Act 2018*, in order to:

- Consider my application and operate an effective and impartial admissions process;
- Monitor the University's applicant and student profile;
- Comply with all laws and regulations;
- Ensure the wellbeing and security of all students and staff;
- If my application is successful to form the basis of the statement made within my application.

If the University of Bristol discovers that I have made a false statement or omitted signification information from my application, for example examination results, I understand that it may have to withdraw or amend its offer or terminate my registration, according to circumstances.

Curriculum Vitae

Name   Mob.
B.S.- M.S. (Majoring in Mathematics)   ***@gmail.com
The Indian Institute of Science Education and Research (IISER), Mohali   ***@iisermohali.ac.in

Course	College/University	Year	CGPA/%
B.S.-M.S.	Indian Institute of Science Education and Research (IISER), Mohali	2020-2025(expected)	7.55
Intermediate (+2)	Govt. Sen. Sec. School, Nadampur (Sangrur)	2019	91.56%
High School	FCS Adarsh Sen. Sec. School, Balad Khurd (Sangrur)	2017	10.0

SKILLS & INTERESTS

- **Programming Languages and other tools**: C/C++, Python, Julia, SageMath, LaTeX
- **Languages**:English, Hindi, Punjabi(Mother tongue)
- **Mathematical Interests**: Combinatorics, Algebraic Geometry, Number Theory.
- **Other Interests**: Machine Learning, Ecology, Bird Watching, Trekking, Chess, Listening Music, Social Theory .

PROJECTS

- **Polytope Algebra ⏐ Dr. Vaibhav Vaihs**(IISER Mohali)   [Dec 2024-Present]
  - Peter McMullen's Polytope Algebra and Hodge Riemann structure on Combinatorial Geometries
- **Lorentzian Polynomials ⏐ Dr. Vaibhav Vaish**(IISER Mohali)   [Sep 2024-Dec 2024]
  - Matroid Theory, Hyperbolic Polynomials and cones, Stable Polynomials and various operations preserving them, log-concavity, Jump Systems, interlacing, Lorenzian polytomials, c-Rayleigh Property.
- **Problems in Algebraic Number Theory ⏐ Dr. Vaibhav Vaish**(IISER Mohali)   [May 2024-Aug 2024]
  - The ABC Conjecture, Euclidean Rings, Liouville's Theorem, Algebraic Numbers and Integers, Integral Bases, Dedekind Domains.
- **Greatest Integer Function and Trigonometric Functions ⏐ Prof. Ajit Iqbal Singh** (Delhi University)   [June 2023-July 2023]
  - A Cute Observation (Link removed to maintain anonymity): Variants of the Greatest Integer Function as point-wise limits of sequences of infinitely differentiable functions formed using repeated composition of trigonometric functions.
- **A Study of Arithmetic Functions ⏐ Prof. Sudesh Kaur Khanduja**(Panjab University)   [May 2022-July 2022]
  - Elementary Number Theory, Quadratic Congruences, Arithmetic Functions, Euler's Theorem, Primitive Roots, Numbers of Special Form, Quadratic Reciprocity, attempting solutions of $\sigma(s) = 2s + 1$.
- **Basics of Number Theory ⏐ Dr. Sugandha Maheshwary**(IISER Mohali)   [Apr 2021-May 2021]
  - Got introduced to Number Theory and worked on elementary concepts.

