Brief Statement of Activities 2023-24

सत्यमेव जयते

Government of India
Ministry of Science & Technology
Department of Science & Technology

Department of Science and Technology and its various institutions made some sincere efforts towards boosting the research, technology development and innovation ecosystem. These pictures represent some of the significant outcomes of Indigenous Technology Developments in the areas of Mega facilities for basic sciences, Integrated cyber physical systems, Student-led innovations, Astronomy and Socio-economic empowerment, etc.

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New Delhi

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OVERVIEW

Department of Science & Technology (DST) is the nodal agency in the country for strengthening science, technology and innovation; identifying gap areas in S&T sectors; and promoting new areas of S&T in view of future demands. DST also serves in connecting the science and technology sectors with different Government horizontals and verticals, academia, R&D labs/institutions and industries. DST provides extramural research and development support in the country to scientists cutting across institutions and disciplines through a competitive mode reinforcing the education system, scientific and industrial R&D and the overall Science, Technology and Innovation landscape of the country.

While a detailed account of achievements of activities during the year is presented in relevant chapters, some of the major achievements and initiatives during 2023 are briefly presented in the following sections:

- India retains 40th position in Global Innovation Index among the top innovative economies globally as per Global Innovation Index (GII) 2023. As per WIPO Report 2022, India is ranked at 7 position in terms of Resident Patent Filing activity in the world. India improves its ranking to 60th position (2023) from 79th position (2019) as per Network Readiness Index (NRI) 2023 report.
- **The ANUSANDHAN NATIONAL RESEARCH FOUNDATION (ANRF) 2023** Bill has been passed by the Parliament in its monsoon session to provide high level strategic direction for research, innovation and entrepreneurship in the fields of natural sciences and scientific and technological interfaces of humanities and social sciences and also to promote, monitor and provide support as required for such research.
- The **Fund for Improvement of S&T Infrastructure (FIST)** has enabled many R&D equipment facilities in institutions across the country and largely at the University and Academic sectors to perform cutting edge research. The FIST support was extended to 121 R&D equipment facilities with 61.48% funds allocated towards PG Colleges & Universities sector.
- **Promotion of University Research and Scientific Excellence (PURSE)** programme pro-actively supports strengthening the R&D base of the performing Universities. During the year, 11 newly established universities supported through a special announcement for undersupported regions. In addition to the special call, 13 New universities are also supported through an open call.

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- The 15 **Sophisticated Analytical Instrument Facilities (SAIF)** have so far been accessed by over 22000 users, analyzing over 125000 samples along with contributing to over 2800 publications from the users. About 125 Workshops/Training Programs have been conducted under the programme
- **Three Sophisticated Analytical & Technical Help Institutes (SATHI)** centres have been hosted in first phase at IIT Delhi, IIT Kharagpur and Banaras Hindu University, Varanasi. Initiatives have been launched to set up 3 new SATHI centers at IIT Hyderabad, ICT Mumbai and BITS, Pilani.
- **Synergistic Training program Utilizing the Scientific and Technological Infrastructure (STUTI)**: Around of 248 training programs and 132 awareness programs were successfully organized via active involvement of 13 PMUs for human capacity building.
- **Support for Upgradation Preventive Repair and Maintenance of Equipment (SUPREME),** a new initiative for the revival of major facilities established by DST Projects has been launched.
- **Policy Research Cell (PRCs):** Under the programme, 6 new Centres for Policy Research have been established along with support to the 2 ongoing CPRs to carry out STI policy research in different STI policy domains. In addition, 10 Satellite centres for Policy Research (SPRs) have been identified.
- **National Science & Technology Management Information System (NSTMIS)** continued conducting national surveys to generate and make available information on manpower as well as financial resources devoted to S&T activities. The National S&T Survey on Resources Devoted to Research and Development Activities, 2021-22 and National Manufacturing Innovation Survey, 2021-22 have been completed. Based on these surveys, seven national publications were prepared and published. Science, Technology and Innovation Indicators brought out for evidence-based policy planning for S&T sector of the country.
- **WISE-KIRAN (Knowledge Involvement in Research Advancement through Nurturing)** embraces women-exclusive schemes of DST with the mandate to bring gender parity in S&T through various mechanisms. During the current year, five (5) new programmes viz. WISE-IPR, WISE-PhD, WISE-PDF, WIDUSHI and WISE-SCOPE have been launched to promote women in different sectors. 128 women have been supported under WOS-A. Financial support was extended to 143 ongoing projects under WOS-A and 25 ongoing projects under WOS-B. The Vigyan Jyoti programme extended in Phase-IV to 250 districts of 34 states/UTs of the country.

- **Cognitive Science Research Initiative (CSRI)** encourages research in highly interdisciplinary area of cognitive science. 24 new projects have been supported along with 28 ongoing projects.
- **Innovation in Science Pursuit for Inspired Research (INSPIRE)** attracts young talent to study science from an early age contributing towards building the required human resource pool for strengthening and expanding the R&D base of the country. The INSPIRE- Scholarship for Higher Education (SHE) component supported 10,485 fellows. In addition, 846 applicants under INSPIRE Fellowship and 212 under INSPIRE Faculty have been offered Fellowships.
- The **INSPIRE-(MANAK) Million Minds Augmenting National Aspirations and Knowledge** received 8.54 lakh ideas from middle and high schools across the country. A total of 46,926 students have been shortlisted for providing financial assistance of Rs. 10,000/- each under the programme.
- **International Cooperation programme** continued towards fostering international bilateral cooperation and partnerships with more than 45 countries through dedicated regional and multilateral programmes. Supported around 350 bilateral, multilateral and regional R&D joint projects. VAIBHAV Fellowship was announced, covering 18 thematic research areas, wherein 22 proposals were recommended for support. Under a call for nominations, 2 candidates recommended for support out of the 7 submissions.
- **National Mission on Nano Science & Nano Technology** promotes basic research and focuses on Nano Technology adaptation and transfer to industry for use by masses. During the year, 16 technologies were transferred to suitable start-ups and industries. Similarly, 7 start-ups have been nucleated, 50 patents filed, 522 publications brought out and 336 manpower trained.
- The **Mega Facility for Basic Research** supported various activities including the participation in FAIR, Germany, Thirty Meter Telescope (TMT) in USA and Square Kilometer Array (SKA) in Australia and South Africa enabling Indian researchers for using such state-of-the-art research facilities for their research work.
- **Climate Change Programme**: A new Centre of Excellence (CoE) has been launched at University of Allahabad Along with strengthening of 11 State Climate Change Cells.
- **National Supercomputing Mission (NSM)** jointly implemented with MeitY targets to set up high performance systems ranging from a few 100 Tera FLOPS to Ten's of Peta FLOPS in the country. In the current year, an indigenous server called Rudra 1.0 has been developed using Intel Cascade Lake processor platform. Around 19,500 manpower has been trained under NSM through various training programs.

- **Technology Development Programme** supports R&D for development of innovative technologies in identified areas. The **Advanced Manufacturing Technology (AMT)** component supported 50 technology development projects. Four **Technology Enabling Centers (TEC)** created to strengthening the technology development ecosystem, a Centre for Marine Therapeutics at NIPER, Kolkata under **Therapeutic Chemicals**, 4 **Biomedical-hubs** have been supported and three brainstorming workshops organized for sensitization and awareness of technology development.

- **Clean Energy Research Initiative (CERI):** India hosted Mission Innovation (MI8) and Clean Energy Ministerial (CEM14) a global event focusing on clean energy solutions with participation from several countries and organizations. The programme also prioritized efficient and affordable solar energy solutions, supporting five National Challenge Grant projects on High-efficiency PV cells and modules.

- **Water Technology Initiative (WTI)** supported 21 projects under 'Optimal Water Use in Industrial Sector'. The projects have resulted in 92 publications, 10 book chapters and filing of 15 patents.

- **National Geospatial Programme (NGP)** aims at promoting R&D in emerging areas of Geospatial technologies and applications. Several projects have been carried out under the programme. A tripartite MoU has been signed between DST, NIGST & TiH IIT Tirupati for establishment of a Geospatial Innovation Hub (Centre of Excellence) in pilot mode to create a robust geospatial innovation ecosystem in the country. A CORS station has been established at the National Centre for Geodesy, IIT Kanpur, which is part of Asia-Pacific Reference Frame (APREF) and IGS network and supported 14 projects under "Geospatial Science Development".

- **National Science & Technology Entrepreneurship Development Board (NSTEDB)** is leveraging the technological strength of the higher learning institutes to nurture the technology start-ups. Supported *8* **NIDHI Centre of Excellences (NIDHI - CoE), supported 22+ Inclusive TBI (i-TBI)**. Seed support has been provided to 14 TBIs during the year. Under **DST - NIDHI's PRomoting and Accelerating Young and ASpiring technology entrepreneurs (PRAYAS)** supported 13 new *PRAYAS centres across the country,* **NIDHI's Entrepreneurs-in- Residence (EIR)** programme supported *10 new EIR centres.*

- **National Council for Science and Technology Communication (NCSTC)** largely aims at communicating and popularizing science and technology (S&T) to masses and stimulate scientific temper amongst them. Conferred 6 National Awards for S&T Communication and Popularization on National Science Day and 6 scholars (PhD & PDF) were given AWSAR prize. Around 0.25 million students participated in **National**

Children's Science Congress (NCSC). More than 200 static and mobile exhibitions were organized in different parts of the country under **STEMM India.**

- **Science for Equity Empowerment and Development (SEED) Programme** supports a variety of schemes towards the socio-economic empowerment and development of disadvantaged sections of the society. During the period, 12 Science Technology and Innovation (STI) Hubs established and supported establishment of Heritage Food and Beverage Research Centre in North Eastern states under Scheduled Caste Sub Plan and Tribal Sub Plan. Under Technology Interventions for Disabled and Elderly (TIDE), 15 various assistive tools and technologies focusing on various disabilities for improving the quality of life for elderly were developed. Released a Compendium of Technologies developed under SYST and supported 10 Women Technology Parks (WTPs) benefitting more than 900 women.
- A National Data Registry (NDR) has been built under **National Spatial Data Infrastructure (NSDI)** to enable data providing agencies publish their datasets/ products/ services onto a singular, standardized platform, 14 State Spatial Data Infrastructure (SSDI) established through cost-sharing between DST and State/ UT Governments in 70:30 mode.
- Organized the 9th edition of **India International Science Festival (IISF) – 2023** at the combined campus of THSTI- RCB, DBT in Faridabad, Haryana organized during 17-20 January, 2024.
- **National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS)**: 25 Technology Innovation Hubs setup in top-ranking national institutions almost in all states covering the entire country. Till date, Mission has developed 311 technologies, 549 technology products, 63000+ Human Resource, 1200 Jobs creation and nearly 124 international collaborations.
- The Department nurtures 25 **Autonomous Bodies (ABs)** including 16 research institutions, 4 specialized knowledge institutions and S&T service organizations and 5 professional bodies to contribute to the S&T eco-system of the country.
- **The Science and Engineering Research Board (SERB**), supports R&D funding in core areas of science, engineering and its interdisciplinary fields through competitive mode targeting the young scientists/researchers to start/initiate their research.
- **Survey of India** and **NATMO** continued efforts for strengthening Survey and Mapping activity and have made some significant contributions with several geospatial solutions catering to various domain services.

- **Technology Development Board (TDB)** as part of its financial assistance to industrial concerns and other agencies attempting development and commercial application of indigenous technology, has signed ten agreements for providing financial support. Organised the **National Technology Week 2023** to commemorate the 25th anniversary of India's landmark technological achievements.

The Department has made sincere efforts to utilize the allocated budget fruitfully to implement its planned activities and programmes during the year. DST and its autonomous institutions have contributed to overall development of the nation with meaningful S&T interventions.

1. S&T INSTITUTIONAL AND HUMAN CAPACITY BUILDING

The umbrella scheme S&T Institutional and Human Capacity Building mainly covers the programmes/schemes related to capacity building in terms of S&T infrastructure and critical human resources in S&T sector at different levels.

1.1 Research and Development Infrastructure

The scheme is devoted to enriching the nation's Science and Technology (S&T) environment through establishment of advanced research and development laboratories within academic and research institutions. These facilities not only enhance the technological capacities of universities and research institutes but also foster a dynamic environment for collaborative research initiatives. Achieving this objective involves a strong emphasis on promoting research collaboration, building synergies among institutions and encouraging interdisciplinary cooperation. Key achievements of the programme categorized by scheme are outlined below:

1.1.1 Fund for Improvement of S&T Infrastructure in Universities and Higher Educational Institutions (FIST)

The Program has enabled many departments across the country to perform cutting edge competitive research activities and establish modern teaching facilities largely at the University and Academic sectors. Currently, the Program is operated in competitive mode of support at four levels i.e. Level A, Level B, Level C and Level D covering six subject areas (Life Sciences, Physical Sciences, Chemical Sciences, Engineering Sciences, Earth & Atmospheric Sciences, Mathematical Sciences) and PG Colleges. Depending on the level, the total financial support is limited to Rs 1.50 Crore, Rs 3.0 Crore Rs 5.0 Crore and Rs 10.0 Crore for Level A, Level B, Level C and Level D, respectively.

Ever since its inception in 2000, the FIST Program has provided sustainable funding over more than two decades that has made deep impacts in many departments across the country to carry out advanced research in contemporary areas of science and technology and also set-up modern teaching facilities. The realm of the FIST Program has benefited many prestigious medical/ veterinary/ paramedical institutions in the country. This scheme also contributes to the improvement in quality of publications within the academic and research domains of India. Based on the call for FIST -2023, FIST Advisory Board (FISTAB) recommended support to 121 projects in various academic institutions. In which 61.48% funds recommended towards Colleges & Universities sector in the year 2023. In addition, grants were disbursed to 91 departments in various academic institutions and also to postgraduate colleges under ongoing projects. Project review is a crucial component for the successful execution of FIST projects.

In the current year, a total of 362 projects were reviewed, encompassing both ongoing and completed projects.

1.1.2 Promotion of University Research and Scientific Excellence (PURSE)

The PURSE programme is specifically designed for universities, aiming to primarily enhance their research infrastructure. Its core objective is to bolster the research capabilities of universities, empowering them to effectively address scientific problems leveraging their inherent potential. Provisions for safety infrastructure, scientific social responsibility (SSR) and industry collaboration have also been included in the restructured programme. Encouraging collaboration between universities, industry and international partners can facilitate the exchange of knowledge and resources, leading to more impactful research outcomes.

