<div align="center">

COURSE INFORMATION: Fall 2023
MATH 453 Combinatorics

</div>

Time and Place: 11:25am-12:40pm, Tuesday & Thursday, at RE 124.

Instructor: Hemanshu Kaul, kaul@iit.edu.

Office: 125C, Rettaliata Engg Center.

Online Discussion: Math 453 Discussion Forums at Campuswire.

Office Hours: Tuesday and Thursday at 1:45-2:45pm. And by appointment in-person or through Zoom (send email to setup appointment).
Questions through Campuswire Discussion Forums listed above are strongly encouraged.

TA Office Hours: Gunjan Sharma. Monday 9am-12pm at RE 129 or through Zoom link at Math Tutoring Center.

Course Communication: Course Webpage
Check the course webpage regularly for a weekly log that includes a class log, Topics and reading HW for discussion in class, and weekly Homework for submission.
I often send emails with comments regarding HW problems, Exams, etc. Make sure your IIT email account is active and working.

Prerequisites: Math 230 Intro to Discrete Math, or its equivalent, and familiarity with proofs.

Textbook: *Combinatorics: A Guided Tour*, David R. Mazur.

Course Description: The primary aim of this proof-based course is to introduce elementary counting techniques in Combinatorics, and develop:
− Proficiency in counting techniques like Permutations and combination, pigeonhole principle, inclusion-exclusion principle, recurrence relations and generating functions, enumeration under group action, and
− Good habits of understanding, communicating, and writing discrete mathematics.

Also see the separate document 'My Aim for this Course'.

Grade Break-down (Tentative): Weekly Homework, Daily Reading Homework, and Class Discussion are worth 30%; Two mid-term exams worth 35% total; Final exam worth 35%. The grading scale will be no more strict than A:85-100, B:75-84, C:65-74, D:55-64.

> **Weekly Schedule:** Reading HW and topics will be assigned a few days in advance of each lecture. On *Tuesday and Thursday*, we will have in-class lectures and discussion on these topics. By *Friday* morning, the weekly HW based on these topics, due a week later, will be uploaded.
> There might be minor modifications to this schedule at the beginning or end of the semester and before or after exams/holidays.

Class Attendance and Participation: You are expected to attend every class and participate in the class discussion, especially based on the reading HW. Not everything will be covered in the book and topics may not be covered in the same way. Moreover, The multitude of concepts introduced and developed in each class, as well as the importance of proofs in this course makes it critical to attend lectures and participate in class discussions. You are also expected to read the text, including examples not covered in class.
Multiple absences from the lectures without permission from instructor will result in **deductions from your 'HW and Participation' score** *at the discretion of the instructor.*

Examinations: The exam dates and their precise topics will be announced on the course webpage. The final exam will be on all the topics covered during the semester. Make-up exams will be given

only in case of a documented emergency.

<u>Homework Assignment:</u> Before every class meeting, there will be a required reading assignment.Within each reading assignment you will find several questions, which you must complete. These questions are not trivial; they generally require a bit of thought. In addition, as you read, you should make a note of any questions that you have. Standard homework problems will be assigned once a week (typically by Thursday evening or Friday morning) which will be due one week later.

It is your responsibility to check the course webpage for assignments and their due dates. Homework needs to be submitted through the appropriate webpage on *Blackboard Assignment*. You will upload a PDF file of your submission - either typed solutions (use LaTeX), or a <u>scanned</u> copy of your handwritten solutions.

<u>HW solutions must be written following the rules described in the section below.</u>

<u>HW Discussion and Solution Rules:</u> You are allowed to discuss homework problems **only with your classmates, course TA, and me**. However, the solutions should be written by you alone and, if you discussed HW problems with a classmate or TA, you have to **write their name at the top of the HW submission as a collaborator**. Any incident of plagiarism/ cheating (from a person or from any online resource) will be strictly dealt with according to University rules.

Homework Solutions must be written clearly, legibly, and concisely, and will be graded for both mathematical correctness and presentation. Points will be deducted for sloppiness, illegible handwriting, incoherent or insufficient explanation, or for lack of supporting rationale. It is your responsibility to convince the grader of the correctness of your argument in a systematic manner. Solutions can only be graded on basis of what is written in your submission and not based on your unwritten intention.

