International Olympiad on Astronomy and Astrophysics

Summary report for the years 2007 to 2016

Introduction

The International Olympiad on Astronomy and Astrophysics is an international competition for high-school students along the lines of the other *International Science Olympiads*, covering the fields of Astronomy and Astrophysics.

Participating students, who must not be attending higher education and must be under the age of 20 on 30th June of the year of the event, solve theoretical, data analysis, observational problems individually and in teams under controlled and timed conditions over a period of 10 days.

Problem tasks (conforming to the Statutes and Syllabus) are set by the local organisers, verified by the team leaders of the participating countries, and presented to the participating students in their own languages. Problems are designed to reflect current astronomical knowledge as well as test the students' abilities. Medals and other prizes are awards to the most successful participants as specified in the Statutes.

Additionally each event includes cultural and social occasions and excursions designed to widen the students' experience.

The host country covers all costs (accommodation, food, excursions) of the primary team from each participating country (consisting of up to 5 students and up to 2 adult team leaders) during the event, except for travel and visa costs to the host country. In addition, the host country may at its discretion accept Observers and (secondary) Guest Teams, specifying a fee for each to cover costs.

The name *International Olympiad on Astronomy and Astrophysics*, as well as the abbreviation *IOAA*, are commonly used to refer to:

(a) the general concept of the competition, an Olympiad relating to the fields of astronomy and astrophysics,

(b) the overall organisation and structure, for clarity referred to as *IOAA organisation* in this document,

(c) each individual event (usually associated with a number, e.g. *9th IOAA*), for clarity this document will refer to these as *IOAA events*.

Organisation and Governance

The International Olympiad on Astronomy and Astrophysics is governed by a set of Statutes*, initially derived from those of the International Physics Olympiad, and subsequently modified (through a voting process described in the statues) to better reflect the needs of the competition. All participants agree to abide by the terms of the Statutes.

According to the statutes, the governing body of the IOAA organisation is the *International Board* (IB), sometimes also called the *International Board Meeting* or *IBM* as meetings of the Board are referred to in the event schedules. The IB consists of the team leaders of the primary (non-guest) team from each country attending an IOAA event, who serve as members from the first IBM of that event until the next IOAA event. Many leaders have participated in several IOAA events and may thus be members of the International Board for a corresponding number of years.

Decisions of the Board are taken by open majority vote (except for elections, which are by closed ballot) following free discussions. Each member may vote independently, regardless of country affiliation. The Board is considered *the highest decision making body of the IOAA* and may override decisions of the local event organiser if it deems so necessary. It may also change the Statutes following the procedures outlined therein.

Past decisions of the Board made in response to particular circumstances are considered to form a *precedent* if those circumstances recur, thus ensuring consistency and continuity.

In addition to the members, the Board has a President and a General Secretary, who are elected by the Board by majority vote for terms of 5 years. There are no limits on re-election. The President and Secretary advise the local organisers, supervise Board meetings and competition events, ensure compliance with the Statues and previous Board decisions, and have a tie-breaking vote.

This governance structure allows for continuity between IOAA events and for the aggregation of collective knowledge and experience, leading to improvements in the events from year to year. Further, the democratic structure and collective governance system makes the IOAA organisation independent of any one person and grants it an fair and open structure in which the voices of all participants can be heard.

Each individual event is organised by a *Local Organising Committee*, often with an *Academic Committee* or equivalent overseeing setting of the problem tasks, and a *Jury* responsible for marking student papers, as well as other assistants as required.

* The Statutes and Syllabus of the IOAA are given in an Appendix to this Report.