In 2023, grants were disbursed to 11 universities as part of “special drive under PURSE for under-supported regions” with an aim of establishing fundamental infrastructure and facilitating equipment facilities to foster R&D endeavors in the domains of emerging science & technology. This initiative specifically targeted UGC-recognized state-funded universities and private universities situated in the NE- region, Jammu & Kashmir, Chhattisgarh, Madhya Pradesh, Jharkhand, Bihar, Haryana, Telangana, Himachal Pradesh and Rajasthan. During the Year 2023, 13 new universities were supported under this scheme through an open call in addition to the special drive support in 2023. This targeted expansion of support not only reinforces the commitment to nurturing scientific excellence but also demonstrates a strategic vision aimed at fostering research capabilities in areas that hold promise for emerging scientific and technological breakthroughs. The dual approach of supporting both identified universities and addressing regional gaps reflects a comprehensive strategy to elevate the overall scientific landscape and promote inclusive growth across the academic spectrum. A major scientific event ‘Vishwavidyalaya Anusandhan Utsav 2023’ was organized by DST at Dr. Ambedkar International Centre, New Delhi, on 24 April 2023 to showcase the research accomplishments of Indian universities supported under the DST-PURSE scheme. This event marked a pioneering initiative in the DST, showcasing the research potentials within the university sector for the first time.

1.1.3 Sophisticated Analytical Instrument Facility (SAIF)

The SAIF program is being implemented to provide the facilities of sophisticated analytical instrument to the research in general and specially from the institutions which do not have such instruments to enable them to purse R&D activities requiring such facilities and keep pace with development taking place globally. Currently, 15 SAIF Centres (i.e. Indian Institute of Technology, Chennai; Indian Institute of Technology, Mumbai; Central Drug Research Institute, Lucknow; Punjab University, Chandigarh; NEHU, Shillong; Indian Institute of Science, Bangalore; All India Institute of Medical Sciences, New Delhi; Gauhati University, Guwahati; Charutar Vidya Mandal, Vallabh Vidyanagar; Sophisticated Test and Instrumentation Centre,

Cochin University campus, Kochi; Shivaji University, Kolhapur; Indian Institute of Technology, Patna; Indian Institute of Engineering Science and Technology, Shibpur; Mahatma Gandhi University, Kottayam and Karnataka University, Dharwad) are operating.

These facilities have so far been accessed by over 22000 users, analyzing over 125000 samples along with contributing to over 2800 publications from the users. About 125 Workshops/Training programs have been conducted under the programme. Efforts are being made to augment the existing facilities/centres with replacement of existing obsolete instrument and with addition of latest State-of-Art instruments.

1.1.4 Sophisticated Analytical & Technical Help Institute (SATHI)

Sophisticated Analytical & Technical Help Institutes (SATHI), a shared, professionally managed service and strong S&T infrastructure facility for intensifying the base of S&T infrastructure and manpower, S&T led innovation and start-ups, technology development and futuristic areas of S&T were established to meet the demands of researchers, scientists, students, start-ups, manufacturing units, industries and R&D Labs. So far, three SATHI facilities are established in first phase at IIT Delhi, IIT Kharagpur and Banaras Hindu University, Varanasi. The initiation of SATHI facilities across the country adopts a consortium approach involving academia, research institutes, non-government organizations, S&T councils and industries. Initiatives have been launched to set up three new SATHI centers at IIT Hyderabad, ICT, Mumbai and BITS, Pilani for establishing national level research infrastructure facilities.

1.1.5 Synergistic Training Program Utilizing the Scientific and Technological Infrastructure (STUTI)

Under the program, many innovative activities have been organized for creating human capacity building via providing open access and full sensitization on cutting edge research facilities to researchers/school students/industry persons, etc. Indeed, these activities act as a bridge to fill the gap between resource-endowed and resource-limited institutions, also promoted collaboration and fostered a sense of responsibility within the scientific community. 248 training programs and 132 awareness programs were successfully organized via active involvement of 13 PMUs from different regions and 167 institutes (including central/state government universities, IITs, NITs, IISERs, IISc, under graduate/post graduate colleges and private universities) with diverse geographical spread.

1.1.6 Support for Up-gradation Preventive Repair & Maintenance of Equipment (SUPREME):

A new programme, 'Support for Up-gradation Preventive Repair & Maintenance of Equipment (SUPREME)' has been launched during the year to facilitate repair/ upgradation/ maintenance/ retrofitting or acquiring additional attachment to increase functional capabilities of existing DST supported analytical instrumentation facilities in various institutions/laboratories/

academic institutions. This distinctive program is unparalleled in its kind and addresses a current necessity.

1.2 State Science and Technology Programme (SSTP)

State Science and Technology Programme (SSTP) supports State Science & Technology Councils set up in the states & UTs across the country for their S&T Human Resources to strengthen the Science Technology and innovation (STI) ecosystem. To facilitate the awareness about the Intellectual Property Rights (IPR) including patent, copyright, geographical indication etc. and protecting the same in Chhattisgarh, the Patent Information Centre was re-established.

1.3 Policy Research Cell (PRC)

To build and strengthen an institutional mechanism for a robust evidence-driven Science, Technology and Innovation (STI) policy system in India, DST has been implementing a Policy Research initiative. Under the programme, DST-Centres for Policy Research (DST-CPRs) have been established in different academic institutions across the country. These centres are engaged in targeted research in number of key STI areas relevant to the country, train scholars in STI policy domain and contribute towards better STI policy making. In addition, to generate a critical mass of policy professionals/researchers, DST has been supporting a STI Policy Fellowship Programme (DST-STI PFP). The DST-STI PFP provides scientists, engineers and policy enthusiasts, an opportunity to gain exposure from the close quarters of policy making and contribute their knowledge and analytical skills in the STI policy realm.

During the current year, financial support was extended to 6 new CPRs along with the 2 ongoing CPRs to carry out policy research in different STI policy domains and 10 new Satellite centres for Policy Research (SPRs) have been identified. So far, five cohorts of DST-STI fellowships have been supported and the recruitment of 6th cohort is under process.

1.4 National Science and Technology Management Information System (NSTMIS)

The National Science and Technology Management Information System (NSTMIS) programme being implemented since inception of the department, is responsible for assessment and benchmarking of S&T potential of the country. NSTMIS is primarily entrusted with the task of collection, collation, analysis and dissemination of vital S&T information at a national level. A number of national S&T reports are published, providing vital information on national R&D indicators which serves as an evidence-base for S&T assessment and policy formulation.

1.4.1 S&T Resources Studies

The National S&T Survey on resources devoted to research and development activities, 2021-22 completed during the period. Based on this survey, two national publications

i.e. **"Research and Development Statistics at a Glance, 2022-23"** and "**Science & Technology Indicators Tables, 2022-23**" were prepared and published. The latest data on the S&T indicators brought out reflects the status of national STI ecosystem. The salient findings of this survey are:

- The Gross Expenditure on R&D (GERD) in the country has more than doubled from Rs. 60,196.75 crore in 2010–11 to Rs. 127,380.96 crore in 2020–21.
- India's GERD as percentage of GDP remained at 0.66% and 0.64% during the years 2019–20 and 2020–21, respectively.
- India's per capita R&D expenditure has increased to current PPP$ 42.0 in 2020–21 from current PPP$ 29.2 in 2007–08.
- GERD is mainly driven by the Government sector comprising Central Government (43.7%), State Governments (6.7%), Higher Education (8.8%) and Public Sector Industry (4.4%) with Private Sector Industry contributing 36.4% during 2020–21.
- Amongst the 12 Central Government Major Scientific Agencies, DRDO accounted for the maximum share of 30.7% of R&D expenditure followed by DOS (18.4%), ICAR (12.4%), DAE (11.4%), CSIR (8.2%) and DST (6.8%), DBT (4.4%) and ICMR (3.1%), MeitY (2.2%), MoES (1.5%), MoEFCC (0.8%) and MNRE (0.1%) during 2020–21.

National Manufacturing Innovation Survey (NMIS) 2021-22, in collaboration with UNIDO, Austria completed during the period. Based on the survey, 7 reports (5 Sectorial Reports, 1 Firm Level Report & 1 Summary Report) were brought out and are available on DST website. The salient findings of this survey includes:

- First India Manufacturing Innovation Index (IMII) was created, for comparing innovation performance across the 28 states and 6 union territories of India.
- 25.01% of the 8,074 firms surveyed were innovative - they have successfully implemented either new or significantly improved products or processes.
- One-fifth of the firms surveyed indicated successful innovation outcomes.
- The NMIS study of Sectorial Systems of Innovation identified the urgent need for participation of Arbitrageurs (banks, financial institutions, venture capital and angel investors) and Intermediary organisations (industry associations, institutions supporting technical change and incubators) and a well-diffused ICT in the context of the fourth industrial revolution (I4.0), to improve the sectorial systems of innovations.
- Further, the SSI study presents sector specific findings on knowledge and resource flows within and between the actors (Linkages) for fostering innovation is presented in the report. The survey provides barriers' analysis to innovations within each of the sectorial system of innovation.

1.4.2 Information System/Database Activities

With a view to disseminate information on sponsored research and development (R&D) projects for the benefit of different stakeholders, NSTMIS since 1990-91, has been continuously engaged in compiling information on extramural R&D projects funded by various central S&T agencies and publishing an annual Directory of Extramural R&D Projects. The latest directories "**Directory of Extramural R&D Projects"** for the years **2019-20 and 2020-21** have been published together. The key highlights of Directory of Extramural R&D projects, 2020-21 are:

- Total number of Extramural projects were 3180 in 2020-21 as compared to 4076 in 2019-20 with the support of Rs. 2002.70 Crore in 2020-21 as compared to Rs. 2529.42 Crore in 2019-20.
- The two departments under Ministry of Science and Technology i.e. DST & DBT together contributed to 73% of the total extramural R&D funding in India.

1.4.3 NSTMIS Sponsored Studies

As a part of its outreach research programme, NSTMIS has sponsored several research studies/projects to various stakeholders viz. research institutions, universities, colleges, NGOs and consultancy organizations spread across the country. At present, there are 25 ongoing projects under the programme. The completed project reports/studies are available in public domain through a web-based digital repository (http://www.nstmis-dst.org/NSTDRepository.aspx).

1.4.4 International Collaboration

The department has actively participated and contributed in the UNESCO Institutes of Statistics (UIS) and Organization for Economic Cooperation and Development (OECD) meetings for the development and revision of standards/concepts/definitions used for collection of Science Statistics and development of Science, Technology and Innovation Indicators. The department also provided information for the country on Science & Technology Indicators to UNESCO Institute for Statistics for the Global database on S&T Indicators and other related publications such as UNESCO Science Report etc.

1.5 Training of Scientists and Technologists Working in Government Sector

Department of Science & Technology (DST) continues its programme of Human Resource Development namely 'National Programme for Training of Scientists & Technologists working in Government Sector' for scientific and technical personnel during 2023-24 as well. The programme strives to achieve better understanding about professional requirements, enhancing professional knowledge and skills needed for better performance of individuals

and organizations in the domain of science and technology, creating awareness of latest technological, economic and social developments.

Target groups for the training are Scientists/ Technologists holding working in scientific ministries/ departments of Govt. of India and State Governments, Autonomous Institutions/ Public Sector Undertakings of Central/State Governments, Research and Development Institutions/ Research Laboratories of Central/ State Governments, Central/ State Universities, State Science & Technology Councils. 26 training programmes were approved in the FY 2023-24 under this scheme with a target to train 600 scientists.

Government of India launched the National Programme for Civil Services Capacity Building (NPCSCB) – 'Mission Karmayogi' in September 2020 with the objective of enhancing governance through Civil Service Capacity Building. Capacity Building Commission (CBC) has developed Annual Capacity Building Plan (ACBP) in consultation with Capacity Building Unit (CBU) of DST and the same was launched by Hon'ble MOS(I/c)- S&T on 17.08.2023.

1.6 Women in Science and Engineering-KIRAN (WISE-KIRAN)

The 'Women in Science and Engineering-KIRAN (WISE-KIRAN)' programme aims to promote participation of girls and women in Science & Technology sector towards bringing gender parity in S&T and has several windows to cater to women from all walks of life. This year several new programmes have been initiated under the WISE-KIRAN Scheme. The achievements under WISE-KIRAN during the period are as follows:

1.6.1 New Initiatives

During 2023-24, five (5) new programmes have been launched to promote women in different sectors.

- **WISE Internship in Intellectual Property Rights (WISE-IPR)** programme has been launched with the target to train women aged 25-45 years in the field of Intellectual Property Rights (IPRs). A total of 2741 women have applied for this internship and finally, 100 women scientists have been selected.
- **WISE Fellowship for Ph.D. (WISE-PhD)** Programme aims to provide opportunities to women of the age group of 27-45 years to pursue Ph.D. in basic and applied sciences. 909 proposals in five (5) subject areas have been received during 2023. The division has conducted four (4) meetings of Subject Expert Committees wherein 296 proposals have been evaluated and finally, project proposals of 70 women scientists have been recommended for financial support.
- **WISE Post-Doctoral Fellowship (WISE-PDF)** programme provides support to carry out research in five (5) subject areas of Basic and Applied Sciences. A total of 1011 proposals have been received under WISE-PDF and 690 proposals have been evaluated by the

Subject Expert Committees. Finally, 91 project proposals have been recommended for budgetary support.

- **WIDUSHI (Women's Instinct for Developing and Ushering Scientific Heights and Innovation)** initiative of DST is opening vistas for senior women scientists who have the potential to conduct cutting-edge research and have a flair to nurture budding researchers. The programme supports two (2) categories of senior women scientists viz. who are not in regular employment and retired women scientists. Around 70 proposals have been received in this programme.
- **WISE-SCOPE:** This unique initiative provides an opportunity to women to address societal challenges through their S&T expertise. The programme has identified five (5) thematic areas including Agriculture and Allied Sciences, Health, Food & Nutrition, Engineering & Technology, Climate Change and Environment and Waste and Water Management. A total of 66 proposals have been received under the programme.

1.6.2 Ongoing Programmes

Vigyan Jyoti: The Vigyan Jyoti Programme aims to encourage girls to pursue career in Science, Technology, Engineering and Mathematics (STEM) fields where participation of women is low. During 2023, the programme has been extended in Phase-IV to 250 districts of 34 states/UTs of the country. Vigyan Jyoti is providing various interventions to 21600 meritorious girls of Class IX-XII from JNVs, KVs, Army and other Government Schools in Phase-IV. IBM India has renewed its MoU with NVS to continue various activities under Vigyan Jyoti in future.

Women Scientists Programme: The Women Scientists Programme provides opportunities to women scientists who had a break in their careers to pursue research. This year 128 women have been supported under WOS-A and financial support has also been extended for 143 ongoing projects under WOS-A and 25 ongoing projects under WOS-B. Progress has also been evaluated of 198 ongoing projects under WOS-A and 168 projects under WOS-B by different Subject Expert Committees.

CURIE (Consolidation of University Research for Innovation & Excellence): In 2023, two (2) Women Universities and 18 Women PG Colleges in the country have been supported under CURIE programme for improving R&D infrastructure and establishing state-of-the-art laboratories to create excellence in the S&T domain.

Gender Advancement for Transforming Institutions (GATI): The pilot phase of the GATI programme has been completed in 2023. The institutions have submitted self-assessment reports to DST which have been evaluated by the Expert Committees. Based on the evaluation reports and final assessment by the Programme Advisory Committee, 12 institutions have been identified as GATI achievers.