RELEVANT COURSES

- **Symmetry ⏐ Curves and Surfaces ⏐ Number Theory & Cryptography ⏐ Intro to Data Science ⏐ Machine Learning ⏐ Linear Algebra ⏐ Set Theory & Logic ⏐ Real Analysis ⏐ Groups, Rings and Modules ⏐ Complex Analysis ⏐ Measure Theory ⏐ Topology ⏐ ODEs ⏐ Functional Analysis ⏐ Fields and Galois Theory ⏐ Manifolds ⏐ Nonlinear Dynamics ⏐ Visual Art: Studio Practice and Theory ⏐ Network Science ⏐ Algebraic Topology ⏐ Discrete Mathematics ⏐ Fuchsian Groups ⏐ Linear Operators on Hilbert Spaces ⏐ Commutative Algebra ⏐ Algorithms and Complexity theory**   [IISER-Mohali]

SOCIETY AND RESPONSIBILITIES

- **PoR: Hostel Representative, Mess Committee Member, SRC Member**   [Sep 2022 – Sep 2023]
- **Organized Blood Donation Camps, Cultural Festivals, and other social gatherings. Active participation in the Mathematics Club, Astronomy Club and Ambient Club at IISER Mohali.**,

Research Statement

Introduction and motivation

During my MS thesis, my guide, Dr. Vaibhav Vaish, introduced me to combinatorics. While my university did not offer dedicated courses in combinatorics, I undertook self-study in this area to develop my understanding, which significantly influenced my growing interest in the field. As I studied and explored more deeply into the field, I felt a deep connection. It aligns with my natural way of thinking and philosophy of life, where many problems are simple to state yet challenging to address, often revealing unexpected connections between seemingly unrelated areas or concepts in mathematics. This process compels one to rethink and view mathematical objects through a new lens. Thus, I choose this branch to pursue further as my career and as part of my mathematical journey of understanding.

In the following, I express my deep interest and research ideas to explore this fascinating field though a PhD project under the guidance and vision of Dr. Farhad Babaee. My fundamental goal will be to uncover and understand many of the "likely" cornerstones in this field and potentially create many more of them.

Research Experience

- **Lorentzian Polynomials:** I started by exploring the fundamental idea of matroid, unifying many of the combinatorial concepts and then learned about the links between certain combinatorial objects and polynomials — specifically, basis generating polynomials of a matroid and generating polynomials for enumeration sequences for certain combinatorial structures. These polynomials often possess an interesting geometrical property: stability. This led me to delve into stable polynomials and hyperbolic polynomials, where I studied various related concepts such as generalized multiplier sequences, stability-preserving operations, jump systems, and generalized interlacing. This exploration eventually guided me toward Lorentzian polynomials. Roughly speaking, these are a generalization of real homogeneous stable polynomials from a combinatorial perspective. Though they hold a greater significance, particularly in relation to June Huh's vision of the Hodge-Riemann, which demands a deeper understanding of the subject. Since stable polynomials don't capture all matroids (for example Fano's matroid), Lorentzian polynomials appear to be the "correct" generalization. They are also in one-to-one correspondence with homogeneous completely log-concave and strongly log-concave polynomials, further supporting this idea. Finally, after establishing the so-called "Hodge-Riemann relations" in this context, I concluded the first part of my thesis project with some applications, such as demonstrating that homogeneous multi-variate Tutte polynomials are Lorentzian and exploring Mason's conjectures.

- **Polytope Algebra:** Initially, I began reading "Hodge Theory for Combinatorial

Geometries" by Karim Adiprasito, June Huh, and Eric Katz. Early in the paper, the authors mentioned that their work is largely inspired by Peter McMullen's work on polytope algebra. This motivated me to study McMullen's work to gain a broader perspective on the overall framework. The theory begins by considering the free group generated by convex polytopes over a finite-dimensional vector space over a ordered field, with invariance under the group of translations and the valuation property. By defining multiplication as the Minkowski sum, one establish a ring structure that further extends to an almost-graded commutative algebra (arising from dilation). A key element in McMullen's proof is the ingenious idea of the logarithm of a polytope and then use of the algebra structure of a certain subring of Π to extend this structure to the entire ring. This framework provides a complete theory of equidissectability under the group of translations. I am currently working on this project and aim to study McMullen's g-theorems and Hodge-Riemann relations in this context.