Current International Board

President Greg Stachowski*
General Secretary Aniket Sule*

1. Marietta Gyulzadyan (Armenia)
2. Vardges Mambreyan (Armenia)
3. Mosharul Amin (Bangladesh)
4. Stanislaw Sekerzhitsky (Belarus)
5. Gennady Tyumenkov (Belarus)
6. Gustavo de Araujo Rojas* (Brasil)
7. Eugenio Reis (Brasil)
8. Nikola Karavasilev (Bulgaria)
9. Zahari Donchev (Bulgaria)
10. Vera Zagainova (Canada)
11. Yuri Khoroshilov (Canada)
12. Yan Dai (China)
13. Ziping Zhang (China)
14. Christian Alberto Goez Theran (Colombia)
15. Barrios Nestor (Colombia)
16. Damir Hrzina (Croatia)
17. Ivan Romstajn (Croatia)
18. Jan Kozusko (Czech Republic)
19. Tomas Graf (Czech Republic)
20. Tiit Sepp (Estonia)
21. Tonis Eenmaee (Estonia)
22. Giorgi Bakhtadze (Georgia)
23. Teimuraz Gachechiladze (Georgia)
24. John Hugh Seiradakis* (Greece)
25. Loukas Zacheilas* (Greece)
26. Udvardi Imre (Hungary)
27. Jozsef Kovacs (Hungary)
28. Md. Ikbal Arifyanto* (Indonesia)
29. Rhorom Priyatikanto (Indonesia)
30. Manojendu Choudhury (India)
31. Swapnil Jawkar (India)
32. Hossein Hakimi Pajouh Haghi (Iran)
33. Mehdi Khakian Ghomi (Iran)
34. Nurzada Beissen (Kazakhstan)
35. Yelena Sakenova (Kazakhstan)
36. Aleksandra Shumeiko (Kyrgyzstan)
37. Dzharkyn Bapanova (Kyrgyzstan)
38. Yong Hee Kang (Korea)
39. Hyuwoo Kang (Korea)
40. Jokubas Sudzius (Lithuania)
41. Audrius Bridzius (Lithuania)
42. Wooi Hou Chan (Malaysia)
43. Bakary Coulibaly (Mali)
44. Diallo A. Aliou (Mali)
45. Carlos Garcia Rosas (Mexico)

** IAU member*

46. Daniel Tofaya Martinez (Mexico)
47. Suresh Bhattarai (Nepal)
48. Manisha Dwa (Nepal)
49. Mary Grace Navarro (Philippines)
50. Aris Larroder (Philippines)
51. Waldemar Ogloza* (Poland)
52. Damian Jableka (Poland)
53. Jorge Manuel Custadio Grave (Portugal)
54. Hani M. Dalee (Qatar)
55. Zlatan Tsvetanov (Qatar)
56. Petru Craciun (Romania)
57. Cristian Pirghie (Romania)
58. Boris Eskin (Russia)
59. Mikhail Kuznetsov (Russia)
60. Sonja Vidojevic* (Serbia)
61. Aleksandar Miladinovic (Serbia)
62. Yongli Seow (Singapore)
63. Conrad Zheng (Singapore)
64. Ladislav Hric* (Slovakia)
65. Maria Hricova Bartlomejowa (Slovakia)
66. Andrej Gustin (Slovenia)
67. Maruska Zerjal (Slovenia)
68. K. P. S. Chandana Jayaratne (Sri Lanka)
69. K. L. Isuru Gunawardhana (Sri Lanka)
70. Utane Sawangwit (Thailand)
71. Phichet Kittara (Thailand)
72. Andrew Simon (Ukraine)
73. Charles Barclay* (United Kingdom)
74. Sandor Kurk (United Kingdom)
75. Roohi Dalal (United States of America)
76. Ngo Van Chat (Vietnam)
77. Le Manh Cuong (Vietnam)
78. Mayank Vahia*
    (Chair of IBM; by Statute #14)

List of Past Events

The IOAA has been successfully organised every year since the first event, held in Thailand in 2007. Below is a brief summary of these events. Please see the next chapter for details of participating countries

1st IOAA (2007)	Chiang Mai, Thailand
2nd IOAA (2008)	Bandung, Indonesia
3rd IOAA (2009)	Tehran, Iran
4th IOAA (2010)	Beijing, China
5th IOAA (2011)	Katowice, Chorzow & Krakow, Poland
6th IOAA (2012)	Rio de Janeiro, Brazil
7th IOAA (2013)	Volos, Greece
8th IOAA (2014)	Suceava, Romania
9th IOAA (2015)	Magelang, Indonesia
10th IOAA (2016)	Bhubaneswar, India

Participating countries

The table below shows the countries which participated in the IOAA events from 2007 to 2016. An 'o' indicates an Observer only, with no participating students; these are not counted towards the total. A number of countries registered participation but were unable to take part at the last moment, the names of these are listed in the 'Country' column but have not been marked as attending a given event. Finally, some countries have participated with two teams (a primary and a guest team), this information is not distinguished in the table.

	Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1	Armenia							X	X	X	X
2	Azerbaijan	X	X								
3	Bangladesh	X	O	X	X	X	X	X	X	X	X
4	Belarus	X	X	X	X	X	X	X	X	X	X
5	Bolivia	X	X	X	X		X	X	X	X	
6	Bosnia & Herz.								X		
7	Brazil	X	X	X	X	X	X	X	X	X	X
8	Bulgaria					X	X	X	X	X	X
9	Cambodia		X	X	X						
10	Canada							X	X	X	X
11	Chile										
12	China	X	X	X	X	X	X	X	X	X	X
13	Colombia					X	X	X	X	X	X
14	Croatia					X	X	X	X	X	X
15	Cyprus							X			
16	Czech Rep.				X	X	X	X	X	X	X
17	Egypt										
18	Estonia									X	X
19	Georgia									X	X
19	Ghana										
20	Greece	X	X	X	X	X	X	X	X	X	X
21	Hungary					X	X	X	X	X	X
22	India	X	X	X	X	X	X	X	X	X	X

	Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
23	Indonesia	X	X	X	X	X	X	X	X	X	X
24	Iran	X	X	X	X	X	X	X	X	X	X
25	Jordan										
26	Kazakhstan			X	X	X	X	X	X	X	X
27	Kyrgyzstan									X	X
28	Laos	X									
29	Lithuania	X	X	X	X	X	X	X	X	X	X
30	F.Y.R.O. Macedonia							X	X	X	
31	Malaysia		O					X		X	X
32	Mali										X
33	Myanmar	X	X								
34	Mexico								X	X	X
35	Moldova								X		
36	Morocco										
37	Nepal								X	X	X
38	New Zealand							X			
39	Pakistan								X	X	
40	Paraguay										
41	Philippines				X						X
42	Poland	X	X	X	X	X	X	X	X	X	X
43	Portugal					X	X	X	X	X	X
44	Qatar									O	X
45	Romania	X	X	X	X	X	X	X	X	X	X
46	Russia				X	X	X	X	X	X	X
47	Serbia			X	X	X	X	X	X	X	X
48	Singapore	X	X			X	X	X	X	X	X
49	Slovakia	X	X	X	X	X	X	X	X	X	X
50	Slovenia							X	X	X	X
51	South Korea	X	X	X	X	X	X	X	X	X	X
52	Sri Lanka	X	X	X	X	X	X	X	X	X	X
53	Sweden									O	
54	Thailand	X	X	X	X	X	X	X	X	X	X

	Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
55	Turkey										
56	U.A.E.						X				
57	Ukraine	X	X	O	X	X	X	X	X	X	X
58	U.K.									X	X
59	U.S.A.							X	X	X	X
60	Venezuela										
61	Viet Nam										X
	Total	21	20	19	23	26	28	34	36	39	41

List of Planned Events

The following countries have offered to host the International Olympiad on Astronomy and Astrophysics in future years. Three of these have confirmed their intentions with official letters of support from the Ministry of Education or equivalent body; we are awaiting confirmation from the remainder. The list of hosts remains open beyond 2022.