Outreach Activities: A five-day training workshop on 'Brain Science and Artificial Intelligence' has been organized at the Indian Institute of Technology, Delhi for budding women neuroscientists. About 100 young female scientists and engineers from across India, from undergraduate to postdoctoral level have participated in this workshop. Further, the International Women's Day on 8th March 2023 has been celebrated under the programme.

1.7 Cognitive Science Research Initiative (CSRI)

The Cognitive Science Research Initiative (CSRI) encourages research in highly interdisciplinary areas of cognitive science to address various questions by combining ideas, principles and methods of psychology, computer science, linguistics, philosophy, neuroscience etc. During 2023-24, financial support was extended to 24 new projects along with 28 ongoing projects. Further, financial support has also been extended for 12 ongoing projects of the SATYAM (Science and Technology of Yoga and Meditation) programme. Task Force meeting was conducted to review the progress of 54 projects under CSRI, 49 projects under SATYAM and 12 projects under CSRI-PDF.

1.8 Innovation in Science Pursuit for Inspired Research (INSPIRE)

INSPIRE is a flagship programme of DST which aims to attract meritorious youth to study basic and natural sciences at the college and university level and to pursue research careers in both basic and applied science areas including engineering, medicine, agriculture and veterinary sciences. The ultimate aim is to expand the R&D base of the country. INSPIRE progamme is aligned with the 'Minimum Government, Maximum Governance Model' as it makes use of technology in its operations right from submission of application to the delivery of grants. The programme is implemented through the dynamic INSPIRE web-portal and scholarship(s)/ fellowship(s) are released to the INSPIRE beneficiaries on receipt of the requisite documents through online mode. INSPIRE web-portal is also integrated with UMANG and has its Mobile application for the INSPIRE aspirants/beneficiaries.

- **INSPIRE Internship** component of INSPIRE was reinstated after post pandemic stabilisation of the academic institutions. Scheme Guidelines for the year 2023 and Expert Committee for consideration of INSPIRE Internship proposal was reconstituted with the approval of Competent authority.
- **Scholarship for Higher Education (SHE)** component aims to attract top 1% rank holder students to pursue their career in basic and natural science areas in higher academic qualifications by providing scholarships and mentorship grants. The scheme offers 12,000 Scholarships every year @ Rs 0.80 lakh per year (including Mentorship grant) for undertaking Bachelor and Master level qualification in natural and basic sciences for the talented youth in the age group of 17-22 years. Main feature of this component is to develop interest in scientific research among UG and PG level science students through research projects during their vacation period. Call for applications for 2022

for INSPIRE-SHE was completed and in response, 16,522 applications were received. 10,045 INSPIRE scholarships have been offered to the selected candidates. Also, 440 INSPIRE scholarships have been offered to the selected candidates through institutes (institute mode). Out of the total students who were offered INSPIRE SHE scholarship, 54% were Female.

- **INSPIRE Fellowship** component offers 1000 Fellowships every year for carrying out doctoral degree in both basic and applied sciences including engineering and medicine in the age group of 22-27 years. INSPIRE fellowship is offered to students having secured 1st rank in basic & applied sciences including Engineering, Medicine, Agriculture, Veterinary at the university/ academic institute of national importance i.e. IITs, NITs, IISERs level examination. Students who have obtained scholarship at UG and PG level under INSPIRE-SHE are eligible for INSPIRE Fellowship if they have secured 70% marks in aggregate at the M.Sc. level and taken admission to the Ph.D. Program in any recognized university/ academic institutions in the country. The fellowships are tenable for a maximum of five years (2 years as JRF and 3 years as SRF) period or completion of PhD, whichever is earlier to pursue full-time PhD program. The fellowship amount including the contingencies is equivalent to CSIR-UGC NET Fellowship and is governed by GoI norms & regulations.

  The Level-1 scrutiny of applications of INSPIRE Fellowship Call 2022 has been completed and out of 2,038 received applications, 1811 applications were cleared in the level-1 evaluation. The applicants who have cleared level 1 evaluation and are not yet registered for Ph.D. are given one-year time to upload the requisite documents like research proposal etc. Upon Level-2 evaluation of applications, so far, 846 INSPIRE Fellowship applicants have been offered INSPIRE Fellowship. Out of the awarded/ offered INSPIRE Fellows 65% are female and 35% are male. Of the total awarded/ offered INSPIRE Fellows, about 33% are SHE Scholars who have joined doctoral degree program in science and technology after availing 5 years INSPIRE Scholarship. A total of 347 INSPIRE Fellows were promoted from Junior Research Fellowship (JRF) to Senior Research Fellowship (SRF) after evaluation of the research work carried out by them. Nine INSPIRE Fellows have been selected for participation in 15th JSPS-HOPE meeting scheduled to be held in Japan during February-March 2024.

  Two research exposure cum training programs, one each in Artificial Intelligence and Machine Learning in Natural Sciences and Biomedical Sciences were organised for the students from North-Eastern States and UTs of Jammu and Kashmir and Ladakh and trained 26 talented youth from these states/UTs to excite them to opt research career in these frontier areas of Science Technology and Innovation.

- **INSPIRE Faculty Fellowship** provides opportunities to the post- doctoral researchers in the age group of 27-32 years for 5 years INSPIRE Faculty Fellowship in both basic

and applied sciences area including engineering, agriculture, veterinary and medicine. Each fellow receives fellowship of Rs 1,25,000/- per month with an annual increment of Rs. 2000/- and Rs. 35 lakh (at the rate of Rs 7.0 lakh per year) of Research Grant for 5 years.

During the year, 212 INSPIRE Faculty Fellows received their fellowship and are pursuing the post- doctoral research through contractual and tenure track position for 5 years in both basic and applied science areas including Engineering, Agriculture, Veterinary and Medicine. During the year, 99 INSPIRE Faculty Fellowships were supported in academic and research institutions. Out of the 40% are female and 60% are male. Also, research progress of 281 INSPIRE Faculty Fellows, beneficiaries from July, 2016 to July, 2018, was reviewed with the help of Expert Committees in the areas of Chemical Sciences, Earth and Atmospheric Sciences, Engineering Sciences, Life Sciences, Material Science Mathematical, Sciences and Physical Sciences.

About 2021 applications have been received against the 2023 call of INSPIRE Faculty Fellowship for award of INSPIRE Faculty Fellowship. INSPIRE Faculty Fellowship selection process is in progress.

1.9 INSPIRE – MANAK

DST is implementing a national programme, INSPIRE MANAK (Million Minds Augmenting National Aspiration and Knowledge) with objectives to promote creative thinking and foster a culture of innovation among young students and to attract young students to study science and pursue a research career. Following are some the key achievement under INSPIRE – MANAK programme during the period:

- INSPIRE MANAK has successfully reached schools and students across the nation, promoting STEM education. A total of 8.54 lakh ideas and innovations were mobilized from schools of all States and UT's across the country during the year 2023-24.
- All 36 States and UT's participated in the program.
- 53% of nominations received from Girls and 47% from Boys.
- 83.6% of participating schools are based in rural parts of the country.
- A total of 46926 school students have been selected for INSPIRE- MANAK in the FY 2023-24 and provided with financial assistance of Rs. 10000/- each.
- The 10th National Level Exhibition and Project Competition was held during 09-11 October 2023 in New Delhi. Hon'ble Minister of Science and Technology graced the event and felicitated the top 60 winners.

2. RESEARCH AND DEVELOPMENT

2.1 International Cooperation (IC)

The International Cooperation programme of the department is assigned with activities: (i) negotiating, finalizing and executing Science & Technology agreements between India and collaborating nations; (ii) fostering scientific research and development initiatives through diverse regional and multilateral platforms; (iii) delivering insights on Science and Technology matters in international forums. These activities performed in collaboration with the Ministry of External Affairs, Indian Missions abroad, S&T Counsellors in Germany, Japan, Russia and the USA, stakeholders in scientific, technological and academic institutions, sister scientific government departments and various industry associations in India. Some of the key highlights and achievements towards fostering international cooperation and partnerships during the period are as under:

- The Department is actively engaged in bilateral Science and Technology (S&T) cooperation programs with over 45 countries. This includes dedicated initiatives for various regions and multilateral programs such as the Asia Cooperation Dialogue (ACD), Africa, Association of Southeast Asian Nations (ASEAN), Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC), Brazil, Russia, India, China and South Africa (BRICS), European Union (EU), Indian Ocean Rim Association (IORA), Indo-Pacific Oceans Initiative (IPOI), Shanghai Cooperation Organisation (SCO) and neighbouring countries. Additionally, the Department participates in various United Nations programs, including the United Nations Educational, Scientific and Cultural Organization (UNESCO), Organisation for Economic Co-operation and Development (OECD), United Nations Commission on Science and Technology for Development (UNCSTD), among others.
- Dissemination of information and networking through about 70 bilateral workshops, symposiums and exhibitions.
- Facilitation of bilateral advanced schools and training programs including participation of young student researchers in international meets.
- About 350 bilateral, multilateral and regional R&D joint projects including multi-institutional networked projects.
- About 35 Industrial and applied R&D projects involving industry participation with Canada, France, Germany, Israel, Italy, Russia, Spain, South Korea, Sweden and USA.

- Co-investment of resources including funds for symmetric joint research projects and strategic joint initiatives with Australia, Israel, Japan, Portugal, Russia and United Kingdom.
- Support to bi-national S&T Centres under institutional framework- Indo-French Centre for Promotion of Advanced Research, Indo-German S&T Centre and Indo-U.S. S&T Forum.
- Provision for Human Capacity Development for scientists/ researchers from select neighbouring countries researchers, Africa and ASEAN region to undertake R&D work in India.
- Proactive engagement and participation in international advanced research facilities like FAIR and DESY in Germany, Indian beam-line facility at KEK Japan, CERN in Geneva, Elettra in Italy and Rutherford Appleton Lab in UK.
- An individual **Joint Committee Meetings (JCM)** on Science, Technology and Innovation Cooperation with Netherland, Taipei and South Africa.
- The **Seventh Session of the Heads of Ministries and Agencies of Science and Technology of the SCO Member States**, chaired by Dr. Jitendra Singh, Hon'ble Minister of Science and Technology, Govt. of India, took place virtually at Anusandhan Bhawan, New Delhi, on 16.05.2023. The meeting focused on shaping and advancing programs and projects of scientific and technical cooperation aligned with mutual interests, guided by the SCO Charter and the Agreement between Governments of the SCO Member States on Scientific and Technical Cooperation.
- A **Memorandum of Understanding (MoU)** on Research and Innovation has been signed with the newly formed Department of Science, Innovation and Technology of the United Kingdom. This collaboration aims to foster research and innovation between the Governments of the United Kingdom and India, promoting long-term sustainable growth. The MoU seeks to enhance and maximize cooperation in research and innovation across government bodies, public entities, research organizations, higher education institutions, start-ups and industry.
- The **India-Japan Cooperative Science Programme (IJCSP)** introduced a new call for proposals, titled "*IJCSP, 2023*," maintaining the collaborative effort between the Department of Science and Technology (DST) in India and the Japan Society for the Promotion of Science (JSPS) in Japan. The call welcomed project submissions across various domains, including Physical Sciences, Chemical Sciences, Life Sciences and Agriculture, Mathematics and Computational Science, Astronomy and Earth Science, as well as Materials and Engineering.
- Participated in **G-20 meeting on Research & Innovation** Gathering track as a Presidency candidate. Member countries expressed their appreciation for successful

completion of G-20 in follow up meetings and reaffirmed their commitment to strengthen collaborative efforts in Science, Technology and Innovation.

- The **11th BRICS Science, Technology and Innovation (STI) Ministerial** Meeting took place on August 4, 2023. Significant outcomes included the adoption of two key documents: the BRICS Science, Technology and Innovation Declaration for 2023 and the BRICS Calendar of Science, Technology and Innovation activities for 2023-2024.
- During the 4th edition of the **ASEAN India Grassroots Innovation Forum (AIGIF)**, two grassroots innovators and one student innovator from India were honoured in the grassroots innovation and student innovation competition, respectively. Malaysia's Ministry of Science, Technology and Innovation (MOSTI) hosted this flagship program, which concluded on November 30, 2023.
- As part of India's efforts to foster S&T partnerships with neighbouring countries, the Department of Science and Technology (DST), Government of India, has initiated the **India Science and Research Fellowship (ISRF) Programme**. The program, active since 2015, aims to engage researchers from Afghanistan, Bangladesh, Bhutan, Maldives, Myanmar, Nepal, Sri Lanka and Thailand. In the latest round, 50 candidates have been recommended for the prestigious ISRF award, facilitating collaborative research in Indian Universities and Research Institutions.
- Creation of a dedicated cell for interaction with Indian STEM diaspora and implementation of **VAIBHAV Fellowships** and **Distinguished VAIBHAV Fellowships.** The VAIBHAV Summit, initiated on October 2, 2020 by the Hon'ble Prime Minister, serves as a platform to link the global Indian scientific community (STEMM diaspora) with institutions in India. The Government of India has taken a progressive stride by introducing the VAIBHAV Research Programme. The inaugural cycle of VAIBHAV Fellowships, announced on June 15, 2023, covering 18 thematic research areas, concluded its first call on July 31, 2023. Out of the 302 applications received, 22 proposals were recommended for support under this call. The call for nominations resulted in the receipt of 7 submissions for Distinguished VAIBHAV Fellows. Subsequently, the Apex Committee reviewed the nominations and recommended the support of 2 candidates out of the 7 submissions.

2.2 Nano Science and Nano Technology

The Nano Science and Technology program primarily focus in supporting the basic and applied research of the nation wherein technology readiness level scale 1-9 are being supported through competitive funding. It also supports the post-doctoral fellowship under Nano S&T and caters to the international facilities users programme which provides access to various beamline and state-of-the-art facilities to the Indian researchers. Few scientific highlights from the report outputs are as follows:

- Agarkar Research Institute, Pune has reported the PLGA based nanoparticle formulations vaccine for Chikungunya which tested with antigen load showed promising results in preliminary experiments. Further exploration is under process.
- ICAR-National Research Centre on Equnies, Hisar reported the development of QS loaded nanoparticle-based drug synthesized to control the Trypanosoma evansi. Validation of the synthesized particle is under progress. Two journal articles are published.
- Design of smart carrier based on mesoporous silica nanoparticles for herbicide delivery system is reported by ICAR-National Rice Research Institute, Cuttack.
- Under NNetRA (inter-ministerial program) as on 2023, 16 technologies has been transferred to suitable start-ups and industries. Similarly, 7 start-ups are nucleated, 50- patents filed/granted, 522 publications and 336 manpower trained. The Soilsens moisture sensor developed under this program is listed in the GeM portal.

