HOMI BHABHA CENTRE FOR SCIENCE EDUCATION
TATA INSTITUTE OF FUNDAMENTAL RESEARCH
and
NATIONAL BOARD FOR HIGHER MATHEMATICS
DEPARTMENT OF ATOMIC ENERGY
GOVERNMENT OF INDIA

2016-2017

Mathematical Olympiad Programme in India

Leading to participation in International Mathematical Olympiad

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MATHEMATICAL OLYMPIAD PROGRAMME IN INDIA AND RELATED ACTIVITIES

The Mathematical Olympiad Programme in India is organized by the Homi Bhabha Centre for Science Education (HBCSE) on behalf of the National Board for Higher Mathematics (NBHM) of the Department of Atomic Energy (DAE), Government of India.

Apart from the International Mathematical Olympiad (IMO), in which India is participating since 1989, since 2015 we have also started participating in two more international Olympiad events: the Europen Girls' Mathematical Olympiad (EGMO) and Asia Pacific Mathematics Olympiad (APMO). The process for selection of students for participation in the events have been merged, taking into account the requirements of the individual tests.

Team Selection and Training Process

For the purpose of training and selection of students for the Olympiad contest, 25 regions all over the country have been designated and each assigned a Regional Coordinator. Additionally, three groups (Central Board of Secondary Education (CBSE), Navodaya Vidyalaya Samiti (NVS) and Kendriya Vidyalaya Sangathana (KVS) have a 'Regional Coordinator' each.

The proces for selection to IMO team involves, as in the past, the following steps. These steps will now be applicable also to EGMO and APMO, along the lines indicated below.

Step 1: Regional Mathematical Olympiad (RMO and pre-RMO). The RMO is a three hour written test with six problems. On the basis of the performance in RMO, up to 30 students from each region are selected for Stage 2 (INMO). In case of a tie for the closing ranks, a tie-breaking mechanism shall be applied by the regional coordinator, following appropriate norms, to arrive at the final list of maximum 30 students from the region. The Regional Coordinators hold the charge of conducting the RMO in their respective regions. They have the option of preparing RMO question papers on their own or they may choose to use the central RMO question paper prepared by the Mathematical Olympiad Cell, HBCSE, TIFR. Some regions may hold a pre-RMO examination through which students will be selected to appear for RMO. All pre-RMOs will be conducted by the concerned regional coordinator in the respective regions. The format of the pre-RMO paper and the criteria for selecting students for RMO are at the sole discretion of the respective Regional Coordinators.

In the context of participation in EGMO it is decided that up to five girls be additionally selected apart from the general quota of 30 students for each region. This provision is independent of the number of girls who may be part of the list of 30 students from the region.

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The RMO will be held in all the regions on Sunday, 9th October, 2016 between 1.00 p.m. and 4.00 p.m. The centres facing a difficulty in conducting the test on that date may under exceptional circumstances conduct the test on an alternate date between October 1 and 16, 2016, with the approval of the National Coordinator.

The results of RMO for all the regions are to be declared centrally by HBCSE before 6th December, 2016. Therefore the regional coordinators should send the final results to HBCSE by 30th November, 2016. The regional coordinators shall not declare the results in their respective regions prior to that date.

Eligibility. All Indian students who are born on or after August 1, 1997 and, in addition, are in Class IX, X, and XI are eligible to appear for the RMO. Class XII students will not be eligible to appear for RMO/pre-RMO. Highly motivated and well prepared students from Class VIII may also take the RMO at the discretion of the Regional Coordinator. The Regional Coordinators may charge a nominal application fee (not more than Rs. 200) to meet the expenses for organizing the contest.

Step 2: Indian National Mathematical Olympiad (INMO). The INMO will be held on the **third Sunday of January (January 15, 2017) from** **12.00 noon to 4.00 p.m.** Only those students who are selected in RMO 2016 and those who have received an INMO certificate of merit in 2016 are eligible to appear for the INMO provided they are in class XI or below. This contest is a four hour written test. On the basis of the INMO, the top 30 students in merit from all over the country will be chosen as INMO awardees. In addition to INMO awardees, the next 45 students who are in class XI or lower and have performed well in INMO, but have not qualified as INMO awardee, are awarded INMO certificate of merit. These students will be eligible to appear for INMO 2018 directly without qualifying through RMO 2017, provided they are not in class XII at the time of writing INMO.