- **Number Theory:** I have done two projects in number theory during my summer breaks: one on elementary number theory and the other on algebraic number theory. Since this is not very relevant here, I will only briefly mention the topics I studied: quadratic congruences, arithmetic functions, Euler's theorem, primitive roots, numbers of special form, quadratic reciprocity, attempts at solutions of $\sigma(n) = 2n + 1$, where σ denotes the sum of divisors function; the ABC conjecture, Euclidean rings, Liouville's theorem, algebraic numbers and integers, integral bases and Dedekind domains.

Statement of Purpose

During my exploration of combinatorics and its intersection with algebraic geometry, I felt as though I were a bird soaring above this vast landscape, observing patterns, connections, and structures unfold beneath me. I encountered many broad areas to explore and questions to answer. There are many fundamental ideas and structures I would like to study further, for example the Chow ring of a matroid, Hodge theory in combinatorics, or Hodge-Riemann relations in combinatorial structures. Here I have given a brief motivation to study stable polynomials further, but I also express my interest in pursuing a PhD project in combinatorial algebraic geometry through a project suggested by Dr. Farhad Babaee.

- **Combinatorial Objects and Stable Polynomials in General** Stable polynomials, historically originating from control theory, now appear almost everywhere in combinatorics and other branches of mathematics. Examples include basis generating polynomials for many matroids, sequences in enumerative combinatorics where counting certain families of structures indexed by some parameters leads to stable polynomials, and certain probability generating functions. Though they have been generalized to Lorentzian polynomials, I feel this notion contains more subtleties that need to be explored further.

  There are many sequences in enumeration literature where we expect unimodality, and many where it is already known, stable polynomials also appears here: the stability of polynomials formed from these sequences very often implies log concavity,

which in turn implies unimodality. While this may not be a direct connection, it is a crucial one.

Another connection lies in the theory of negative dependence, where incorporating stable polynomials directly in the definition leads to a well-structured and expected theory.

A third connection emerges from a broader perspective in mathematics, motivated by G.C. Rota's philosophical note:

"The one contribution of mine that I hope will be remembered has consisted in just pointing out that all sorts of problems of combinatorics can be viewed as problems of the locations of zeros of certain polynomials...".

For instance, the Riemann Hypothesis is equivalent to Ω-stability, where Ω is $\{z \mid \Re(z) \neq \frac{1}{2}\}$. While this may seem like a strained connection, there exists literature explicitly motivated by understanding the zeta function through this perspective. Hence the motivation to have take a deeper look into stable polynomials from a more general prospective, here rather than posing a direct question, I am driven by curiosity to explore and better understand stability in this context.

Conclusion

I hereby express my strong interest in pursuing a PhD at the University of Bristol under the guidance of Dr. Farhad Babaee, focusing on research at the intersection of combinatorics and algebraic geometry. I come from a background where education wasn't strongly emphasized, and the quality of resources was modest. Adjusting to the fast-paced academic environment at IISER was initially challenging. While this affected my grades at times, I gradually found my footing and developed a deep connection with mathematics, where ideas often reveal themselves through persistence and thoughtful reflection. I believe my curiosity, determination, and will for better understanding demonstrate my readiness for doctoral study. I would be deeply grateful to the University of Bristol, its Mathematics Department, and Dr. Babaee for the opportunity to contribute to this field under his guidance.

INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH MOHALI
(Ministry of Education, Govt. of India)
Sector 81, Knowledge City, SAS Nagar, 140306, Punjab, India

Five year BS-MS Dual Degree Programme
Interim Grade Card

Name of the student   : **HARPREET SINGH**
Registration No.   : **MS20049**
Year & Month of Completion   : (*Programme not complete*)
Cumulative Performance Index (CPI) : **7.5**