2.3 Mega Facilities for Basic Research

Mega science projects are very long-term projects which involve state-of-the-art technologies and very complex issues. Such projects require very large resources both in terms of funds and expertise. Because of these reasons, such projects are manifestly multi-agency, multi-institutional and most often, international in character. Mega Facilities for Basic Research scheme is aimed to enable participation of Indian researchers in such state-of-the-art research facilities abroad, especially from academic and scientific sectors and to create such facilities in and out of the country. In many of these projects, Department of Science and Technology (DST) is partnering with other governmental agencies, viz. Department of Atomic Energy.

Under this programme, Indian researchers are participating in experiments at Large Hadron Collider (LHC), European Organization for Nuclear Research (CERN), Geneva, Brookhaven National Laboratory (BNL), USA Elettra Sincrotrone, Italy, Fermi National Accelerator Laboratory (Fermilab), USA. Also, India is a partner in establishment of international facilities like Facility for Antiproton and Ion Research (FAIR) in Germany, Thirty Meter Telescope (TMT) in USA and Square Kilometer Array (SKA) in Australia and South Africa. During the year, lot of developments took place and the notable ones are described below project-wise.

2.3.1 Indian Participation in Research Initiatives at LHC, CERN:

Indian researchers are participating in Compact Muon Solenoid (CMS) Experiment and A Large Ion Collider Experiment (ALICE) at CERN. In addition, they are also involved in utilization of Regional Worldwide Large Hadron Collider Computing Grid (WLCG) for CMS and ALICE experiments. India is also an Associate Member State of CERN. The important achievements from these initiatives are as under.

- **Indian Participation in CMS Experiment at LHC, CERN:** Indian participation in the experiment involves 32 Indian faculty members/scientists and about 70 PhD students/ post-docs from 13 institutions. During the year, 15 research publications were produced with Indian faculties/students as the lead authors and 15 PhDs.
- **Indian Participation in ALICE/STAR Experiment at CERN/BNL:** 15 Indian research groups involving 30 scientists/engineers and 60 PhD students/post-docs continued their work in ALICE experiment at CERN and Solenoid Tracker at RHIC (STAR) experiment at BNL, USA. Output from the project also included 6 PhDs.
- **Utilization of Regional WLCG:** During the year, two Tier-2 Centers at Mumbai and Kolkata continued processing voluminous data obtained from CMS and ALICE experiments, thereby supporting the researchers from 29 Indian research groups.

2.3.2 Indian Institutions-Fermilab Collaboration in Neutrino Physics:

Indian researchers are participating in ongoing neutrino experiments at Fermilab, USA which includes 14 faculty members, 20 PhD students and 2 post-docs from 9 research groups across the country. At present, 9 PhD students are stationed at Fermilab for experiments. Output from the project included 10 collaborative research publications, 15 other research publications, 3 PhDs and, training of about 10 human resources.

2.3.3 Utilization of Indian Beamlines, XRD2 and Xpress, at Elettra Synchrotron, Italy:

During the year, utilization of Indian beamlines, XRD2 and Xpress beamlines at Elettra continued. Around 27 experiments carried out involving 16 institutions. The output included 22 research publications and 6 PhDs.

2.3.4 Low-Energy Accelerator-based Research Facility at Kurukshetra University:

During the year, more than 30 experiments were performed with gaseous and solid ions. Output from the project included 9 research publications and 14 conference papers.

2.3.5 Indian Participation in FAIR project at Darmstadt, Germany:

India is participating in construction of FAIR as a Founder-Member partner. Civil construction of the project completed and installation of accelerator components has been scheduled. Output from the project included 2 research publications, 17 conference papers and 6 PhDs.

2.3.6 India's Participation in TMT project at Mauna Kea, Hawaii, USA:

India is participating in construction of TMT as a Founder-Member partner with continued support from DST and DAE. India-TMT continued design, development and prototyping activities towards its in-kind commitments to the project involving 28 Indian industries.

In addition to developmental activities, the project resulted in 1 scientific and technical publication, 5 PhDs were ongoing, 6 Outreach activities were undertaken by India-TMT team members.

2.3.7 Indian Participation in Square Kilometer Array (SKA) project in Australia and South Africa:

SKA is an upcoming next-generation global radio astronomy facility. During the year, Government of India granted approval for Indian participation in the project.

2.3.8 Establishment of Laser Interferometer Gravitational-wave Observatory-India (LIGO-India):

LIGO-India aims to establish 3rd Detector of LIGO in Hingoli District in Maharashtra. During the year, Government of India granted approval for the project.

2.4 Climate Change Programme

The Department has been implementing two National missions on Climate Change. These are (a) National Mission for Sustaining the Himalayan Ecosystem (NMSHE) and (b) National Mission on Strategic Knowledge for Climate Change (NMSKCC). Both missions aim to build human and institutional S&T capacities, generate strategic knowledge and create awareness in the key areas of climate change science, impacts and adaptation. Important highlights and achievements of the activities during the period are as under:

- Launched Capacity Building Program in Glaciology spanning three years (2023-2026), the program focuses on theoretical aspects of glaciology, advanced research methodologies, utilization of state-of-the-art facilities and instruments, glacier field training and engagement with a highly skilled team of field glaciologists. The 21-day capacity building program was conducted from September 11 to 30, 2023 at University of Kashmir and at the Machoi Glacier site, Drass, Ladakh.
- Hosted an exclusive technical side-event on Climate Change Vulnerability in the Himalayan Region: Impacts and Implications and Climate Resilient Development Strategy for Indian Himalayan Region (IHR)-Green Resilient Mountain Communities at the 28th Conference of the Parties (COP-28) held this year in Expo City, Dubai, United Arab Emirates (UAE), from 30 November–12 December, 2023 and presented the impactful initiatives and achievements under NMSHE.
- In the second phase, strengthened 6 State Climate Change Cells (SCCCs) under NMSKCC in the states of Telangana, Tamil Nadu, Kerala, Puduchchery, Karnataka and Chhattisgarh and 5 SCCCs under NMSHE in the states of West Bengal, Arunachal Pradesh, Nagaland, J&K and Meghalaya.

- Launched new Centre of Excellence (CoE) on “Climate Change Research” (DST-CoE-CCR) in area of Variability and Predictability of Indian Monsoon in a Changing Climate at University of Allahabad and Major R&D Programme in the area of Hydro Climate Extremes (CE-HCE) at Indian Institute of Technology Gandhinagar, Gujarat.
- Co-organized the International Climate Research Conclave 2023 (ICRC-2023) at IIT Bombay wherein a report on “India’s Climate Research Agenda: 2030 and Beyond” was released jointly by Secretary, DST and Secretary, Ministry of Earth Sciences.

2.5 National Supercomputing Mission (NSM)

Under the mission, an indigenous server called Rudra 1.0 has been developed using Intel Cascade Lake processor platform. During the reporting period a lot of technical challenges has been addressed towards validation of Rudra server and finally the technology has been transferred to an Indian manufacturer for mass production. Also, the 1st batch of Rudra servers has been arrived at Inter-University Accelerator Centre, Delhi where the Phase-III commissioning of supercomputing system powered by home server is taking place. Around 19,500 manpower has been trained under NSM through various level of training programs. So far, 8896323 computing jobs has been carried out and 7420 users from more than 100 institutes across the nation are using the NSM infrastructure for their High-Performance Computing needs.

2.6 Technology Fusion & Application Research (TFAR)

The mandate of Technology Fusion & Applications Research (TFAR) Programme of Frontier & Futuristic (FFT) Division is to boost research in emerging technologies. The TFAR programme, an initiative with Pan India applicability is being implemented at a total outlay of Rs 250 Crore for a period of three years. The programme is meant to boost research in emerging technologies like Quantum Enabled Science & Technology (QuEST), Imaging Spectroscopy**,** Epidemiology Data Analytics, Data Science, IoT and Cyber Security. Some Success Stories of TFAR programme

2.6.1 Quantum Enabled Science & Technology (QuEST):

- Demonstrated free space Quantum Key Distribution (QKD) over 200 meters using weak coherent pulses and entangled photons at Physical Research Laboratory (PRL), Ahmedabad.
- Advanced Single Photon Detector & Establishment of Single Photon Detection Based Quantum Standard by setting up state-of-the-art focused ion beam (FIB) and the same has been used to produce meander structures of W and Nb with well-defined superconducting properties with signature of quantum phase fluctuations.

- Design and Development of Fast and Robust Authentication and Key Distillation Protocols for QKD Systems.
- Development of setup to Perform Qubit Control at Room Temperature:
  - Confocal Microscope: A room temperature confocal microscope has been built.
  - Confocal Imaging and calibration.
  - Performed anti-bunching measurements.
  - Designed and fabricated a triple ring resonator to act as the antenna to perform Qubit Control.
  - To enhance the light-matter interaction our first goal is to design and fabricate nano-photonic structures. Fabrication of novel mechanically stable cavity demonstrated.
- Established the Precision and Quantum Measurement laboratory (PQM-lab: https://pqmlab.iucaa.in/).
- Developed Ring Resonator-Based Coupling Architecture for Enhanced Connectivity in a Superconducting Multiqubit Network.

2.6.2 Epidemiology Data Analytics Research Initiative (EDARI):

Developed a tableau based data visualization platform and user-focused tools for malaria data management, analysis, report generation, & decision-making at CSIR-Indian Institute of Chemical Technology (CSIR-IICT), CSIR Fourth Paradigm Institute (CSIR-4PI) & National Institute of Pharmaceutical Education & Research (NIPER), Guwahati.

2.6.3 Networked Project on Imaging Spectroscopy & Application (NISA):

Establishment of sophisticated analytical equipment facilities and state-of-the-art Instrumentation facilities for end-to-end research involving imaging spectroscopy.

2.6.4 Internet of Things Research Initiative (IoTRI):

- Developed software architecture for streaming and predictive IoT applications to execute at scale across Edge, Fog and Cloud computing resources, at IISc Bengaluru.
- Developed a base framework based on Language Server Protocol (LSP) for development of Domain-Specific Languages in an Integrated Development Environment (IDE)-agnostic fashion, at IIT Delhi.
- Successfully implemented the Landslide Detection System and Flood Detection System at NIT Agartala.

- Developed a set of DSLs for different stakeholders (Domain Experts, Architects, Deployment engineers, Network engineers) in an IoT development environment at IIT Delhi.

2.6.5 Data Science Research Initiative (DSRI):

- Developed an integrated inference and visualization, analysis and benchmarking tool at Sikkim University, Sikkim.
- Developed a new graph neural network based embedding method and node, edge anomaly detection methods for social networks, at NIT Puducherry.

2.6.6 Cyber Security Research Initiative (CSRI):

- Designed a detection module by integrating hypergraph properties with intelligent learning models and optimization algorithms to detect unknown attack vectors at Shanmugha Arts, Science, Technology & Research Academy, (SASTRA) University, Thirumalaisamudram.
- Developed a push button facilitated software for forensic investigation and detection of forged images at IIT Kharagpur.
- Developed analysis tools for mobile financial apps on Android, at IISc, Bengaluru.

3 INNOVATION TECHNOLOGY DEVELOPMENT AND DEPLOYMENT

The umbrella scheme 'Innovation, Technology Development and Deployment' mainly focuses on strengthening the Innovation, technology development ecosystem tech-led entreprenureship in the country. This umbrella scheme with its sub-schemes contribute broadly on capacity building for research and innovation, creating an ecosystem for technology development and adaptation of need-based technologies to address the identified societal challenges; research and technology-based solutions for India-centric challenges related to Water and Clean Energy etc.; nurturing and scaling up of innovative technology-based start-ups through institutional support and incubation; scientific awareness, communication, popularization and scientific temper for all; development of geo-spatial solutions for sustainable socio-economic growth; translation of research into products and processes for greater economic and societal benefits.

3.1 Technology Development Programme (TDP)

The Technology Development Programme (TDP) promotes and supports activities related to indigenous development of innovative technologies in identified areas at various R&D laboratories/ institutions. Under the Programme, feasibility of fresh ideas/ concepts is also assessed for their potential conversion into useful technology/product. This has resulted in the development and deployment of technologies both in the advanced/emerging areas and in traditional sectors/areas with subsequent transfer of know-how for their commercial production. Some of the key achievements under different components of TDP are as follows:

- Through the **Advanced Manufacturing Technology (AMT)** programme, DST has created a Centre of Excellence on "Development of Continuous Manufacturing Technologies for Specialty Chemicals and Electronic Grade Materials" at CSIR-NCL, Pune and also supported 50 technology development projects under the thrust areas of (1) Advanced forming and near net shape processing (2) Robotics & Automation (3) Manufacturing of nanomaterials, electronic grade materials, smart materials, & metamaterials (4) Precision Manufacturing and (5) Novel surface coatings & surface texturing.
- Through the **Waste Management Technologies** (**WMT)** programme, a Swachh Bharat aligned initiative, DST has supported a technology development project for management & recycling of end-of-life tyres and batteries.
- For strengthening the technology development ecosystem, DST has created **Technology Enabling Centers** (TEC) at (1) University of Ladakh, Ladakh, (2) Medicaps University,

Indore, Madhya Pradesh, (3) Rajiv Gandhi University, Doimukh, Arunachal Pradesh, (4) Career Point University, Hamirpur, Himachal Pradesh.

- To become self-reliant on key starting materials (KSM) and Active Pharmaceutical Ingredients (API), DST has created a Centre for Marine Therapeutics at NIPER, Kolkata through **Therapeutic Chemicals** (TC) program.
- Under the **Biomedical Device and Technology Development (BDTD)** programme, support has been extended for 4 Biomedical-hubs which have been established at Chandigarh, Chennai, Delhi & Karnataka which house sophisticated facilities to assist the translational platform used for technology up-scaling or prototype development or development of devices in substantial number for market validation.
- Three brainstorming workshops have also been organized for sensitization and awareness of technology development at (i) Vasantrao Naik Marathwada Krishi Vidyapeeth in Parbhani, Maharashtra; (ii) Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu; (iii) National Research Development Corporation (NRDC), Visakhapatnam.

3.2 Technology Missions (Energy, Water and Others)

Under Technology missions, the main focus is on two programmes, i.e. Clean Energy Research Initiative and the Water Technology Initiative. Additionally, emphasis is placed on Carbon Capture Utilization and Storage Technologies (CCUS), with the establishment of three National Centres of Excellence and participation in the Clean Energy Transition Partnership. Further, three draft white papers on electric mobility: (a) Tropical EV Battery; (b) Motors and Power Electronics; and (c) EV Charging Infrastructure have been developed through an extensive process of consultation with stakeholders.