In addition to the 30 students in the list of INMO awardees as above, up to five girl students (outside the INMO awardees list) will be chosen based on the performance in INMO, for training and possible selection in EGMO 2018 team.

All INMO awardees, the selected girl students as above and all the students designated as senior students of IMOTC 2017 will be eligible to write APMO. The APMO tests will be held in the respective regions.

The INMO results will be declared in the last week of February.

Step 3: International Mathematical Olympiad Training Camp (IMOTC). The INMO awardees and the girls selected from INMO for training are invited to a

month long training camp in April-May each year at the Homi Bhabha Centre for Science Education (HBCSE), Mumbai. Besides, the INMO awardees from the previous years and the selected girl students of the previous years who are eligible for IMO-2017/EGMO-2018 and have gone through postal tuition throughout the year satisfactorily are invited to the training camp as senior students. An INMO awardee who has completed one year of 12th standard will not be eligible for the next year's IMOTC.

The junior students will receive INMO certificate and a prize in the form of books.The senior students will receive a prize in the form of books and cash.

On the basis of a number of selection tests during the Camp, a team of the best six students is selected from the combined pool of junior and senior batch participants as the IMO 2017 Team.

A team of upto four girl students will be selected for participation in EGMO 2018, based on the performance of girl students from the combined pool at IMOTC.

Step 4: Pre-Departure Training Camps. The selected team of six students goes through another round of training and orientation for about ten days prior to departure for IMO. A Pre-departure camp will also be arranged for girl students selected for participation in 2018, at a suitable time.

Some Details Concerning the Tests

International Mathematical Olympiad (IMO). The six member team selected at the end of IMOTC accompanied by a leader, a deputy leader and observers represent the country at the IMO, held in July each year in a different member country of the IMO. The IMO contest consists of two written tests held on two consecutive days. On each day of the contest the test consists of three problems and lasts for four and half hours. India has been participating in the IMO since 1989. Students of the Indian Team who receive gold, silver and bronze medals at the IMO receive a cash prize of Rs. 5000/-, Rs. 4000/- and Rs. 3000/- respectively at a formal ceremony at the end of the training camp during the following year.

The selection of the members of the Indian team for IMO will be subject to their fulfilling criteria such as age limit, medical fitness, parental consent, etc., as may be applicable. In particular, the selected students need to have a valid Indian passport meeting the visa regulations of the host country.

Students aiming to go through the Mathematical Olympiad programme leading to international participation (IMO) should note that RMO is the first essential step for the programme. To appear for the RMO, the students should get in touch

with the RMO coordinator of their region well in advance for enrolment and payment of stipulated (nominal) fees.

European Girls Mathematical Olympiad (EGMO). A team of at most four girl students selected at the end of IMOTC accompanied by a leader, a deputy leader and an observer represent the country at the EGMO, held in April each year in a different European country. The EGMO contest consists of two written tests held on two consecutive days. On each day of the contest the test consists of three problems and lasts for four and half hours. India has been participating in the EGMO since 2015.

The selection of the members of the Indian team for EGMO will be subject to their fulfilling criteria such as age limit, medical fitness, parental consent, etc., as may be applicable. In particular, the selected students need to have a valid Indian passport meeting the visa regulations of the host country.

Students aiming to go through the Mathematical Olympiad programme leading to participation in EGMO should note that RMO is the first essential step for the programme. To appear for the RMO, the students should get in touch with the RMO coordinator of their region well in advance for enrolment and payment of stipulated (nominal) fees.

Asia Pacific Mathematics Olympiad (APMO). APMO is a contest specifically held for students in Asian countries and the countries in the rim of Pacific ocean. There is a senior coordinating country which coordinates this examination. The advantage of this contest is that one can participate in it being in her/his country. India has started participating in it from 2015. The contest consists of solving 5 problems in four and a half hours.