Code	Title of the Course	Cr	Gd	Code	Title of the Course	Cr	Gd
	Semester I				*Semester II*		
BIO101	Cellular basis of life	3	A	BIO102	Gene expression & development	3	A
BIO111	Basic Biology Lab	1	A	BIO112	Biology Lab II	1	A
CHM101	Chemistry of elements & chemical transformations	3	A	CHM102	Atoms molecules & symmetry	3	B
CHM111	Chemistry Lab I	1	B	CHM112	Chemistry Lab II	1	A
HSS101A	Language skills - A	2	A	HSS102	History of science	2	B
IDC101	Introduction to computers	2	A	IDC102	Hands-on electronics	2	A
MTH101	Symmetry	3	B	MTH102	Analysis in one variable	3	B
PHY101	Mechanics	3	C	PHY102	Electromagnetism	3	B
PHY111	Physics Lab I	1	A	PHY112	Physics Laboratory II	1	A
	Semester III				*Semester IV*		
BIO201	Genetics & evolution	3	B	BIO202	Behaviour & ecology	3	B
BIO211	Biology Lab III	1	B	BIO212	Biology Lab IV	1	B
CHM201	Spectroscopic & other physical method	3	B	CHM202	Energetics & dynamics of chemical reactions	3	B
CHM211	Chemistry Lab III	1	B	CHM212	Chemistry Lab IV	1	A
IDC205	Differential equation for scientists	2	A	HSS202	Philosophy of science	2	A
MTH201	Curves & surfaces	3	B	IDC207	Number theory & cryptography	2	B
PHY201	Waves & optics	3	B	MTH202	Probability & statistics	3	A
PHY211	Physics Lab III	1	A	PHY202	Thermodynamics & statistical physics	3	B
	Semester V			PHY212	Physics Laboratory IV	1	A
IDC351	Seminar (Attending)	1	A		*Semester VI*		
IDC409	Introduction to Data Science	4	B	IDC352	Seminar (Attending)	1	B
MTH301	Real Analysis	4	C	IDC410	Machine learning	4	A
MTH302	Linear Algebra	4	B	MTH305	Complex analysis	4	D
MTH303	Set Theory & Logic	4	B	MTH306	Measure & Integration theroy	4	D
MTH304	Group Theory	4	C	MTH307	Topology	4	D
	Semester VII			MTH308	Rings & Modules	4	C
HSS304	Studio Art	4	A		*Semester VIII*		
IDC402	Nonlinear Dynamics	4	C	IDC407	Network Science	4	A
IDC451	Seminar (Delivering)	1	B	IDC452	Seminar (Delivering)	1	B
MTH402	Functional analysis	4	C	MTH408	Algebraic Topology	4	D
MTH403	Fields & Galois Theory	4	D	MTH409	Discrete Mathematics	4	B
MTH406	Manifolds	4	F	MTH418	Fuchsian Groups	4	D
	Semester IX			MTH420	Linear Operators on Hilbert Spaces	4	D
MTH401	Ordinary differential equations	4	C		*Summer Semester 2022*		
MTH404v2	Commutative & homological algebra	4	C	IDC211	Workshop training	1	A
PRJ501A	Thesis Research - I	8	A				
PRJ501B	Thesis Research - II	8	A				

Date of Issue: **February 3, 2025**

Associate Dean Academics

Meaning of Grades: A=Excellent, B=Good, C=Average, D=Pass, F=Fail.
Points for Grades: A=10, B=8, C=6, D=4, F=0
CPI is the credit weighted average of points earned.

Cr: Credits; Gd: Grade

$$CPI = \frac{\text{Total of (Credits} \times \text{Points)}}{\text{Total Credits}}$$

Singh, Harpreet

Last (Family/Surname) Name, First (Given) Name Middle Name
Email: Ms20049@iisermohali.ac.in

Singh, Harpreet
Hostel 7, IISER Mohali
SAS Nagar, Punjab(140306)
Mohali, Punjab 140306
India

Institution Code	Department Code

Test Date: November 09, 2024
Appointment #: 3328 2112 4062 5673
Native Language: Punjabi
Test Center Country: India
Test Center: STN14925A - Edu Assist Services

Gender: Male
Date of Birth: December 21, 2000
Country of Birth: India

Test Date: November 09, 2024

Total Score	📖 Reading	🎧 Listening	🎤 Speaking	✏️ Writing
93 out of 120	**24** out of 30	**26** out of 30	**22** out of 30	**21** out of 30

MyBest® Scores | Your highest section scores from all valid test dates, as of November 13, 2024.

