

National Board for Higher Mathematics
Department of Atomic Energy
Government of India.

Mathematics Olympiad

Mathematics Olympiad activity on a national level has been one of the major initiatives of NBHM (National Board for Higher Mathematics) since 1986. The activity aims to spot mathematical talent among High School children. NBHM, with Homi Bhabha Centre for Science Education (HBCSE), also has taken on the responsibility of selecting and training the Indian team for the International Mathematical Olympiad every year.

For the purpose of the Olympiad contests, the country has been divided into about 25 regions. The selection process for participation in the International Mathematical Olympiad (IMO) consists of the following stages:

Stage 1: Regional Mathematical Olympiad (RMO): RMO is currently held on the first Sunday of October each year in each of the regions in the country. The Regional coordinator each region holds the charge of conducting RMO in the region. All school students from Class XI are eligible to appear in RMO. Students from Class XII may also appear in RMO, but the number of students selected from Class XII is at most 6. Exceptionally brilliant students from lower standards may also appear for RMO subject to the approval of the Regional Coordinator. RMO is a 3-hour written test containing 6 or 7 problems. On the basis of the performance in RMO, students are selected for the second stage.

The Regional Coordinators may charge a nominal fee to meet the expenses in organising the contest.

Stage 2: Indian National Mathematical Olympiad (INMO): INMO is currently held on the third Sunday of January each year at the regional centres in all regions. Only those students who are selected in RMO are eligible to appear in INMO. This contest is a 4-hour written test. The evaluation of these papers is centralised, and is undertaken by the IMO Cell of NBHM. The top 75 contestants in INMO receive Merit Certificates.

Stage 3: International Mathematical Olympiad Training Camp (IMOTC): The top 30-35 INMO certificate awardees are invited to a month long training camp in May/June each year. The training camp is organised by HBCSE, Mumbai. The number of students from Class XII who are selected for IMOTC is at most 6. In addition to these 35 students, a certain number of INMO awardees of previous year(s) who have satisfactorily undergone postal tuition over the year are also invited to a second round of training. A team of *six* students is selected from the combined pool of junior and senior batch participants, based on a number of selection tests conducted during the camp, to represent India in the International Mathematical Olympiad.

Stage 4: International Mathematical Olympiad (IMO): The six member team selected at the end of IMOTC, accompanied by a leader and a deputy leader represent India

at IMO, that is normally held in July each year in one of the chosen for the years IMO. IMO consists of two 4-and-a-half hour tests held on two consecutive days. The normal schedule between departure and return of the team takes about two weeks. The students of Indian team who win gold, silver and bronze medals at IMO receive from NBHM a cash prize of Rs. 5000/-, Rs. 4000/- and Rs. 3000/- respectively. MHRD (Ministry of Human Resource Development) finances international travel of the 8-member Indian delegation to IMO, while NBHM (DAE) finances the entire in-country programme and takes care of other expenditure connected with international participation. The six students representing India at IMO automatically qualify for Kishore Vaigyanik Protsahan Yojana (KVPY) scholarship (Rs 3000/- per month and some contingency) instituted by Department of Science and Technology, Government of India.

Syllabus for Mathematical Olympiad: The syllabus for Mathematical Olympiad (regional, national and international) consists of pre-degree college mathematics. The difficulty level increases from RMO to INMO to IMO. Broadly the syllabus for RMO and INMO is: Algebra (basic set theory, principle of Mathematical Induction, inequalities (AM-GM and Cauchy-Schwarz), theory of equations (remainder theorem, relation between roots and coefficients, symmetric expressions in roots, applications of the Fundamental theorem of algebra and its applications), functional equations); Geometry (similarity, congruence, concurrence, collinearity, parallelism and orthogonality, tangency, concyclicity, theorems of Apollonius, Ceva, Menelaus and Ptolemy, special points of a triangle such as circum-centre, in-centre, ex-centres, ortho-centre and centroid); Combinatorics (Basic counting numbers such as factorial, number of permutations and combinations, cardinality of a power set, problems based on induction and bijection techniques, existence problems, pigeonhole principle); Number theory (divisibility, gcd and lcm, primes, fundamental theorem of arithmetic (canonical factorisation), congruences, Fermat's little theorem, Wilson's theorem, integer and fractional parts of a real number, Pythagorean triplets, polynomials with integer coefficients). An idea of what is expected in mathematical olympiad can be had from the earlier question papers (see <http://www.isid.ac.in/~rbb/olympiads.html>) and the following books:

1. *Problem Primer for Olympiads*, by C R Pranesachar, B J Venkatachala and C S Yogananda (Prism Books Pvt. Ltd., Bangalore).
2. *Challenge and Thrill of Pre-College Mathematics*, by V Krishnamurthy, C R Pranesachar, K N Ranganathan and B J Venkatachala (New Age International Publishers, New Delhi).
3. *An Excursion in Mathematics*, Editors: M R Modak, S A Katre and V V Acharya (Bhaskaracharya Pratishthana, Pune).
4. *Problem Solving Strategies*, Arthur Engel (Springer-Verlag, Germany).
5. *Functional Equations*, B J Venkatachala (Prism Books Pvt. Ltd., Bangalore).
6. *Mathematical Circles*, Fomin and others (University Press, Hyderabad).

Reference to many other interesting books may be found in *An Excursion in Mathematics*.

Nurture Programme: The INMO awardees who choose Mathematics as one of the subjects in their undergraduate studies are eligible for a scholarship by NBHM (which is at present Rs 1500/= per month) throughout their undergraduate studies. If they further pursue their studies to masters, they continue to get scholarship (enhanced). Even the students who do not pursue Mathematics in their undergraduate studies are eligible for certain benefits under a novel programme instituted by NBHM, called *Nurture Programme*. Under this programme, each batch of students (selected from among the INMO awardees through their responses to a few sets of postal problems) is assigned to an institution. The coordinator in that institution gives out some reading material which the students can go through during their leisure time while pursuing their undergraduate studies. At the end of each year, during summer, they are invited to that institution for a contact programme with working Mathematicians. Based their performance, they may be recommended to a scholarship given by NBHM. This programme continue for four years. Thus, even those who pursue under-graduate studies in some other discipline can still get training in Mathematics and use it in their further pursuit of knowledge.