The requirement for participation in APMO is like IMO: one should not have entered university and below the age of 20 years. Besides the contestants should have been selcted through a national selection process. In view of this, all the INMO-2017 awardees and all the senior batch students for the year 2017 are eligible to write APMO-2017. Generally, it is on the second Monday of March and the following Tuesday in some countries. (For the exact date and timings of the contest, see HBCSE website.)

The students can take their examination in their respective regions. The regional coordinator will conduct the test in his region.

Syllabus for Mathematical Olympiad: The syllabus for Mathematical Olympiad (regional, national and international) is pre-degree college mathematics. The areas covered are arithmetic of integers, geometry, quadratic equations and expressions, trigonometry, co-ordinate geometry, system of linear equations, permutations and combination, factorisation of polynomial, inequalities, elementary combinatorics, probability theory and number theory, finite series and

complex numbers and elementary graph theory. The syllabus does not include calculus and statistics. The major areas from which problems are given are algebra, combinatorics, geometry and number theory . The syllabus is in a sense spread over Class XI to Class XII levels, but the problems under each topic involve high level of difficulty and sophistication. The difficulty level increases from RMO to INMO to IMO.

A good idea of what is expected of students in mathematical Olympiad can be had from the question papers of earlier years (which are available at http://olympiads.hbcse.tifr.res.in/subjects/mathematics/previous-question-papers-and-solutions) and the following books:

1. **Problem Primer for Olympiads**
    C R Pranesachar, B J Venkatachala and C S Yogananda (Prism Books Pvt. Ltd., Bangalore).

2. **Challenge and Thrill of Pre-College Mathematics**
    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 and V M Sholapurkar (Bhaskaracharya Pratishthana, Pune).

4. **Problem Solving Strategies**
    A Engel (Springer-Verlag, Germany).

5. **Functional Equations**
    B J Venkatachala (Prism Books Pvt. Ltd., Bangalore).

6. **Inequalities an approach through problems** (texts & readings in mathematics), B J Venkatachala (Hindustan Book Agency)

7. **Mathematical Circles**
    Fomin and others (University Press, Hyderabad).
    Many other interesting references may also be found in the book **An Excursion in Mathematics** mentioned above.

INMO Scholarship. The INMO awardees successfully completing IMOTC, who pursue B.Sc., or other courses adjudged by the Board to be on the same footing, with mathematics as one of the principal subjects of study, are eligible to receive a scholarship of NBHM, which is at present Rs. 4,000 per month, through the period of their undergraduate studies (subject to satisfactory progress). An enhanced scholarship would be available for pursuing masters studies in mathematics.

Results

IMO 2016
International Mathematical Olympiad

No.	Students Name	Region	Medal
1	Kapil Pause	Goa	Silver
2	Sutanay Bhattacharya	West Bengal	Bronze
3	Madhusudhan Reddy	Andhra Pradesh	Bronze
4	Supravat Sarkar	West Bengal	Bronze
5	Anant Mudgal	Delhi	Bronze
6	Deepesh Singhal	Pune	Bronze

EGMO 2016
European Girl's Mathematical Olympiad

No.	Students Name	Region	Medal
1.	Uma T. V	Tamil Nadu	Bronze

APMO 2016
Asian Pacific Mathematics Olympiad

No.	Students Name	Region	Medal
1	Supravat Sarkar	West Bengal	Silver
2	Aditya Raut	Maharashtra	Silver
3	Srisht Fateh Singh	Punjab	Silver
4	Prasun De	Kolkata	Bronze
5	Dhruva Kelkar	Maharashtra	Bronze
6	Anant Mudgal	Delhi	Bronze
7	Kapil Pause	Goa	Bronze
8	Utkarsh Gupta	Delhi	Honourable Mention

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Indian Delegation for the
International Girls Mathematical Olympiad (EGMO) 2016

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Indian Delegation for the
57th International Mathematical Olympiad (IMO) 2016

From Left to Right: Prithwijit De (Leader), Prof. B. Sury (Observer A), Sutanay Bhattacharya, Madhusudhan Reddy, Deepesh Singhal, Kapil Pause, Supravat Sarkar, Anant Mudgal, Prof. Udayan Prajapati (Deputy Leader), Shri. Alok Kumar(Observer B)

**The Mathematical Olympiad programme
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