Sum of Highest Section Scores **93** out of 120	Reading (0–30)	Listening (0–30)	Speaking (0–30)	Writing (0–30)
	24 Test Date Nov 09, 2024	**26** Test Date Nov 09, 2024	**22** Test Date Nov 09, 2024	**21** Test Date Nov 09, 2024

SECURITY IDENTIFICATION
ID Type: PASSPORT
ID No.: xxxxxxxxxxxxxxxxxxxxx3264
Issuing Country: India

A total score is not reported when one or more sections have not been administered. Expired scores are not included in *MyBest®* calculations.

79-79

THIS IS A PDF SCORE REPORT, DOWNLOADED AND PRINTED BY THE TEST TAKER.

✻toefl ibt.

For additional TOEFL iBT scoring details, score ranges, and how to improve your skills, visit www.ets.org/toefl/ibt/scores.

Score Ranges Total Score Range: 0-120

Reading	0–30
Advanced	24–30
High–Intermediate	18–23
Low–Intermediate	4–17
Below Low–Intermediate	0–3

Listening	0–30
Advanced	22–30
High–Intermediate	17–21
Low–Intermediate	9–16
Below Low–Intermediate	0–8

Speaking	0–30
Advanced	25–30
High–Intermediate	20–24
Low–Intermediate	16–19
Basic	10–15
Below Basic	0–9

Writing	0–30
Advanced	24–30
High–Intermediate	17–23
Low–Intermediate	13–16
Basic	7–12
Below Basic	0–6

Comparison to CEFR (Common European Framework Reference for Languages)

CEFR Level	Total Score
C2	114-120
C1	95-113
B2	72-94
B1	42-71
A2	Below 42

Institution Codes

Department	Where the Report was Sent
00	Admissions office for undergraduate study
01, 04-41, 43-98	Admissions office graduate study in the field other than management (business) or law according to the codes selected when you registered
02	Admissions office of a graduate school of management (business)
03	Admissions office of a graduate school of law
42	Admissions office of a school of medicine or nursing or licensing agency
99	Institution or agency that is not a college or university

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To,   March 28, 2024
 Admissions Committee,
 University of Bristol.

<u>Sub: Recommendation for Mr. Harpreet Singh</u>

Dear Admissions Committee,

It is my pleasure to recommend Mr. Harpreet Singh for the PhD program in mathematics at your university.

I am an Assistant Professor in the Department of Mathematics at IISER Mohali working in Algebraic Geometry, particularly on motives associated with Shimura varieties. I have closely interacted with Mr. Harpreet Singh in various capacities since about three years — first as an instructor (*Set Theory and Logic*, 5th semester mandatory and *Introduction to Commutative Algebra, 7*th semester elective), and finally as an advisor for his Master's thesis (fifth year).

Mr. Harpreet Singh's primary interest has been combinatorics. He chose to work with me because as such the department here does not currently have a faculty working full-time in the area. For his thesis work he has been exploring work of June Huh, which I am also interested in given that it connects well with Algebraic Geometry.

Mr. Harpreet Singh started with exploring their work on stable polynomials and Lorentzian polynomials beginning with their 2010 Annals paper. These were then connected to the study of several polynomials (e.g. Tutte polynomials) arising in the study of graphs, and more generally, on matroids. Currently, he is exploring their relationship with Peter McMullen's work on polytope algebra. Our hope is that the thesis will have a concrete bearing within algebraic geometry — we observed before the start of this study that certain algebraic geometric objects (Abelian varieties, which are essentially complex tori) can also carry what are essentially analogues of polytope algebra and that it is therefore meaningful to ask natural analogies for notions of volume forms and corresponding polynomials.