When grading your work, we pay close attention to the following **fundamental aspects of a solution**:

1. Is your proof mathematically correct? Does it start from the correct assumptions and does it conclude in the correct final statement? Is each intermediate statement correct? Is the logical implication in each of your steps correct? Does your proof contain any gaps? Are there any unjustified assumptions? Are there any aspects of the problem that you have not considered?

2. Have you justified the reasons for each of your steps and intermediate statements? Have you clearly explained the thinking and logic underlying your solution? Can the reader follow your justification and explanation? Will the reader be convinced by the detail of your explanation?

3. Does your writing clearly express the mathematical content of your solution? We can only grade based on what you have explicitly written, and not based on your underlying/unexpressed intent. Have you explicitly defined the notation, the variables and the functions you are working with? Have you included appropriate introductory or concluding comments that give context to the problem and your solution?

4. Is your solution readable, particularly, is your handwriting legible and have you used proper indentation and typesetting? Have you corrected any obvious misspellings or incorrect grammar?

'Why and How' of Homework: Homework serves as an opportunity for students to practice communicating written mathematics with clarity of thought and language. In a course like this, learning good communication skills in mathematics is very important. As significant is the opportunity that a homework provides you to test your understanding of the material covered in class that week. Mathematics cannot be learned by listening or just reading a book - you have to **do it**. Considering the varying pace of learning of students in class and the lack of class time to explore

every detail of every concept/Theorem, working through problems in the HW is an easy way for you to make sure that you are keeping up with the class. This is why homework is given a lot of importance in this course - dedicate enough time to it every week.

To improve your mathematical writing quickly, start by writing draft solutions to the homework early. A day or two later after you have had time to forget what you wrote, read it. If it doesn't make sense or convince you, rewrite it. **Writing a solution** requires saying what you mean and meaning what you say. Be intellectually honest. Intellectual dishonesty includes: 1) stating a "reason" without understanding its relevance. 2) Claiming a conclusion when you know you haven't proved it. 3) Giving an example and claiming you have proved the statement for all instances. **Include enough detail in your solutions so that your explanation is convincing to someone who hasn't thought about the problem before**. The proofs/ arguments should be presented so that your classmates could read them and follow the logic (step-by-step).

Some of the HW problems will be straightforward applications of the definitions or theorems studied in class, however every homework will also contain some challenging problems. Don't be disheartened if some problems take some time to solve. Such problems help develop your mathematical creativity. Discuss such problems with your classmates, and/or ask me for help, but only after you have given them sufficient thought. Please remember that **homework is NOT meant to be an examination, it is meant to assist in your learning and development. If you need help with it, don't hesitate to ask.**

Ask for Help: You are encouraged to ask questions during the *lectures*, through the *Online Discussion Forums*, during *my Office Hours*, during the *TA office hours*, or through *Email to me.* If you are having trouble solving a homework problem, I will be glad to direct you in the right direction. The same goes for any reading in the book, or any concept you have difficulty understanding.

Don't hesitate to ask for help! I cannot help you if you don't take the initiative.

Accommodations through the Center for Disability Resources:

Reasonable accommodations will be made for students with documented disabilities. In order to receive accommodations, students must obtain a letter of accommodation from the Center for Disability Resources and email me to make an appointment to speak with me as soon as possible. See the CDR website for more details.

Illinois Tech's Sexual Harassment and Discrimination Information:

Sexual harassment, sexual misconduct, and gender discrimination by any member of the Illinois Tech community is prohibited. This includes harassment among students, staff, or faculty. Sexual harassment by a faculty member or teaching assistant of a student over whom they have authority or by a supervisor of a member of the faculty or staff is particularly serious. Such conduct may easily create an intimidating, hostile, or offensive environment.

Illinois Tech encourages anyone experiencing sexual harassment or sexual misconduct to speak with the Title IX Office for information on the resolution process and support options.

You can file a complaint electronically, which may be completed anonymously. You may also file a complaint in-person by contacting the Title IX Coordinator, Virginia Foster at 312.567.5725/ foster@iit.edu or the Deputy Title IX Coordinator 312. 567.5726/ eespeland@iit.edu.

If you are not ready to file a formal complaint but wish to learn about your rights and options, you may contact Illinois Tech's Confidential Advisor service at 773.907.1062. You can also contact a licensed practitioner in Illinois Tech's Student Health and Wellness Center at 312.567.7550

For a comprehensive list of resources regarding counseling services, medical assistance, legal assistance and visa and immigration services, you can visit the Title IX Office's website.