11th IOAA (2017)	Phuket, Thailand	*12th to 21st November 2017*
12th IOAA (2018)	Sri Lanka	
13th IOAA (2019)	Hungary	*confirmed*
14th IOAA (2020)	Colombia	
15th IOAA (2021)	Serbia	
16th IOAA (2022)	Russia	

Impact on Local Programmes

The IOAA actively encourages the development of astronomy olympiad programmes on a local (national) level. Interest in participation and the positive experiences of participants in previous events have directly contributed to the establishment of national astronomy olympiad programmes or selection processes in a number of countries which did not previously have them, including among others Singapore, Canada, the United States and most recently the United Kingdom. In some cases these have been helped along by the assistance of former team leaders or participants who have moved for work or study reasons and have taken the idea of the Olympiad with them, helping to catalyse local efforts. Preparation for participation in the IOAA has also resulted in the organisation of 'mini-olympiads', training camps and other regional events, thus further popularising the idea of friendly competition in astronomy.

The chance to participate in an IOAA event, both as an international competition and as an 'adventure' in a distant country is a strong motivator for high-school students in many countries who choose to take part in national competitions. This can be particularly important in countries where astronomy is competing for able high-school students with other subjects, such as physics.

Sustainability

The IOAA has now been successfully organised annually for nine years, and countries willing to host at least the next seven have been found. The event has shown consistent growth in terms of the numbers of participants, and repeated attendance by almost all participating countries. Elections for the posts of President and General Secretary were held successfully in 2011, and the next elections are planned (in accordance with the Statutes) for 2016. Each year a number of former contestants from many countries return as team leaders, thus providing both additional insight to the International Board from the contestants' point of view, as well as replacements as older members retire or move on to other projects. The governance structure is based on democratic principles and cooperation. The organisation and planned events are thus not tied to particular individuals or personalities, and can be expected to continue into the foreseeable future.

Discussions are under way within the International Board regarding innovation in the competition using information technology and new competition formats, regarding financial support for the organisation and tuning the organisational structure to better manage the larger participation and ensure a high academic standard.

Appendix 1: Statutes

Including revisions agreed by the International Board on 2nd August 2015.

#1

In recognition of the growing significance of astronomy and related subjects in all fields of Science and Technology, including the general education of young people, and with the aim of enhancing the development of international contacts between different countries in the field of school education in astronomy and astrophysics, an annual competition in these subjects has been organized for high school students; the competition is called the "International Olympiad on Astronomy and Astrophysics" (IOAA). The International Olympiad on Astronomy and Astrophysics should be organized during the period of July – December.

#2

The competition is organized in one of the participating countries on whose territory the competition is to be conducted. Participation in the IOAA is restricted to teams from countries or territories with National Olympic Committees duly recognized by the International Olympic Committee, under the condition that they agree to abide by the Statutes of the IOAA and the decisions of the IOAA Board, and appropriate international legal and diplomatic agreements. In the event of a dispute regarding the official name of a participating team, the name recognized by the International Olympic Committee will be used.

The organizing country is obliged to ensure equal participation of all delegations, and to invite all the participants of any of the latest three competitions. Additionally, it has the right to invite other countries.

The International Olympiad on Astronomy and Astrophysics is a purely educational event. No country may have its team excluded from participation on any political ground resulting from political tension, lack of diplomatic relation, lack of recognition of some countries by the government of the organizing country, imposed embargo and similar reasons. When difficulties preclude formal invitation of the team representing a country, students from such a country should be invited to participate as individuals.

Any kind of religious or political propaganda against any other country at the Olympiad is forbidden. A country that violates this rule may be barred from participation.

Within five years of its entry in the competition a country should declare its intention to be the host for a future Olympiad. This declaration should propose a timetable so that a provisional list of the order of countries willing to host Olympiads can be compiled. A country that refuses to organize the competition may be barred from participation, even if delegations from that country have taken part in previous competitions.

#3

The competition is coordinated by the Ministry of Education or other appropriate institution of the organizing country. Hereunder, the term "Ministry of Education" is used in the above meaning.

The Ministries of Education of the participating countries, as a rule, assign the organization, preparation and execution of the competition to a scientific society or other institution in the organizing country. The Ministry of Education of the organizing country notifies the Ministries of Education of the participating countries of the name and address of the institution assigned to organize the competition.

#4

Each participating country sends one regular team consisting of high school students. Also students who finish their high school in the year of the competition can be members of a team. The age of the contestants must be less than twenty on June 30th of the year of the competition. Each team should normally have 5 students.

