NCRA also offers post-doctoral fellowships and visiting positions in the Centre for work in astronomy and astrophysics, radio astronomy, instrumentation, image processing applications and development of astronomical software. Exceptionally motivated candidates are also considered for regular staff positions.

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I M O – 1998: A Brief Report

Introduction: The Indian team performed magnificently in the recently concluded 39th International Mathematical Olympiad at China–Taipei to finish with three gold and three silver medals. Going by the total marks obtained by the team, India was placed 7th among the 76 countries which took part, the best ever achieved by India since it's first participation in 1989.

The Team: The team of six students was selected during the four-week IMO – Training Camp held in Homi Bhabha Centre for Science Education, Mumbai from May 7 to June 4, 1998 and consisted of:

Chetan Balwe, 103, Dnyandeep, Swanand Society, Sahakarnagar 2, Pune 411 009
Abhinav Kumar, 9A, Hulang Road, Kadma, Jamshedpur 831 005
Soham Mazumdar, Quarter No. A-30, Satellite Colony, Dhurwa, Ranchi 834 004
Hariharan Narayanan, B-54, I I T Bombay, Mumbai 400 076
Rishi Raj, E-2, Sector II, HEC Dhurwa, Ranchi 834 004
N V Tejaswi, 212, 2E Cross, Girinagar I Phase, Bangalore 560 085

With the exception of Rishi Raj all the other five students have finished their 12th standard (or its equivalent) while Rishi is now studying in 12th standard. While Chetan, Soham, Hariharan and Rishi are from the INMO – 96 batch, Abhinav and Tejaswi are from the INMO – 97 batch. For the first time in the ten years of Indian participation in the IMO the team had no representatives from the Junior batch (i.e., from the INMO – 98 batch). In that sense we had a very experienced team who had gone through two/three years of our training programme which may have played a significant role in the performance at the IMO – 98.

The leader of the team was S A Shirali, Rishi Valley School, Rishi Valley 517 352 and the deputy leader was C S Yogananda, MO Cell (NBHM, DAE), Department of Mathematics, IISc, Bangalore 560 012.

The Problems

The six problems of the IMO–98 are reproduced at the end of this report. While two of the Indian proposals were shortlisted one was selected for the final six and it appeared as problem no. 2. The proposal was authored by R B Bapat of ISI, Delhi who has been participating in the IMOTC since 1997. (The other shortlisted proposal is essentially due to Sambuddha Roy, a two-time silver medal winner.) This is the third time that an Indian proposal is making it to the final six, earlier occasions being IMO-90 and IMO–92. There were two problems from geometry, no. 1 and no. 5, one from combinatorics, no. 2, two from number theory, no. 3 and no. 4 and the last one was a functional equation.

Our team's performance

Our team performed very well on nos. 1, 2 and 5, badly on nos. 3 and 6 and moderately on no. 4. The marks and medals obtained are as follows:

Chetan Balwe	7	7	2	5	7	3	31	Gold Medal
Abhinav Kumar	7	7	3	7	7	1	32	Gold Medal
Soham Mazumdar	7	7	1	4	7	0	26	Silver Medal
Hariharan N	7	7	2	1	7	0	24	Silver Medal
Rishi Raj	7	7	2	7	7	0	30	Silver Medal
N V Tejaswi	7	7	2	7	7	1	31	Gold Medal

The cut-offs for gold, silver and bronze medals were 31, 24 and 14, respectively. Thus we had more gold medals in this year's IMO than we had so far in all the previous 9 participations put together! As someone remarked we can do this only once more!

The first ten (unofficial ranks) countries (followed by their totals and the number of gold, silver and bronze medals) are : Iran (211, 5-1-0), Bulgaria (195, 3-3-0), Hungary (186, 4-2-0) and USA (186, 3-3-0), Taiwan (184, 3-2-1), Russia (175, 2-3-1), India (174, 3-3-0), Ukraine (166, 1-3-2), Vietnam (158, 1-3-2), Yugoslavia (156, 0-5-0) and Romania (155, 3-0-2).

Problem 1: In the convex quadrilateral $ABCD$, the diagonals AC and BD are perpendicular and the opposite sides AB and DC are not parallel. Suppose that the point P, where the perpendicular bisectors of AB and DC meet, is inside $ABCD$. Prove that $ABCD$ is a cyclic quadrilateral if and only if the triangles ABP and CDP have equal areas.

Problem 2: In a competition, there are a contestants and b judges, where $b \geq 3$ is an odd integer. Each judge rates each contestant as either 'pass' or 'fail'. Suppose k is a number such that, for any two judges, their ratings coincide for at most k contestants. Prove that $k/a \geq b-1/2b$.

Problem 3: For any positive integer n, let $d(n)$ denote the number of positive divisors of n (including 1 and n itself).

Determine all positive integers k such that $d(n^2)/d(n)=k$ for some n.

Problem 4: Determine all pairs (a, b) of positive integers such that $ab^2 + b + 7$ divides $a^2b + a + b$.

Problem 5: Let I be the incentre of triangle ABC. Let the incircle of ABC touch the sides BC, CA and AB at K, L and M, respectively. The line through B parallel to MK meets the lines LM and LK at R and S, respectively. Prove that $\angle RIS$ is acute.

Problem 6: Consider all functions f from the set N of all positive integers into itself satisfying $f(t^2f(s)) = s(f(t))^2$, for all s and t in N. Determine the least possible value of $f(1998)$.

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Department of Mathematics, IISc, Bangalore

Mathematics is one component of any plan for liberal education. Mother of all the sciences, it is a builder of the imagination, a weaver of patterns of sheer thought, an intuitive dreamer, a poet. The study of mathematics cannot be replaced by any other activity that will train and develop man's purely logical faculties to the same level of rationality. Through countless dimensions, riding high the winds of intellectual adventure and filled with the zest of discovery, the mathematician tracks the heavens for harmony and eternal verity. There is not wholly unexpected surprise, but surprise nevertheless, that mathematics had direct application to the physical world about us. For mathematics, in a wilderness of tragedy and change, is a creature of the mind, born to the cry of humanity in search of an invariant reality, immutable in substance, unalterable with time. Mathematics is an infinity of flexibles forcing pure thought into a cosmos. It is an arc of austerity cutting realms of reason with geodesic grandeur. Mathematics is crystallized clarity, precision personified, beauty distilled and rigorously sublimated. The life of the spirit is a life of thought, the ideal of thought is truth; everlasting truth is the goal of mathematics.

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