As such his work is progressing well as is reflected in the mid term evaluation of the work (which included an external expert) and fetched an 'A' grade which is the highest grade here.

Mr. Harpreet Singh is a sincere student who needed some detours to figure out his area of primary interest. In the initial years of my acquaintance I was somewhat concerned with his mathematical progress (which also reflects in his lower CPI), but in the thesis year he has challenged this understanding and demonstrated that he is both capable of quality work and that he can work independently: note that my own interests are a bit divergent from the students' and he worked hard on his own to figure out the readings and material for a progress in the thesis. His current CPI is 7.3/10.0 which does not accurately reflects his ability: note that his SPI in the last semester is 8.7/10.0 which is a more accurate representation of where he stands.

Mr. Harpreet Singh is also a reasonable speaker and comfortable with English. Last few months he has been giving regular talks on his readings to my group, and they have been well received. Note that the medium of instruction here is English.

In summary, given the recent progress, and demonstrated work and work ethics, I have no hesitation recommending Mr. Harpreet Singh for the graduate program. I have no doubt that he will do very well under the able mentoring of your department.

Sincerely,

Dr. Vaibhav Vaish,
Department of Mathematical Sciences.

भारतीय विज्ञान शिक्षा एवं अनुसंधान संस्थान मोहाली

(मानव संसाधन विकास मंत्रालय का एक स्वायत्त संस्थान, भारत सरकार के अधीन)

सैक्टर—81, नॉलेज सिटी, पो. ओ. मनौली, एस.ए.एस. नगर, मोहाली, पंजाब-140 306

INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH MOHALI

(Estd. By Ministry of Human Resource Development, Govt. of India)

Sector – 81, Knowledge City, P.O. Manauli, S.A.S. Nagar, Mohali, Punjab -140 306

Subject: Letter of Recommendation for PhD Application of Mr Harpreet Singh

Dear Members of the Admissions Committee,

I am pleased to write this letter in support of Harpreet Singh's application to the PhD program at the University of Bristol. As an Assistant Professor at the Indian Institute of Science Education and Research (IISER) in Mohali, India, I have had extensive interactions with Harpreet as an instructor for multiple courses he has completed over the past four and a half years. Additionally, as a member of his MSc thesis monitoring group, I have closely followed his academic progress.

Harpreet is part of a cohort of 250 students whose academic journey at IISER Mohali began with their first semester conducted online. Despite the challenges of remote learning, he actively participated in classes, demonstrating remarkable dedication and enthusiasm for mathematics. Once in-person classes resumed, he enrolled in a Group Theory course under my guidance. While his scores were not exceptionally high, his commitment, attentiveness, and eagerness to learn were consistently evident.

Harpreet's engagement with advanced mathematical concepts deepened through his MSc thesis on Lorentzian Polynomials and Polytope Algebra. From his half-yearly presentations, it is clear that he has worked diligently to bridge gaps in his mathematical understanding while genuinely enjoying his exploration of Lorentzian polynomials—rigorously studying their properties, stability, and applications. His ability to comprehend the intricate connections between stability theory and combinatorial geometry speaks to his diligence, intellectual curiosity, and research potential.

Harpreet is ambitious and promising. His interest in further exploring the role of stable polynomials in combinatorial structures reflects his forward-thinking perspective. While he may not always be able to think on his feet, his perseverance in revisiting concepts until he achieves a deep understanding has significantly contributed to his academic growth. His ability to tackle complex mathematical challenges and articulate concepts he has explored over an extended period makes him a valuable addition to any research group.

Beyond his academic abilities, Harpreet is a dedicated student with a strong work ethic. He is respectful, kind, and deeply loyal to his peers. His passion for learning and collaborative nature make him an excellent academic peer.