In addition to the students, two accompanying persons are invited from each country, one of which is designated as delegation head (responsible for the whole delegation), and the other – as pedagogical leader (responsible for the students). The accompanying persons become members of the International Board, where in they have equal rights. Members of the International Board are treated as contact persons for the participating countries concerning the affairs of the International Olympiad on Astronomy and Astrophysics until the following competition.

The competition is conducted in a friendly atmosphere designed to promote future collaborations and to encourage friendships in the scientific community. To that effect all possible political tensions among the participants should not be reflected in any activity during the competition. Any political activity directed against any individuals or countries is strictly prohibited.

The delegation head and pedagogical leader must be selected from scientists or teachers, capable of solving the problems of the competition competently. Normally each of them should be able to speak English.

The delegation head of each participating team should, on arrival, hand over to the organizers a list containing the contestants' personal data (first name, family name, date of birth, home address and address of the school attended) and certificates (in English) from the schools confirming the contestants attendance or graduation in the year of the competition.

#5

The organizing country has the right to invite guest teams in addition to the regular teams (no more than one guest team per country). Normally the guest team consists also of five students and two leaders. However, the leaders of the guest teams are not members of the International Board. Except for that, their duties are the same as those of the leaders of the regular teams.

Participation of a guest team always needs approval from the organizing country. The country sending a guest team pays all the expenses arising from its participation.
The next organizers are not obliged to invite guest teams present at the previous competition. Countries present with guest teams only are not obliged to organize the IOAA in the future.
Contestants from guest teams and guest teams are classified in the same way as regular teams. They may receive diplomas and prizes, their names should be identified with the letter “G” (“Guest”) in all official documents.

#6
The working language of the International Olympiad in Astronomy and Astrophysics is English. Competition problems and their solutions should be prepared in English; the organizers, however, may prepare those documents in other languages as well.

#7
The financial principles of the organization of the competition are as follows:
The Ministry which sends the students to the competition covers the round-trip travel expenses of the students and the accompanying persons to the place where the competition is held.
The Ministry of the organizing country covers all other costs from the moment of arrival until the moment of departure. In particular, this concerns the costs for board and lodging for the students and the accompanying persons, the costs of excursions, awards for the winners, etc.

#8
The competition consists of 2 parts: the theoretical competition (including short and long questions) and practical competition (including observations and data analysis). There should normally be 15 short and 2 or 3 long questions for the theoretical part. For the practical part, the organizer may give a set task on 1) observation, 2) paper-based practical problem, 3) computer-based problem, 4) planetarium simulation or combination of the four, which is expected to be solvable in 5 hours. The problems should involve at least four areas mentioned in the Syllabus.
The sequence of the competition days is decided by the organizers of the competition. There should be one free day between the two parts of the competition. The time allotted for solving the problems should normally be five hours for the theoretical part and five hours for the practical part. The duration of the Olympiad (including the arrival and departure days) should normally be 10 days.
When solving the problems the contestants may use non-programmable pocket calculators without graphics and drawing materials, which are brought by the contestants themselves. Collections of formulae from mathematics, chemistry, physics, etc., are not allowed.

#9
The host country has to prepare 5 short and 1 long spare of theoretical problems and 2 spare practical problems. They will be presented to the International Board if some of the originally presented is/are rejected by two thirds of members of the International Board. The rejected problem cannot be reconsidered.
The competition tasks are prepared by the host country.

#10
The theoretical part makes 50% of the total mark, and the practical part 50% (25% data analysis and 25% observation) of the total mark. The practical solutions should consist of theoretical analysis (plan and discussion) and practical execution. The solution to each problem should contain an answer and its complete justification.

#11
The contestants will receive diplomas and medals or honorable mentions in accordance with the number of points accumulated as follows:
The mean number of points accumulated by the three best contestants is considered as 100%.
The contestants who accumulated at least 90% of points receive first prize (diplomas and gold medals).
The contestants who accumulate 78% or more but less than 90% receive second prize (diplomas and silver medals).
The contestants who accumulate 65% or more but less than 78% receive third prize (diplomas and bronze medals).
The contestants who accumulate 50% or more but less than 65% receive an honorable mention (diplomas).
The contestants who accumulate less than 50% of points receive certificates of participation in the competition.
The participant who obtains the highest score (Absolute Winner) will receive a special prize and diploma.
Other special prizes may be awarded.