3.2.1 Clean Energy Research Initiative Programme (CERI)

The overarching objective of CERI is to nurture S&T led breakthroughs to make clean energy affordable and accessible through strengthening Research and Innovation ecosystem for Clean Energy. Under CERI, India hosted Mission Innovation (MI8) and Clean Energy Ministerial (CEM14) a global event focusing on clean energy solutions, with participation from several countries and organizations. The programme also prioritized efficient and affordable solar energy solutions, supporting five National Challenge Grant projects on High-efficiency PV cells and modules. Some of the highlights and major achievements during the period are as follows:

- India hosted the joint Ministerial event of 8th Mission Innovation (MI8) and 14th Clean Energy Ministerial (CEM14) on the sidelines of G20 Energy Transition Ministerial Meeting (ETMM) on 19-22 July 2023 in Goa. The 4-day long event witnessed the largest footfall (nearly 3000 registered participants) of the Global Clean Energy Community. Ministers

and HoDs of about 40-member Countries and 10 International Organizations along with CEOs of the leading energy companies, policy makers and academician were present in various meetings including Plenary, Round Tables, Side events and High-level dialogues. More than 80 side events were organized on various Missions/ Platforms and Work streams of MI/ CEM. Technology Showcase focusing on “Zero Emission Vehicles” and “Advancements in Clean Energy” was also organized in which 25 prototypes were exhibited to propel the global clean energy transition solutions.

- The harvesting of energy from Solar in efficient and affordable configuration is priority to provide green power solution in the country. The emerging solar cell offer solution for applications that need mechanical flexibility, thinness, semi-transparency and high-performance-to-weight ratio and a combination of these features suitable for building-integrated photovoltaics, wearable textiles, Internet-of-things (IoT) devices and portable electronics. The department has supported five National Challenge Grant projects on High efficiency PV cells and modules to augment the innovation in device architectures.
- Carbon Capture Utilization and Storage Technologies (CCUS) are required for the countries that have heavy dependence on fossil fuel. During the year, three National Centres of Excellence on CCUS have been supported and mobilized 156 RD&D proposals on CCUS.
- Projects to establish 2 Test beds have been approved for integrating CCU in existing coal gasification facilities supported by DST.
- Developed a strategic approach to address the critical role of Distribution System Operators (DSOs) in transforming India’s power sector and a detailed roadmap for implementation.
- Fight Against Pollution: Flow Battery an ‘Efficient Replacement’ to Diesel Generators and cutting-edge quantum-technology backed green hydrogen production unveiled to power a green future.
- A technology of metal hydride based hydrogen purification system has been transferred to NTPC.
- Proof of concept demonstrated for metal hydride-based storage for vehicular applications. Commercialization of Cost-effective Sodium-ion batteries boosting two-wheeler EVs is to hit the market.
- Development of wear resistant coated components for paddy straw briquetting machine: A small-scale (350 kg/hr.) decentralized 100% paddy straw-based briquetting plant has been demonstrated at M/s PRESPL, Village Kulburchan, Distt. Patiala, Punjab, in Public Private Partnership (PPP) mode. The finding of the studies has shown improvement in shredder blades, hammer blades & wear-rings by 1.5 to 2 times, resulting in a reduction

in the production cost of briquettes.

- THERMAX & IIT Delhi team have indigenously designed 1 TPD pilot plant through DST support and successfully demonstrated technology for conversion of Indian high ash coal to methanol (Major setup located in Thermax premises in Pune). Oxy-blown coal gasification is a significant milestone for conversion of high ash coal into syngas. This has helped to achieve directly the H2/CO ratio needed for methanol synthesis, which was used as an input in the 1 TPD methanol pilot plant.
- DST has supported project performance evaluation of M15 fuel on gasoline 2 & 4 wheelers (vehicles and engine) to Automotive Research Association of India, Pune and the test results indicated M15 blend reduced the emissions. The methanol from the ingenious source could be a potential source for blending fuels.
- DST funded 7 projects under the joint DST and DBT call for converting sunlight to storable fuels, biochemical and energy rich chemicals, etc. which have resulted in a total of 34 research publications and 4 filed patents.
- Three projects supported under the Mission Innovation (MI) 'Joint call on Energy Storage Solutions' (MICall19) have resulted in a total of 28 publications and filing of one patent.
- Three draft white papers on electric mobility: (a) Tropical EV Battery; (b) Motors and Power Electronics and (c) EV Charging Infrastructure have been developed through extensive consultation with stakeholders and is at an advanced stage of release.

3.2.2 Water Technology Initiative (WTI)

The goal of WTI programme is to promote R&D activities that enable the winning of water from sustainable sources, augmentation of water quality for specific applications and recycling and reuse of water. Some of the achievements made during the period are as under:

- Supported 21 projects under Research Stream -Establishment of Proof-of-Concept projects funded under the call 'Optimal Water Use in Industrial Sector'. The projects have resulted in 92 publications, 10 book chapter and filing of 15 patents.
- Under a call for proposals on Water Technology for Applied Research, Technology Development, Technology Assessment and Convergent Solution Stream in the thematic priority for (i) Water Availability, Distribution and Management (ii) Water Quality Monitoring and Treatment and (c) Waste Water Recycling and Management for Industrial, Domestic and Community based solutions, 945 proposals have been received.
- DST- The Dutch Research Council (NWO) collaborative joint research call for scientific knowledge and innovative solutions in the field of water disaster management has been initiated. The call focused on new data assimilation techniques and the utilization of new remote sensing products. The latter could include new low-cost sensor monitoring to

capture flash floods (urban floods), hill city water disasters, as well as drought monitoring and received 8 proposals.

3.3 National Geospatial Programme (NGP)

The National Geospatial Programme (NGP) aims to catalyze the National Geospatial Ecosystem with the mandate of promoting geospatial science and technology, policy, solution, capacity building, entrepreneurship and international cooperation for sustainable socio-economic development at all levels of governance. Some of the achievements made under the programme during the period are as follows:

- A tripartite MoU has been signed between DST, NIGST & TiH IIT Tirupati for establishment of a Geospatial Innovation Hub (Centre of Excellence) in pilot mode with an aim to create a robust geospatial innovation ecosystem in the country. This hub shall cater to various aspects of innovation in the geospatial domain, like Technology Development, Capacity Building, R&D & support to start-ups, entrepreneurs & innovators.
- A Capacity Building Workshop for Teachers and Educators from the Hyderabad area was organized in accordance with the conversation about the Geospatial Innovation Hub's activities, which served as a means of raising knowledge of geographic technologies and their applications. The Workshop had a component for creation of awareness around Geospatial technologies and its uses. More than 40 teachers from various districts of Telangana attended the workshop.
- Call for proposals on "Geospatial Science Development" was issued, under which 14 projects are being supported to strengthen the country's geospatial science domain. The themes of the projects include geo-kinematics, generalization of spatial data, ubiquitous mapping, improved geodetic positioning, big geospatial data cube development and analytics, geospatial knowledge graphs, geospatial data collection standards and geoid modelling.
- A Call for prososal in Geospatial Capacity building was issued with a new initiative of spatial thinking. Total 30 proposals on various Summer/ Winter Schools and three day Geo-innovation Challenge programme were recommended for support.
- The National Centre for Geodesy at IIT Kanpur, supported as part of the Geospatial Science sub-programme, has been selected as the host institute for the next DORIS station, which is also the first DORIS station in India. The selection was made after competing with 7 other international proposals submitted under Call for Proposals by International DORIS Service. Also, the Cross-Origin Resource Sharing station established at NCG is now the part of Asia-Pacific Reference Frame and International Global Navigation Satellite System (GNSS) Service network and will be used in the next International Terrestrial Reference System (ITRF) realisation.

- As part of the Landslide Hazard Mitigation Programme, an Integrated Monitoring and Prediction of Rockfall Hazard System has been installed in Manikaran, Himachal Pradesh by the Department of Geology, Panjab University.
- A 3-day workshop on "Practical aspects of Conceptual Modelling of Geospatial data" was conducted at GISE Hub, IIT Bombay which was attended by scientists and officers from various government departments handling geospatial data. GISE Hub also conducted its second OGC Stack Winter School along with IIIT Hyderabad, IIT Tirupati and IIT Kharagpur.

3.4 National Science and Technology Entrepreneurship Development Board (NSTEDB)

NSTEDB, through its strong network of incubators is leveraging the technological strength of the higher learning institutes for nurturing the national innovation and entrepreneurship ecosystem. NSTEDB has adopted a multipronged approach in its mission to foster innovation & technology-based entrepreneurs. The key outcome and activities under the programme are as follows:

3.4.1 National Initiative for Developing and Harnessing Innovations (NIDHI)

A key component of the NSTEDB is the NIDHI Programme, which focuses on nurturing start-ups and individual innovators. This programme exemplifies the commitment to translating research into practical applications, fostering innovation and promoting entrepreneurship in technology.

- ***NIDHI Technology Business Incubator (NIDHI – TBI)*** is a flagship programme of DST, under which TBIs are established in higher educational institutions for supporting and promoting S&T-based innovations and entrepreneurship by providing office space, required equipments, mentoring, legal support, IP support, access to finance, investor connect etc. So far, DST has established 150+ Technology Business Incubators across the country.
- Through the ***NIDHI Centre of Excellences (NIDHI - CoE)*** programme, selected experienced TBIs are scaled up to become NIDHI – CoE. These NIDHI – CoE's act as a reservoir of knowledge in venture promotion including the resources and relevant network and help in aligning the linkages with both national as well as international partners. Till date, a total of 8 CoEs are under active support from DST.
- ***NIDHI – Inclusive TBI (i-TBI)*** aims to ensure inclusiveness in innovation and entrepreneurship across the country and to foster innovation and startup culture among the students, faculties, entrepreneurs and nearby communities. So far, 22+ iTBIs have been established across the country through DST support.

- ***NIDHI – Seed Support Programme (NIDHI-SSP)*** provides early stage financial assistance to potential startups with promising ideas, innovations and technologies. During 2023, Seed Support has been provided to 14 Technology Business Incubators (TBIs) to support startups. During the year, 80 startups got benefitted under SSP.
- Through the **Training Program**, 105 WEDP Programs were conducted under which 2625 women were trained; 115 TEDP programs were conducted under which 2990 persons were trained and 77 TEDP programs were conducted under which 2079 faculty were trained.
- ***DST - NIDHI's PRomoting and Accelerating Young and ASpiring technology entrepreneurs (PRAYAS) programme*** supports young innovators to turn their ideas into prototypes. Through NIDHI-PRAYAS, 13 new PRAYAS centres have been supported during the year 2023, along with support to 41 ongoing PRAYAS centres across the country which benefitted 242 PRAYASEEs in 2023.
- ***DST – NIDHI's Entrepreneurs-in- Residence (EIR) programme*** supports aspiring or budding entrepreneurs of considerable potential for pursuing a promising technology business idea over a period up to 18 months. Through NIDHI – EIR, during the year 2023, 10 new EIR centres have been supported along with support to 27 ongoing EIR centres across the country. This benefitted 227 EIRs during 2023.
- ***DST-NIDHI Accelerator Programme***, a 3 to 6-month fast-track initiative, is a post-incubation effort aimed at rapidly scaling potential startups through intensive mentoring and networking, targeting those with significant market validation and readiness for growth. In 2023, 18 institutions were recommended to run the NIDHI - Accelerator Program.

3.4.2 Conference/ Workshops/ Expo Supported

- ***National Technology Award for Technology Business Incubator*** was presented to T-Hub Foundation, Telangana, during the National Technology Week 2023, for outstanding contribution in techno-entrepreneurship development and promotion of S&T based startups. DST has established a NIDHI – CoE at T-Hub, which is high contribution in India's pioneering innovation ecosystem.
- Director General of World Intellectual Property Organization (WIPO), Dr. Daren Tang along with the WIPO delegation visited DST established NIDHI CoE at IIT Delhi (FITT) and interacted with the startups. DST appraised the WIPO delegation about the diversity of India's Innovation Ecosystem and the critical role of Intellectual Property Rights.
- ***DST Geospatial Hackathon*** was organised by DST in consultation with Survey of India, the Technology Business Incubator - CIE at IIIT Hyderabad and Microsoft India, with an objective to encourage and support startups and researchers to identify problems

faced in the geospatial domain and work on the solutions which can be useful for the community. Four winners were finally selected for further mentoring support (2 each under Startup challenge and Research challenge) through a finale event in May 2023.

- DST participated in **India ASEAN Startup Summit 2023**, held in Kuala Lumpur, Malaysia leading a delegation of 8 DST supported startups along with 2 NIDHI Centre of Excellence. Start-ups showcased innovations in Med tech, Sustainability and UAV sectors, attracting attention from accelerators, investors and government stakeholders. The event facilitated collaboration between start-up ecosystems, encouraging participants from ASEAN and India to learn how to build a vibrant start-up ecosystem and expand their networks.
- DST supported participation of **12 women led startups** in a combined Startup event 'Expand North Star, GITEX Global, FinTech Surge, Marketing Mania and Future Blockchain Summit', held in Dubai during October 2023. Startups in the domains of drones, sustainability, SAS platform, electronics etc., got good response from entrepreneurs and investors visiting the Expo at Dubai.

3.5 National Council for Science and Technology Communication (NCSTC)

The National Council for Science and Technology Communication (NCSTC) programme plays an important role in fostering scientific temper among Indian citizens. Key initiatives and achievements of the programme include:

- **Initiative for Research and Innovation in STEM (IRIS):** Public-Private Partnership aiming to promote scientific research among young innovators, resulted in significant achievements at the Regeneron International Science and Engineering Fair (ISEF).
- **National Children's Science Congress (NCSC):** A flagship program that engages students aged 10-17 in scientific activities. It was organized during 2023 with a theme focused on understanding ecosystems *for Health and Well-Being*. Over 0.25 million students from almost all the districts of the country participated in NCSC.
- **STEMM India*:*** Conducts science fairs, exhibitions and activities across the country to promote Science, Technology, Engineering, Mathematics and Medicine (STEMM). More than 200 static and mobile exhibitions were organized in different parts of the country.
- **Thirteen Mobile Science** Exhibitions **(MSE) & 2 Mobile Science Lab (MSL)** in 9 states were taken up for underprivileged children right at their door step with a Mission 'Taking Science to the people making them aware of cutting-edge science & new emerging technologies. This has reached out to **3 million** students, teachers and general public.
- STEM BIKE initiative used hands-on experiments to bring science awareness through

demonstration to rural areas in Haryana. Seven experts travelled on bikes to 63 villages, conducting activities like making LED bulbs, testing water and food adulteration testing and demonstrating daytime astronomy through a Telescope, explaining so-called miracles, puppetry and mathematics through Origami were conducted during the demonstration.