I recommend Harpreet Singh for admission to your PhD program. He possesses the mathematical insight, research experience, and determination necessary to make meaningful contributions to the field. I am confident that he will thrive in your program and emerge as a skilled researcher. Please feel free to contact me if you require any further information regarding his application.

Sincerely,

Tanusree Khandai

Tanusree Khandai
Assistant Professor
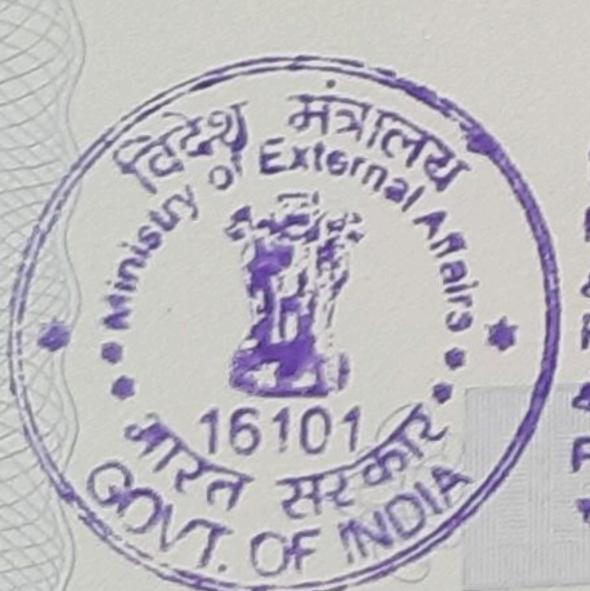Department of Mathematics , IISER Mohali
Email: tanusree@iisermohali.ac.in
Ph number: +918249487747

भारत गणराज्य REPUBLIC OF INDIA

इसके द्वारा, भारत गणराज्य के राष्ट्रपति के नाम पर, उन सभी से जिनका इससे संबंध हो, अनुरोध एवं अपेक्षा की जाती है कि वे धारक को बिना किसी रोक-टोक के स्वतंत्र रुप से आने-जाने दें और उसे हर तरह की ऐसी सहायता और सुरक्षा प्रदान करें जिसकी उसे आवश्यकता हो।

THESE ARE TO REQUEST AND REQUIRE IN THE NAME OF THE PRESIDENT OF THE REPUBLIC OF INDIA ALL THOSE TO WHOM IT MAY CONCERN TO ALLOW THE BEARER TO PASS FREELY WITHOUT LET OR HINDRANCE AND TO AFFORD HIM OR HER, EVERY ASSISTANCE AND PROTECTION OF WHICH HE OR SHE MAY STAND IN NEED.

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BY ORDER OF
THE PRESIDENT OF THE REPUBLIC OF INDIA

Priyanka

प्रियंका मेहतानी, आई. एफ. एस
Priyanka Mehtani, I.F.S
क्षेत्रीय पारपत्र अधिकारी
Regional Passport Officer
क्षेत्रीय पारपत्र कार्यालय
Regional Passport Office
चण्डीगढ़ /Chandigarh

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पासपोर्ट
PASSPORT

इस पासपोर्ट में 36 पृष्ठ है। This Passport contains 36 pages.

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टाईप / Type	कोड / Code	राष्ट्रीयता / Nationality	पासपोर्ट नं / Passport No.
P	IND	भारतीय / INDIAN	B7373264

उपनाम / Surname

दिया गया नाम / Given Name(s)
HARPREET SINGH

जन्मतिथि / Date of Birth
21/12/2000

लिंग / Sex
M

जन्म स्थान / Place of Birth
KAKRA,PUNJAB

जारी करने का स्थान / Place of Issue
CHANDIGARH

जारी करने की तिथि / Date of Issue
08/11/2023

समाप्ति की तिथि / Date of Expiry
07/11/2033

Harpreet Singh

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