#12
In addition to the individual classification one establishes the team classification according to the following rules:
Teams consisting of less than three contestants are not classified.
For judging the best team, a task to be performed by the team as a whole will be designed. This task may form either a part of the theory exam, practical exam, or be held at a different time. In case it is included in the theory or practical exam, the duration of the individual exam may be suitably reduced. The test may contain theory, practical or observation aspect or any combination thereof. The host country will be free to decide which option to use or propose a different format in consultation with the Secretariat. This should be announced to all participants in advance.

#13

The obligations of the organizer:

1. The organizer is obliged to ensure that the competition is organized in accordance with the Statutes.
2. The organizer should produce a set of "Organization Rules", based on the Statutes, and send them to the participating countries in good time. These Organization Rules shall give details of the Olympiad not covered in the Statutes, and give names and addresses of the institutions and persons responsible for the Olympiad.
3. The organizer establishes a precise program for the competition (schedule for the contestants and the accompanying persons, program of excursions, etc.), which is sent to the participating countries in advance.
4. The organizer should check immediately after the arrival of each delegation whether its contestants meet the conditions of the competitions.
5. The organizer chooses (according to the Syllabus) the problems and ensures their proper formulation in English and in other languages set out in # 6. It is advisable to select problems where the solutions require a certain creative capability and a considerable level of knowledge. Everyone taking part in the preparation of the competition problems is obliged to preserve complete secrecy.
6. The organizer must provide the teams with guides.
7. The organizer should provide the delegation leaders with Photostat copies of the solutions of the contestants in their delegation at least 24 hours before the moderation.
8. The organizer is responsible for organizing the grading of the problem solutions and moderation.
9. The organizer drafts a list of participants proposed as winners of the prizes and honorable mentions.
10. The organizer prepares the prizes (diplomas and medals), honorable mentions and awards for the winners of the competition.
11. The organizer is obliged to publish the proceedings (in English) of the Olympiad. Each of the participants of the competition (delegation heads, pedagogical leaders and contestants) should receive one copy of the proceedings free of charge not later than one year after the competition.

#14

The International Board is chaired by a representative of the organizing country. He/she is responsible for the preparation of the competition and serves on the Board in addition to the accompanying persons of the respective teams.

All decisions, except those described separately, are passed by a majority of votes. In the case of equal number of votes for and against, the chairman has the casting vote.

#15
The delegation leaders are responsible for the proper translation of the problems from English (or other languages mentioned in # 6) to the mother tongue of the participants.

#16
The International Board has the following responsibilities:
1. To direct and supervise the competition to ensure that it is conducted according to the regulations.
2. To discuss the organizers' choice of tasks, their solutions and the suggested evaluation guidelines before each day of the competition. The Board can change or reject suggested tasks but cannot propose new ones. Changes may not affect practical equipment. There will be a final decision on the formulation of tasks and on the evaluation guidelines. The participants in the meeting of the International Board are bound to preserve secrecy concerning the tasks and to be of no assistance to any of the contestants.
3. To ensure correct and just classification of the prize winners.
4. To establish the winners of the competition and make decisions concerning the presentation of prizes and honorable mentions. The decision of the International Board is final.
5. To review the results of the competition.
6. To select the country which will be the organizer of the next competition.
The International Board is the only body that can make decisions on barring countries from participation in the International Olympiad in Astronomy and Astrophysics for the violation of these Statutes.
Observers may be present at meetings of the International Board, but may not vote or take part in the discussions.

#17
The institution in charge of the Olympiad announces the results and presents the awards and diplomas to the winners at an official ceremony. It invites representatives of the organizing Ministry and scientific institutions to the closing ceremony of the competition.