- ***Science Communication through Folk Media:*** Conducted 25 training workshops and 1000 awareness programs to popularize S&T awareness using traditional and innovative Methods in local languages in different states, benefitted 2.5 million people.
- **Low-cost Teaching Aids:** Conducted 105 training workshops in different states for teachers, focusing on developing low-cost teaching aids to make science education interesting resulting in approx. 7000 teachers trained.
- **National Science Day (NSD):** The theme of NSD 2023 "Global Science for Global Wellbeing" was launched on 9 January 2023 at National Media Centre, New Delhi by Dr. Jitendra Singh, Hon'ble Minister of State (Independent Charge), Ministry of Science and Technology & Earth Sciences. DST supported celebration of NSD on 28th February 2023 across the country through State S&T Councils/Departments to motivate students of school, college & universities via engaging science lectures, exhibitions, radio, TV talk shows etc. During the celebration of NSD 2023 at Vigyan Bhawan, 6 National Awards for S&T Communication and Popularization to stimulate, encourage and recognize outstanding efforts in the area of science popularization and communication were also given in following categories:

  i) National Award for Outstanding Efforts in Science & Technology Communication in General

  ii) Science & Technology Communication through Print Media including Books and Magazines

  iii) Science & Technology Popularization among Children

  iv) Translation of Popular Science & Technology Literature in Languages Mentioned in the Eighth Schedule of Constitution of India and inEnglish

  v) Science & Technology Communication through Innovative and Traditional Methods

  vi) Science & Technology Communication in the Electronic Media

- **Augmenting Writing Skills for Articulating Research (AWSAR):** An all-India competition encouraging PhD scholars and Post-Doctoral Fellows to communicate research in a popular format. Six scholars (PhD & PDF) were given AWSAR prize on the occasion of NSD 2023. The program also include organising capacity building workshops across the country to guide scholars about popular format, principle, methodology, tips

and tricks for the national-level competition.

- **UNESCO Kalinga Prize for Popularization of Science** for the year 2023 was given to Prof. Ana Maria Cetto, Museum of Light, National Autonomous University of Mexico, for her outstanding contribution in the area of public outreach. The recipient received US$40,000 and a UNESCO Albert Einstein Silver Medal and a Kalinga Chair, introduced by the Government of India in 2001 to mark the 50th anniversary of the Kalinga Prize. The award ceremony took place during the celebration of the World Science Day for Peace and Development at Paris, France.

3.6 Science for Equity Empowerment & Development (SEED)

Science for Equity, Empowerment and Development (SEED) programme aims towards socio-economic empowerment and development of the disadvantaged sections of the society viz., SC/ST, Divyangjan, elderly, Economically Weaker Section (EWS) and women besides encouraging young scientists and regular target groups to take up societally relevant Research and Development (R&D). Some of the key achievements under the SEED programme during the period are as follows:

3.6.1 Scheduled Caste Sub Plan and Tribal Sub Plan

- Twelve (12) Science Technology and Innovation (STI) Hubs have been established for holistic development of Scheduled Caste/Scheduled Tribe (SC/ST) Communities through systemic interventions in different regions of the country to address the weakest linkages in the predominant livelihood systems through Science & Technology (S&T) interventions.
- Supported establishment of Heritage Food and Beverage Research Centre for research on Ethnic Foods and Beverages of Tribals of North East.
- A Coastal Fisheries Information Hub (first of its kind in Car Nicobar Islands) has been established for augmenting livelihood, resilience and knowledge generation.
- Supported a consortia project on CRISPR based gene editing for one-time correction of Sickle Cell Disease.

3.6.2 Technology Interventions for Disabled and Elderly (TIDE)

15 various assistive tools and technologies focusing on various disabilities and for improving the quality of life for elderly were developed. More than 30 research papers were published out of the completed and ongoing projects. Approximately 50 students were trained in research and development activities pertaining to development of various assistive technologies. The

projects yielded 5 patents which were published. The details of few significant products are given below.

- Power Assistive Hybrid e-Trike (PAH e-Trike) has been designed and developed by CSIR-Central Electronics Engineering Research Institute, Pilani for persons with locomotor (lower limb) disabilities.
- Internet of Things (IoT) enabled Remote Vital Information and Surveillance System for Elderly and Disabled Persons had been developed in a collaborative project implemented by CSIR-Central Electronics Engineering Research Institute, Pilani and Chitkara University, Punjab.

3.6.3 Scheme of Young Scientist and Technologists (SYST)

A Compendium of Technologies developed under Scheme of Young Scientist and Technologists (SYST) was releasal on 08th November 2023 by the Secretary, DST and Committee members showcases a spectrum of innovations. The compendium ensembles a collection of 45 technologies emerging from four key sectors: Health, Agriculture, Energy and Engineering, as well as the Waste to Wealth initiative supported under SYST.

- The equipment specifically designed to reduce drudgery faced by bamboo artisans has been successfully implemented at Tool Room and Training Centre in MSME-Amingao, Guwahati.
- The tissue culture technology developed for cultivating dwarf cherry trees, aimed at enhancing crop management efficiency, has been transferred to a private tissue culture lab in Himachal Pradesh.
- The investigator developed dissolvable micro needles for vaccine delivery and has successfully established her own startup company.

3.6.4 Strengthening, Upscaling & Nurturing Innovations for Livelihood (SUNIL) and Women Technology Parks (WTPS)

- Launched a programme Strengthening, Upscaling & Nurturing Innovations for Livelihood (SUNIL) to support cross-bridge collaboration for identifying and addressing livelihood centric local and systemic problems of Economically Weaker Section (EWS) of the society.
- 10 Women Technology Parks (WTPs) have been supported and more than 900 women benefitted through interventions of Science, Technology and Innovations.

3.7 National Good Laboratory Practice (GLP)

DST is implementing the National GLP Compliance Monitoring Programme for certification of Indian Test Facilities (TFs)/ laboratories, conducting non-clinical health and environment safety studies in accordance with the Organization for Economic Co-operation & Development (OECD) Principles of GLP. India is full adherent to Mutual Acceptance of Data (MAD) in the OECD since March, 2011. This facilitates the acceptance of data generated in Indian GLP certified TFs across all the OECD member countries and full adherent non-member countries to MAD.

Key achievements under the National GLP Program during the year 2023 are as follows:

- India has been designated as the Chair to the OECD's Working Party on GLP during 2024-25.
- Currently, 60 TFs across India are GLP certified under the National GLP Programme.
- 10 new TFs/ laboratories have been certified as GLP Compliant.
- 13 TFs have been re-certified as GLP Compliant.
- The scope of GLP certification of NGCMA is being harmonized. The draft scope has been put on public portal for seeking stakeholders' comments.

The following capacity building programmes on GLP have been organized with over 300 personnel trained in the country One 3-Days Training Course for Quality Assurance personnel of GLP TFs

- One 1-Day Training Course on Data Integrity and Computerized systems
- One 2-Days Refresher Training programme for GLP inspectors of NGCMA.
- Two Sensitization workshops on GLP for Academia and Students

Major activities planned during January – March, 2024:

- Refresher training course for GLP inspectors
- Sensitization workshop on GLP for Students and researchers of academia
- Harmonization of scope of GLP certification of NGCMA
- Interactive Meet with Test Facility Managements (TFMs) of GLP TFs

3.8 Technical Research Centre (TRC)

In line with the announcement during the budget speech of 2014-15, 5 Technical Research Centres (TRCs) have been established in 5 DST institutions across India viz. SCTIMST in

Thiruvananthapuram, ARCI in Hyderabad, JNCASR in Bengaluru, IACS in Kolkata and S.N. Bose National Centre for Basic Sciences in Kolkata.

Brief on activities of these TRCs are as follows:

- The TRC at IACS Kolkata focuses on diverse research areas, including the design and synthesis of new nanomaterials, quantum materials, functional polymers and many more. Some of the notable success stories during 2023-24 are: producing C1-C2 useful chemicals from CO2 conversion to methane; development of nucleoside-derived metallo-hydrogel with inherent antimicrobial properties to combat drug-resistant infectious diseases; Development of single-use paper-based sensors for detecting volatile organic compounds; Development of primary tumor cells for drug screening; Segmented polyurethanes have been developed which exhibit highly potent antibacterial activity; Process chemistry is developed for making morpholino oligonucleotides by an automated DNA synthesizer; etc.
- The TRC at ARCI Hyderabad aims to augment the translational research in “Alternative Energy Materials & Systems” for prototype development and demonstration leading to the commercialization of technologies by automotive and other energy related industries. It has many sub-programs in Energy storage, Energy conversion, Energy efficiency, Renewable energy generation.
- The TRC at SCTIMST, Thiruvananthapuram is equipped with cutting-edge 3D bioprinting facility and CNC milling machine, paving the way for tissue engineering advancements. Some of the success stories include Cholederm for wound healing and the Wipro 3D Emergency Breathing Assist System. During COVID-19, crucial products like Chitra Magna RNA isolation kits and Chitra EmBed swabs developed. In-house innovations led to startups like Alicorn Medical (Cholederm) and a novel drug eluding bioceramic beads for treating osteomyelitis is a break through. This technology is transferred to Industry. With ongoing research projects in the TRC phase 2, this institute continues to push the boundaries of healthcare technology.
- The TRC at SNBNCBS, Kolkata made significant progress in diverse areas like materials science, nanotechnology and biomedical instrumentation. It has developed computational models for new materials, explored nano-fabrication for quantum technology and created biosensors using spectroscopic techniques. Highlighting their translational efforts, 32 ongoing projects aimed to address real-world challenges like food adulteration and environmental mitigation. Notably, 80 research papers and 4 PhDs have been the key outcome of the TRC.
- The TRC at JNCASR, Bengaluru has fostered significant innovation and currently implementing 25 promising translational projects. To further bridge the gap between academia and industry, JNCASR hosted an Industry-Academia meet in 2023, connecting with 25 organizations and showcasing cutting-edge research. Additionally,

JNCASR successfully commercialized technology through agreements with a startup. Furthermore, the TRC actively has filed 19 patent applications and secured 6 grants.

3.9 National Spatial Data Infrastructure (NSDI)

National Spatial Data Infrastructure (NSDI)'s vision has been to ensure that "current, accurate and organized geospatial data sets are readily and continuously available and accessible on a national, state, district and village level basis to contribute to economic, environmental and social growth of the country". Some of the key achievements/ activities under the programme are as follows:

- National Data Registry (NDR) has been built over a set of open standards from OGC, ISO and BIS to enable data providing agencies publish their datasets/ products/ services onto a singular, standardized platform.
- Draft International Standard on Unique Identification of Geospatial Features (e.g. Land Parcels or Property Units) have been tested and demonstrated to Department of Land Resources (DoLR) for adoption by 26 State Governments in Land Administration.
- A proof-of-concept Cloud-based Geospatial Platform has been designed, implemented and used in updating National Urban Information System data sets of 1:2,000 scale (for Varanasi City) using survey-grade drones for demonstrating the standards-based methods and techniques in data life cycle management.
- Fourteen (14) State Spatial Data Infrastructure (SSDI) established through cost-sharing between DST and State/ UT Governments in 70:30 mode and are fully functional and providing State Geospatial Data Products and Services.
- West Bengal, Jammu & Kashmir, Arunachal Pradesh and Nagaland drafted their Geospatial Policies apart from the launch of National Geospatial Policy in December 2022 by DST.
- The Draft version of Data Content Standards (DCS) for Forest, Soil and Geology developed by NSDI Working Group has been submitted to Bureau of Indian Standards (BIS) for publication.
- Efforts are underway for establishment of State Spatial Data Infrastructure (SSDI) in Goa, Sikkim, Telangana, Uttar Pradesh and Chhattisgarh States through cost-sharing between DST and State/ UT Governments.

3.10 Exhibitions and Fairs

The Exhibition Cell is assigned with the task of organizing exhibitions and participating in science exhibitions at National and International levels. In addition to this, the Exhibition Cell has also been assigned with the responsibility of coordinating the work of participation of the

Department of Science & Technology along with its organizations (Autonomous Institutions/ Subordinate Offices/Professional Bodies) in science exhibitions. Exhibition Cell aims to organize exhibitions to create awareness among students, scholars and the general public on various Government policies, schemes, scientific innovations & milestones in the field of Science & Technology.

The activities of Exhibition Cell, DST during 2023-24 are as under: -

- Participated in the India International Trade Fair – 2023
- Participated in the 26th National Science Exhibition
- Participated in the India Mobile Congress-2023
- Participated in the Rise in India-2023
- Participated in the 10th Indian National Exhibition Cum Fair – 2023 during FY 2023-24.

Exhibition Cell is also instrumental in organizing the 9th edition of India International Science Festival (IISF) – 2023 at the combined campus of THSTI- RCB, DBT in Faridabad, Haryana during 17-20 January, 2024.

4 NATIONAL MISSION ON INTERDISCIPLINARY CYBER PHYSICAL SYSTEMS (NM-ICPS)

The Union Cabinet approved the National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS) in December 2018 at a total outlay of Rs. 3660 Crores for five years to be implemented by the Department of Science and Technology (DST).

Mission Implementation: The Mission aims at the development of technology platforms to carry out R&D, Translational Research, Product Development, Incubating & Supporting Start-ups as well as Commercialization. The Mission is working with all the concerned Ministries/ Departments to identify their technology needs, develop solutions and technical support.

The mission is being primarily implemented through 25 Technology Innovation Hubs (TIHs) established in the areas of advanced technologies which includes: Artificial Intelligence and Machine Learning (AI/ML), Robotics, Cyber Security, Data Analytics & Predictive Technologies, Technologies for Agriculture & Water, Technologies for Mining, Advanced Communication Systems, Quantum Technologies etc. Each TIH is created as a Section-8 Company, an independent entity within a Host Institute with the involvement of industry as potential members for co-development, partnerships and for commercialization. The Industry-Academic- Govt collaborations are the main focus of the TIHs which carry out their activities under 4 major categories, i.e. Technology Development, Human Resource Development, Entrepreneurship Development and Industrial Collaborations. Till date, Mission has developed 311 technologies, 549 technology products, 63000+ Human Resource, 1200 Jobs creation and nearly 124 international collaborations. Collaborative activities among the Hubs have brought some significant impact on the Mission outcomes. During the current year 2023, some initiatives have been taken under the mission that includes Agri Startup Demo and Funding (ATMAN) organized by the Department of Science and Technology (DST) along with four Technology Innovation Hubs (TIHs) at IIT Bombay, IIT Kharagpur, IIT Indore and IIT Ropar on September 29, 2023. Also, the Medical Cobotics Centre (MCC) established by TIHs at IIIT Delhi and IIT Delhi shows advanced collaboration in improving healthcare technologies. IIT Ropar's annual event, SAMRIDHI, featuring presentations from deep-tech ICPS startups using CPS technologies in different sectors, emphasizes the collaborative spirit of the TIHs. This teamwork extends to workshops organized by different TIHs at the hub level, promoting the exchange of knowledge and enhancing collaborations between hubs. In the future, steps will be taken to make the TIHs self-sustainable beyond the tenure of the Mission. Two new Hubs are under consideration to be set up in the areas of Large Language Model (LLM) and Natural Language Processing (NLP).

Some of the key technologies supported/ developed under the mission are:

- Massive MIMO technology for enhanced 5G network capabilities.

- Security Operations Centre (SoC) for 24/7 cyber-attack monitoring, installed at NHAI and IPA.
- Cost-Effective Electromyography (EMG) Controlled Prosthetic Hand for upper limb amputees.
- Divyang ATM providing accessible banking for visually impaired individuals.
- Medical Cobotics Centre (MCC) at IIT Delhi and IIIT Delhi for education, training and research in healthcare, also fostering a start-up ecosystem.

These technologies find applications in telecommunications, industry, defense, healthcare and fintech, etc.

5. AUTONOMOUS INSTITUTES

The Department of Science and Technology nurtures 25 Autonomous Bodies (ABs). These include 16 research institutions, 4 specialized knowledge institutions and S&T service organizations and 5 professional bodies. These institutions, with long and varied history and their variety of activities, occupy a very important place in the S&T eco-system of the country. Activities and achievements of autonomous institutes during the year under report are briefly described below:

5.1 MACS-Agharkar Research Institute (ARI), Pune

MACS-Agharkar Research Institute (ARI) has achieved a significant milestone with the development of a microbial process for hydrogen production from agricultural waste. ARI has entered into a licensing agreement with KPIT Technology Ltd. to facilitate the field implementation of this transformative technology.

ARI has developed high yield diseases resistant wheat cultivar, MACS 4100, designed specifically for timely sowing in the Peninsular Zone of India, encompassing regions such as Maharashtra and Karnataka. The average yield of MACS 4100 stands at an impressive 45.08 quintals per hectare, with the capacity to reach an even higher potential of 61.8 quintals per hectare. This variety holds promise for enhancing agricultural productivity and contributing to food security in the designated region, striding forward in crop science and sustainable farming practices.

An efficient oil reservoir compatible process named “Petrobee” was developed by ARI to demonstrate significant crude oil recovery of 29.5 % for potential application in the depleted high-temperature oil wells of the Indian subcontinent. It is an eco-friendly process for sustainable recovery of residual oil from depleted oil reservoirs. The process was developed in collaboration with IRS-ONGC and implemented in ONGC oil fields in Western India.

5.2 Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital

Main areas of Astronomy and Astrophysics research of ARIES are study of Sun, Star Clusters and Star Formation, Stellar Variability, Gamma-ray Bursts (GRBs), Supernovae, Active Galactic Nuclei (AGNs) and Quasars.

The 4m International Liquid Mirror Telescope (ILMT) was inaugurated on 21 March 2023 by Honourable Governor, Uttarakhand at Devasthal, Nainital, India. The 3rd BINA workshop on “Scientific potential of the Indo-Belgian cooperation” was organised by ARIES during 22-24 March 2023. Around 150 scientists from around the globe participated. Many outreach activities were also carried out in nearby schools, colleges and universities with more than

2000 students during the workshop. The 11th ARIES Training School in Observational Astronomy (ATSOA) was conducted during 17-28 April 2023 for 44 MSc students to develop their astronomical data-analysis skills.

The *Journal of Astronomical Instrumentation* published a "Special Issue on ARIES" highlighting key observational facilities and a few recent research results from the institute; June 21, 2023. A new science centre was inaugurated at the Devasthal Observatory campus of ARIES in October 2023.

5 major facilities of ARIES (3.6m Devasthal Optical Telescope, 4m International Liquid Mirror Telescope, 1.3m Devasthal Fast Optical Telescope, 104cm Sampurnanand Telescope and ARIES Stratosphere and Troposphere Radar) remained operational throughout the year. ARIES scientists published many important findings in the field of solar physics, space weather, star formation, transients, compact objects, aerosols and meteorology. Total 103 research papers were published in refereed journals in 2023.

5.3 Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow

BSIP carries out research on both fundamental and applied aspects of Palaeosciences and allied Earth System Sciences with an integrated, multi-disciplinary approach. The research activities focus on past life forms, past climates and ecosystems including the origin and evolution of life, vegetation dynamics through time, dynamics of ocean, life under extreme environment, palaeoclimates and exploration of fossil fuels.

The institute scientists are actively organizing and participating in outreach programs under the 'Janbhagidari Program' of the Govt. of India. Under the activity organised with respect to New Education Policy, very recently, 'Exposure visit of CBSE Principals' was organized during 14th to 15th December 2023 at BSIP, wherein the principals were given a brief outlook of the institute activities and their visit to institute's museum and different laboratories.

The research facilities at the institute were strengthened by the establishment of an "Amber Analysis and Palaeoentomology Laboratory" which was inaugurated on the 14th November 2023 in BSIP. The establishment of a Micro-CT laboratory as a National Facility to help 3D reconstruction of fossil and geological samples and the establishment and enhancement of a laboratory for Coal Quality Assessment to cater the Hydrocarbon industry is in process.

A Centre for the Promotion of Geoheritage and Geotourism (CPGG) was established at BSIP on the 28th June 2023. The CPGG has been actively working towards BSIPs mandate for societal outreach and geoheritage conservation efforts.

5.4 Bose Institute, Kolkata

The key achievements of the institute that conducts research in the areas of Plant biology, Systems biology, Molecular Medicine, Microbiology, Computational biology, Basic and Applied

Physics and Environmental science include:

- Development of Gas Electron Multiplier (GEM) Detector and a novel Resistive Plate Chamber (RPC) using indigenous material for the CBM experiment at FAIR. Building a cosmic ray air shower array at an altitude of 2200 m above sea level to study the physics of cosmic ray.
- Discovery of some essential enzymes and small RNA molecules that govern defense-response against early blight pathogen in tomato. Retrieval of Copious complex organic matter degrading bacteria from a Trans-Himalayan lake of eastern Ladakh to study their potential as efficient biodigesters meant for functioning at zero to sub-zero degree Celsius. The role of scaffold protein 14-3-3 in switching the signal between PKA and MAPK and identified the pathway by modulating the catalytic activity of Phosphodiesterase 8A (PDE8A) was elucidated. Drug-gene Interactions were mapped to Identify Potential Drug Candidates Targeting Envelope Protein in SARS-CoV-2 Infection.
- Machine learning methods to detect the mechanisms of Kinase allostery was implemented and to classify the Tubulin-ligands dissecting their potency for cell cycle arrest, both of which are relevant for design of cancer therapeutics.
- A crucial activating modification in a protein was discovered that controls the transitioning of the human pathogen *Giardia lamblia* from a non-infectious to an infectious form. A plant derived compound, Eriodictyol was identified as a selective anti-cancer agent. Also, a novel potential target involved in the process of cancer development was identified.
- Natural product inspired novel small molecules with promising medicinal activities for the management of diabetes and leishmania infection were developed. Complex oligosaccharides corresponding to the cell-wall of pathogenic bacterial species was synthesized for their use in the preparation of glycoconjugate vaccine candidates.

5.5 Centre for Nano and Soft Matter Sciences (CeNS), Bengaluru

CeNS planned activities during 2023-24 were in the fileds of High entropy alloys; Oxide photodetectors; Energy storage devices; Smart windows; Large scale synthesis of nanomaterials; Transition metal oxide-based catalysts for hydrogen energy; Halide perovskite nanocrystals; Printed electronics; Soft-Nano composites; Blue phases materials; Optically active liquid crystals; Polymer self-assembly, phases and rheology at interfaces. These research areas are expected to have great impact in the area of smart windows, displays, metamaterials, energy and environment. The key achievements during the period include:

- A highly porous and fibrous nanostructured alloy of Co–Mn–Sn via a controlled electrodeposition process is realized for hydrogen generation from water. Three-dimensional (3D) photonic crystals with complete photonic band gap (PBG) have been realized by doping high refractive index nanoparticle in cubic blue phase liquid crystals.

NbO_2 is shown to be a highly stable, ultrafast chargeable anode material for Li- and Na-ion batteries. Energy-storing batteries that have the unique ability to change colour for applications in buildings and wearable devices by indicating the remaining energy levels was developed. A highly efficient near-infrared regulating device based on a polymer network liquid crystal (PNLC) reinforced with nanosheets of hexagonal-boron nitride (BN) was fabricated. An affordable, energy-efficient glass window was developed by reducing the cost of components employing metal mesh electrode, thin WO_3 film and Al^{3+} electrolytes to create a revolutionary electrochromic energy storage (EES) device with high switching contrast, area capacitance and long cycling life.

- CeNS published 61 articles in international journals, filed two patents and 06 Indian patents were granted during the year. CeNS signed an MoU with Milman Thin Films Pvt. Ltd. for developing specialized thin film coatings and also with Institute of Wood Science and Technology for joint academic and research activities. CeNS established major scientific infrastructure capabilities such as 4 port glove box facility and rotating disk electrode workstation for battery and energy devices. Also established a high-end Fluorescence spectrometer that covers till near infra-red (IR) region for IR quantum dot applications.

5.6 Indian Association for the Cultivation of Sciences (IACS), Kolkata

Indian Association for the Cultivation of Science (IACS) is pursuing cutting edge research and teaching in all the major areas of basic sciences and interdisciplinary subjects of Applied and Interdisciplinary Sciences, Biological Sciences, Chemical Sciences, Physical Sciences, Mathematical and Computational Sciences and Materials Science.

Several R&D programmes were undertaken during 2023-24 covering multiple domains of basic and interdisciplinary areas. Currently IACS is running Integrated BS-MS, Integrated MS-Ph.D and Regular Ph.D programmes as Academic Programmes. Major facilities created during the year include: Low-Temperature Superconducting Magnet based Measurement System, HR-Transmission Electron Microscope (TEM), Sea Horse Analyzer, EPR Spectrometer and Maskless Lithograph system.

5.7 Indian Institute of Astrophysics (IIA), Bengaluru

As part of the Aditya L1 mission of, the Visible Emission Line Coronagraph (VELC) payload was successfully assembled, tested & calibrated at IIA CREST campus and handed over to ISRO on January 26, 2023, for integration with Aditya-L1 which was launched by ISRO on 2nd Sep 2023.

Five sets of Segment Support Assemblies were successfully manufactured by industry. Stress-mirror polishing machines were received at ITOFF, IIA CREST campus and successfully

commissioned. A few Actuators, Warping Harnesses and Edge Sensors were manufactured for testing and qualification. The Star Sensor Starberry Sense, developed and built by IIA space payload group, was launched by ISRO on 22 April 2023 and was successful in operation. More than 130 papers have been published in refereed journals as of 30 November 2023. One international and two national level conferences were organised by IIA. Infrastructure planning is ongoing at the Hanle Dark Sky Reserve in Ladakh. COSMOS Mysuru project is progressing well, along with a very active outreach program. Extensive outreach was done in multiple Indian languages and in multi-media for the launch of Aditya-L1.

5.8 Indian Institute of Geomagnetism (IIG), Mumbai

The Institute conducted a comprehensive study on the impact of geomagnetic storms on the ionosphere, specifically during the SpaceX satellite loss incident which provided significant insights into the combined effects of storm-time neutral dynamic and electrodynamic forcing on the ionosphere during minor geomagnetic storms. Developed an Iterative Gradient Correction (IGC) method for true height analysis of ionograms which has potential applications in skywave communications, over-the-horizon target detection and ranging applications.

In a pioneering effort, IIG scientists conducted a study on the presence of high-frequency plasma waves in the Martian plasma environment. The study provided conclusive observational evidence of the occurrence of high-frequency plasma waves around the electron plasma frequency in the Martian magnetosphere.

The Institute also carried out extensive research on the deep electrical structure over the Paleoproterozoic intracratonic Kaladgi rift basin in southwestern India using magnetotelluric studies. This study provided insights into the lithology and tectonic architecture of a long-lived rift basin involved in multiple tectonic events. Furthermore, provided new evidence of paleo-liquefaction in the Kopili fault zone in NE India, contributing to the understanding of the long-term seismic history and seismic hazard implications of the Kopili fault zone.

5.9 Institute of Advanced Study in Science and Technology (IASST), Guwahati

The institute developed a novel method of detection of Indian red scorpion venom and observed some therapeutic potential for the prevention of paraquat-induced neurodegenerative diseases from snake venom-derived nobel peptide. In addition, Quality Control and Quality Assurance (QCQA) laboratory has obtained NABL accreditation and drug testing license for AYUSH Products. Filing of Geographical Indications (GI) of three traditional fermented ethnic foods and beverages, development of an experimental animal model to repurpose MAOI as a new therapeutic target to design and develop novel anti-inflammatory drugs, preparation of activated carbon for adsorption of heavy metals are some other achievements. A pool of 101 potential probiotic bacteria isolated from traditional fermented foods and beverages of north-east India have been characterised.

Developed an optical sensing platform for the detection of anti-cancer drugs and their cytotoxicity screening, fabricated organic pyro-phototronic nanogenerator, fabricated free-standing transparent super-hydrophilic flexible protein films with antifogging and self-cleaning properties; edible chemical-resistant biocompatible film for food packaging and a cold atmospheric plasma setup for biomedical applications. IASST also created facilities like NMR, ITC, Solar simulator, CD Spectrometer and dedicated 33 KVA power in this year.

IASST's BioNest program justifies the concept of an incubator wherein innovation and entrepreneurship, networks and collaboration, resource management and outreach are taken care of for emerging Biotech or Life Science Startup Ventures & foster entrepreneurship in and around the Northeast region. At present, 41 virtual incubatees, 9 physical incubatees, 3 self-help group, 32 companies and 18 individuals are working under the Program.

IASST has taken steps to protect the traditional knowledge by IP (Geographical Indication), performs value addition to promote functional food and promotes rural entrepreneurship by forming self-help groups (SHG) and connecting them to business incubation centres as start-ups for marketing their products.

5.10 Institute of Nano Science and Technology (INST), Mohali

The new campus of INST, Nano Anusandhan Bhawan was inaugurated on 02.12.2023. A DST funded NANOBIO Incubation Centre, (spanning 9000 square feet), has been set up as a platform for technology display and envisioned to house budding start-ups.

During the year 2023-24, 33 no of PhD degree awarded. INST organised various National/ International Conference/Workshop like, Indo-France Seminar on Metal Nanoclusters supported by Indo French Centre for the Promotion of Advanced Research, Trends in Emerging Nano Science: Energy, Healthcare & Quantum Materials (TENS-2023), Crystals for Quantum Technology: CFQT2023, 2nd Bilateral Meeting on Innovations in Materials for Energy & Environmental Technologies (i-MEET), Trends in Emerging Nano Science: Energy, Healthcare & Quantum Materials (TENS-2023) etc.

The following important facilities were created: Spectroscopy Facility, Microscopy Facility, Scattering Facility, Chromatography Facility, Surface Characterization Facility, Advance Material Characterization Facility, Advanced Biological Characterization Facility. Linkages have been established with industrial partners such as Tata Steel, NTPC, Indian Oil Corporation, Titan, SAIL, NFL, UNILEVER, Reliance Industries, Kandiyar Inc and with Bharat Petroleum Corporation Limited (BPCL) for execution of Industrial project.

5.11 International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad

Indigenous technology for large scale production of Lithium Iron Phosphate (LFP, a key

cathode material in Li-ion batteries for EVs) is demonstrated for the first time in India and technology has been transfered to an Indian industry (Altmin Pvt. Ltd.) which in turn has established a pilot facility at the incubator space of ARCI.