#18
The long term work involved in organizing the Olympiads is coordinated by a "Secretariat for the International Olympiad in Astronomy and Astrophysics". This Secretariat consists of the President and Secretary. They are elected by the International Board for a period of five years when the chairs become vacant.
The President and Secretary are members of the International Board in addition to the regular members mentioned in #4. They are invited to each International Olympiad in Astronomy and Astrophysics at cost (including travel expenses) of the organizing country.

#19
These statutes are supplemented by:
1. Regulations concerning the details of the organization.
2. The Syllabus mentioned in #8.
3. Supplementary material (including the Banner, Logo, Seal, Anthem, Publications, etc.)

#20
Changes in the present Statutes and Syllabus, the insertion of new paragraphs or exclusion of old ones, can only be made by the International Board and requires qualified majority (2/3 of the votes).
Changes in the Supplementary material can be made by simple majority (1/2 of the votes).
No changes may be made to these Statutes, Supplementary material or Syllabus unless each delegation has obtained written text of the proposal at least 3 months in advance.

#21
Participation in the International Olympiad in Astronomy and Astrophysics signifies acceptance of the present Statutes by the Ministry of Education of the participating country.

#22
The originals of these Statutes are written in English.

Appendix 2: Current Syllabus

General Notes

1. Extensive contents in basic astronomical concepts are required in theoretical and practical problems.

2. Basic concepts in physics and mathematics at high school level are required in solving the problems. Standard solutions should not involve use of calculus and/or the use of complex numbers and/or solving differential equations.

3. Astronomical software packages may be used in practical and observational problems. The contestants will be informed the list of software packages to be used at least 3 months in advance. The chosen software packages should be preferably freewares or low-cost ones enabling all countries to obtain them easily for practice purpose. The chosen softwares should preferably be available on multiple OSs (Windows / Unix / GNU-Linux / Mac).

4. Concepts and phenomena not included in the Syllabus may be used in questions but sufficient information must be given in the questions so that contestants without previous knowledge of these topics would not be at a disadvantage.

5. Sophisticated practical equipments likely to be unfamiliar to the candidates should not dominate a problem. If such devices are used in the questions, sufficient information must be provided. In such case, students should be given opportunity to familiarise themselves with such equipments.

6. The original texts of the problems have to be set in the SI units, wherever applicable. Participants will be expected to mention appropriate units in their answers and should be familiar with the idea of correct rounding off and expressing the final result(s) and error(s) with correct number of significant digits.

A. Theoretical Part

Symbol (Q) is attached to some topics in the list. It means “qualitative understanding only”. Quantitative reasoning / proficiency in these topics is not mandatory.

The following theoretical contents are proposed for the contestants.

1. Basic Astrophysics

Contents	Remarks
Celestial Mechanics	Newton's Laws of Gravitation, Kepler's Laws for circular and non-circular orbits, Roche limit, barycentre, 2-body problem, Lagrange points
Electromagnetic Theory & Quantum Physics	Electromagnetic spectrum, Radiation Laws, Blackbody radiation
Thermodynamics	Thermodynamic equilibrium, Ideal gas, Energy transfer
Spectroscopy and Atomic Physics	Absorption, Emission, Scattering, Spectra of Celestial objects, Doppler effect, Line formations, Continuum spectra, Splitting and Broadening of spectral lines, polarisation
Nuclear Physics	Basic concepts including structure of atom, Mass defect and binding energy Radioactivity, Neutrinos (Q)

2. Coordinates and Times

Contents	Remarks
Celestial Sphere	Spherical trigonometry, Celestial coordinates and their applications, Equinox and Solstice, Circumpolar stars, Constellations and Zodiac
Concept of Time	Solar time, Sidereal time, Julian date, Heliocentric Julian date, Time zone, Universal Time, Local Mean Time , Different definitions of "year", Equation of time

3. Solar System

Contents	Remarks
The Sun	Solar structure, Solar surface activities, Solar rotation, Solar radiation and Solar constant, Solar neutrinos (Q), Sun-Earth relations, Role

	of magnetic fields (Q), Solar wind and radiation pressure, Heliosphere (Q), Magnetosphere (Q)
The Solar System	Earth-Moon System, precession, nutation, libration, Formation and evolution of the Solar System (Q), Structure and components of the Solar System (Q), Structure and orbits of the Solar System objects, Sidereal and Synodic periods, Retrograde motion, Outer reaches of the solar system (Q)
Space Exploration	Satellite trajectories and transfers, Human exploration of the Solar System (Q), planetary missions (Q), Sling-shot effect of gravity, Space-based instruments (Q)
Phenomena	Tides, Seasons, Eclipses, Aurorae (Q), Meteor Showers

4. Stars

Contents	**Remarks**
Stellar Properties	Methods of Distance determination, Radiation, Luminosity and magnitude, Color indices and temperature, Determination of radii and masses, Stellar motion, Irregular and regular stellar variabilities – broad classification & properties, Cepheids & period-luminosity relation, Physics of pulsation (Q)
Stellar Interior and Atmospheres	Stellar equilibrium, Stellar nucleosynthesis, Energy transportation (Q), Boundary conditions, Stellar atmospheres and atmospheric spectra
Stellar Evolution	Stellar formation, Hertzsprung-Russell diagram, Pre-Main Sequence, Main Sequence, Post-Main Sequence stars, supernovae, planetary nebulae, End states of stars

5. Stellar Systems

Contents	Remarks
Binary Star Systems	Different types of binary stars, Mass determination in binary star systems, Light and radial velocity curves of eclipsing binary systems, Doppler shifts in binary systems, interacting binaries, peculiar binary systems
Exoplanets	Techniques used to detect exoplanets
Star Clusters	Classification and Structure, Mass, age, luminosity and distance determination
Milky Way Galaxy	Structure and composition, Rotation, Satellites of Milky Way (Q)
Interstellar Medium	Gas (Q), dust (Q), HII regions, 21cm radiation, nebulae (Q), interstellar absorption, dispersion measure, Faraday rotation
Galaxies	Classifications based on structure, composition and activity, Mass, luminosity and distance determination, Rotation curves
Accretion Processes	Basic concepts (spherical and disc accretion) (Q), Eddington luminosity

6. Cosmology

Contents	Remarks
Elementary Cosmology	Expanding Universe and Hubble's Law, Cluster of galaxies, Dark matter, Dark energy (Q), Gravitational lensing, Cosmic Microwave Background Radiation, Big Bang (Q), Alternative models of the Universe (Q), Large scale structure (Q), Distance measurement at cosmological scale, cosmological redshift

7. Instrumentation and Space Technologies

Contents	Remarks
Multi-wavelength Astronomy	Observations in radio, microwave, infrared, visible, ultraviolet, X-ray, and gamma-ray wavelength bands, Earth's atmospheric effects
Instrumentation	Telescopes and detectors (e.g. charge-coupled devices, photometers, spectrographs), Magnification, Focal length, Focal ratio, resolving and light-gathering powers of telescopes, Geometric model of two element interferometer, Aperture synthesis, Adaptive optics, photometry, astrometry

B. Practical Part

This part consists of 2 sections: observations and data analysis sections. The theoretical part of the Syllabus provides the basis for all problems in the practical part.

The observations section focuses on contestant's experience in

1. naked-eye observations,
2. usage of sky maps and catalogues,
3. application of coordinate systems in the sky, magnitude estimation, estimation of angular separation
4. usage of basic astronomical instruments–telescopes and various detectors for observations but enough instructions must be provided to the contestants.

Observational objects may be from real sources in the sky or imitated sources in the laboratory. Computer simulations may be used in the problems but sufficient instructions must be provided to the contestants.

The data analysis section focuses on the calculation and analysis of the astronomical data provided in the problems. Additional requirements are as follows:

1. Proper identification of error sources, calculation of errors, and estimation of their influence on the final results.
2. Proper use of graph papers with different scales, e.g., polar and logarithmic papers. Transformation of the data to get a linear plot and

3. Basic statistical analysis of the observational data.
4. Knowledge of the most common experimental techniques for measuring physical quantities mentioned in Part A.