A pilot line for automated Polymer Electrolyte Membrane Fuel Cell (PEMFC) stalk fabrication is established and a 1 kW PEMFC stalk is fabricated for demonstration. A Pilot facility for developing low expansion glass ceramics, especially required for space and defense sectors, is installed and commissioned at ARCI for the first time in India.

Technology for production of high strength and high-density tungsten components for defense application were successfully developed and transferred to an Indian industry. IR transparent spinal domes have been developed successfully for high Mach number defense products. As part of the project on clean coal technologies, novel high performance oxide dispersed iron aluminides (Fe_3Al) powders were developed and demonstrated for engineered coating applications.

SiC mirrors (M3 mirror) have been successfully developed and incorporated in Aditya L1 mission optics of Visible Emission Line Coronagraph (VELC). Indigenous novel alloy powders suitable for metal additive manufacturing (AM) have been developed and optimized for AM process suitable for medical, aerospace and tooling applications. Thermal barrier coatings on single crystal turbine blades were successfully coated for the first time in the country using Electron Beam Physical Vapour Deposition (EBPVD) Technology and submitted to user for validation. Wear resistance and corrosion resistant carbide coatings were developed and process optimized on “heavy water pump shafts” and validated for Indian Nuclear Program.

ARCI has signed an agreement with Nsure Reliable Power Solution Pvt. Ltd. Bengaluru on comprehensive technical know-how transfer for the establishment of 2MWh LIB Pilot facility and skill development training program.

ARCI developed a simple and scalable solid-state process for the “production of tropical lithium iron phosphate (LFP) cathode material for Li-ion batteries” that have many advantages such as low-cost, long durability, thermal stability and safety. Further, the large-scale demonstration of lab scale LFP process was successfully carried out for the production of 20 kg/batch. Electrochemical validation has shown that ARCI’s LFP cathode material delivered promising electrochemical performance at par with the performance of commercial LFP material. The process was patented in India and worldwide. This technology was transferred to M/s. ALTMIN Pvt Ltd., Hyderabad for global exclusive rights other than India.

5.12 Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru

JNCASR is one of the top 4.6% of 19,788 universities globally, according to the latest World University Rankings. On the national front, JNCASR secured 30th rank in the “*Research*

Institutions" category, as per recent NIRF rankings 2023. Further, JNCASR ranked 1st among the "*Research Institutions"* category out of 30 pilot institutions under DST GATI project and one among 12 successful institutions recognised as *GATI Achiever*. Several faculty members have received national and international honours and accolades in recognition of their remarkable scientific research.

Several MoUs and Non-disclosure agreements were signed during this period. The Industry-Academia meeting held in September 2023, had an overwhelming response and the Centre hopes to have more tie-ups with Industry R&D. JNCASR has recorded more than 300 research publications in 2023-24 in high-impact international journals reporting some remarkable breakthroughs in the fields of materials science, nanotechnology, green energy, health care, clean environment, neuroscience, etc.

Sixteen science outreach programmes were organised for school and college students and teachers across the country by the Education Technology Unit during 2023-2024. Faculty members from JNCASR and other scientific institutions presented popular science lectures for the students and clarified their doubts during the sessions. These programmes were attended by more than 11,000 students and 850 teachers.

5.13 National Innovation Foundation (NIF), Gandhinagar

NIF scouted few thousand grassroots innovations and traditional knowledge practices, several hundred value added (prototype development, clinical trials of veterinary and human health related practices, on-farm trials for plant varieties) and a total of 106 patents granted. Two indigenous technologies to combat mastitis in dairy animals and poultry feed supplement were transferred to the industry and many other technologies were widely disseminated in various parts of the country through social and commercial channels.

The Festival of Innovation and Entrepreneurship (FINE) 2023 and 11th National Grassroots Innovation and Outstanding Traditional Knowledge awards were successfully concluded at Rashtrapati Bhavan with 51 conferred with the award. In addition, this year 2 grassroots innovators earlier recognized by NIF were recognized with Padma Awards.

Two Grassroots Innovators and one student innovator made the country proud by winning the grassroots innovation and student innovation competition respectively in 4th ASEAN India Grassroots Innovation Forum (AIGIF) in Malaysia during November 2023.

5.14 North East Centre for Technology Application and Reach (NECTAR)

The Centre has established a Skill Development Centre & Geospatial Lab in Guwahati with advanced technology and acquired complete in-house resource capacity on Remote sensing and GIS application including Drone Technology having indigenous, high endurance and

type certified drones along with high resolution sensor systems. 1st Phase of Technology implementation on improving sustainability of traditional terracotta & pottery business in Asharikandi, Assam was successfully completed. Honey Mission project for scientific beekeeping in North East India focusing on extensive training and skill development for 500 bee-keepers on Honey production and associated activities was implemented. Implementation of NECTAR's project to establish and expand saffron cultivation in NER has been successful thereby highlighting the suitability of the region to this expensive spice. 15 stand-alone Solar Dehydrators were installed in the North-East region for solar drying of ginger, turmeric and other spices thereby benefiting SHGs, FPOs, FPCs and individual farmers.

Two major projects amounting to Rs.112 cr. under the PM-DeVINE scheme - Value Chain on Utilization of Banana Pseudo Stem for Value-Added Products and Promoting Scientific Organic Agriculture were initiated in North-East India. Under TOSS & BAANS schemes, 44 projects have been accepted and 12 numbers have been completed successfully, exemplifying a holistic approach to sustainable development and community empowerment in the North-Eastern region.

Formation of 21 Farmer Producer Organizations (FPOs) in seven districts of Arunachal Pradesh was completed to enhance business management, market linkage and formalization, benefiting approximately 2100 local farmers. Drone technology mapping has been done to accomplish 80 sq. km. of Coal Mining Area Mapping, 70 sq. km plantation area mapping in Meghalaya and about 10 missions of flights of data collection for precision agriculture (Organic & Kahsi Mandarin Fruit area) mapping.

Mawkynrew 89.6 FM Community Radio has been established in Meghalaya and Community Radio in Manipur is underway, to broadcast content that fosters agricultural growth, improves rural livelihoods and contributes to holistic community development.

5.15 Raman Research Institute (RRI), Bengaluru

The Institute organised 5 international conferences, a national conference, women centric workshops, launching prestigious lectures and talks that cover the breadth of research at the Institute.

Conceived, designed and completed building and testing, India's first X-Ray polarimeter (POLIX) which was launched into space onboard ISRO's XpoSat. POLIX will study high energy phenomena in the Universe.

The inhouse designed and developed SARAS series of antennas have undergone several upgrades this year. Also, the space counterpart - PRATUSH - has been funded for pre-project studies by ISRO and a concept model is under development.

RRI indigenously built a laboratory facility that can simultaneously cool and trap a large number of dual species of atoms near absolute zero temperature. Quantum sensing of magnetic fields at unprecedented sensitivities was developed using neutral atoms at room temperatures and uncovered novel quantum physics of laser cooled atoms at ultracold temperatures using in-house built apparatus. RRI also achieved a major milestone of free space quantum communication between a moving source and a stationary observer. This is an important step towards India's efforts in secure quantum communications using satellites. RRI also indigenously developed a new instrumentation-facility for electrofluidic detection of single cells.

5.16 S. N. Bose National Centre for Basic Sciences (SNBNCBS), Kolkata

The research outputs during the year include: Role of Machine learning in prediction of new materials for nano alloys, semiconductors & rare earths; Usefulness of 2D composite quantum material for spintronic devices like transistors & diodes; Importance of substrate promiscuity of fungi generated enzyme, Laccase in degrading industrial dye effluents; Importance of weaning information from fluctuations in electrical resistance in a graphene sheet in designing low noise electronic transistors; Importance of Chemically stable cathode material for making Li-ion batteries more efficient; Exploring the fact that gut bacteria respond quickest to sudden changes of optimum size in surrounding environment; Importance of artificial light-harvesting system using organic nanotubes for solar cells, photocatalysis, optical sensors & tunable multi-color light emitting materials; New theoretical explanation for a unique reversing motion of bacteria; Harnessing quantum entanglement for futuristic energy storage technology. The institute published more than 170 papers in refereed journals. 26 PhDs were produced and 06 Indian patent were granted.

5.17 Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTMIST), Thiruvanathapuram

The focus research areas of SCTIMST are Biomaterials Research and Development, Biomedical Device Development, Technology Transfer and Industrial Partnerships, Quality Management Systems, Testing and Technical Services, Research, Advanced Patient Care in Clinical Super-specialties in Cardiac and Neuro Sciences along with Human Resource Development in the above said areas and Public Health.

The institute secured 10th rank under Medical category in National Institutional Ranking Framework (NIRF) in 2023. The Indian Council of Medical Research designated the institute as an ICMR Collaborating Center of Excellence (ICMR-CCoE) in recognition of the commendable achievements in Biomedical research in Heart Failure.

SCTIMST TIMed supported start-up M/s. Sascan Meditech Private Limited was awarded the prestigious National Technology Day Award 2023 at New Delhi on 14th May 2023 for the indigenous development of Oralscan - a handheld device to screen early-stage oral cancers and for biopsy guidance.

SCTIMST was awarded the Best Vascular Surgery teaching institute at national level during Vascular Surgery of India Mid Term conference held in Goa between June 29 – July 1, 2023.

High-end equipments installed are HPLC MS/MS, Digital PCR and real-time PCR machines, Confocal microscope, FESEM, Biological safety cabinet, walk-in cold room

Important highlights of some major programmes in SCTIMST in 2023-24 are given below.

- Cryoablation of WPW Syndrome using a focal cryoablation catheter was done successfully for the first time in South India for a complex arrhythmia case. This is the 3rd case done by this technique using focal cryo catheter in the country. This new technology offers reversibility and high long-term success in safely curing high-risk cases.
- 34 patents and 14 design registrations were granted. The technology transfer agreement of Bioactive HA-TCP ceramic beads for drug delivery was signed with M/s Onyx Medicals Pvt Ltd on 19th July 2023.

5.18 Technology Information and Forecasting Assessment Council (TIFAC), New Delhi

TIFAC developed a dataset on real-life fuel economy, average life of various categories of road vehicles under the project “Estimation of Real-Life Fuel Economy of Indian Vehicles by a Data Driven Approach” sponsored by the International Transport Forum at OECD (ITF-OECD).

SAKSHAM portal developed by TIFAC for mapping the skills of Shramiks vis-à-vis requirements of MSME and other industries has been licensed for large scale implementation on self-sustainable / revenue generation model.

Under TIFAC MSME Programme, Industry sensitization programmes/ workshops for Technology Gap Analysis in following six (06) MSME clusters were organized:

- Coir Cluster, Coimbatore, Tamilnadu
- Tools and Die cluster Hosur, Tamilnadu
- Defence Components Cluster, Hosur, Tamilnadu
- Cricket bat cluster, Bijbihara, J&K

- Wicker Willow products manufacturing cluster Ganderbal, J&K
- Papermachi products manufacturing cluster, Zadibal, J&K

A project for impact assessment of the conversion / replacement of about 40 no. of coal-fired furnaces to gas-fired furnaces in the Moradabad Metal Cluster has been taken up. The project is being financially supported by SIDBI. Draft Report of the Project has been prepared and submitted to SIDBI. TIFAC participated in IIASA Governing Council meeting at IIASA, Laxenburg in June 2023 to discuss various strategic issues and collaboration on a few socio economic sectors.

5.19 Vigyan Prasar, New Delhi

The activities of Vigyan Prasar are executed and carried out primarily through scientific divisions namely publication planning, audio/video programmes, astronomy popularisation, Vigyan Prasar network of science clubs, science communication and training, gender and technology communication, Edu Sat network and Ham radio communication. Vigyan Prasar was involved in the above activities till Sept 2023. The Cabinet in its meeting held on 06.09.2023 has approved the proposal for Closure of Vigyan Prasar (VP). The proposal for closure of Vigyan Prasar has been submitted to Department of Expenditure as decided by the Cabinet. Currently there is no activities being undertaken by Vigyan prasar.

5.20 Wadia Institute of Himalayan Geology (WIHG), Dehradun

WIHG mapped 40 geo-thermal springs (GTS) in the UK Himalaya characterized surface and reservoir temperature and evaluated their geothermal energy potential equivalent to 10,600 MW power. An Initiative was taken for a pilot study in converting geothermal energy into electricity at Tapovan along with a synergistic program on generating geothermal-solar hybrid energy. It was found that reservoir temperature of 100-150 degrees Celsius is suitable for Binary Organic Rankine Cycle (BORC) power plant and that between 70 to 100 degrees Celsius can be used for space heating and balenotherapy. This will add tremendous value for providing Green Energy to the Char-Dham Pariyojana of the UK state and as a measure of climate change mitigation.

First of its kind AI/ML-based semi-automatic approaches were developed and computed a meta-attribute by fusing several other attributes for the semi-automatic delimitation of subsurface geologic features from surface seismic data. This has led to the delineation of 3D configuration of hydrocarbon seepage from the subsurface ‘source to surface’ in the Indo-Gangetic foreland basin of the Himalaya. This study is very important in linking the subsurface with the surface in comprehending geodynamics, resource evaluation and hazards assessment.

Landslide risk maps in hilly areas was updated for Mussoorie and Nainital towns and Bhagirathi and Goriganga basins, using slopes, gradient, curvature, direction, elevation, lithology, structures, geomorphology, rock strength, forest cover, built-up area. Since landslides are triggered mainly by rainfall (earthquake, reservoir drawdown, human intrusion also plays role), WIHG is working to couple the Slope instability with Rainfall threshold for landslide-forewarning by monitoring through web-based sensors like rain gauge, piezometer, inclinometer, extensometer, InSAR, Total stations, etc. at Chakrata in Dehradun.

Seismicity implications in the Delhi-NCR was provided based on MT study. A spurt of seismicity was observed in the study area during the COVID-2019 period from April-August 2020 including the occurrence of 15 earthquakes of M2.0 to M4.4 in the Rohtak area located ~70km SW of Delhi. The study shows that the seismicity in the Rohtak and surroundings is observed at the bifurcation points of NNE-SSW trending Delhi Hardwar Ridge (DHR) and NW-SE trending Delhi Sargoda Ridge (DSR) and at the contact zone of DSR and reverse fault that has been active and generated microseismicity in the past also.

WIHG contributed in many reports to National Disaster Management Authority (NDMA), Uttarakhand State Disaster Management Authority (USDMA) on recent disasters in Uttarakhand and Himachal Pradesh. More than 116 research papers in reputed national and international journals was published, 10 PhDs were produced. A virtual museum was developed which is available at website of the institute.

5.21 Indian Academy of Sciences (IASC), Bengaluru

During this year, the academy published 11 open access online journals including Resonance-Journal of Science Education which is also available in print version. IASC held scientific meetings and discussions at various places of India. Symposia and special meetings on topics of current interest, public lectures, special lectures by eminent scientists were also held. IASC has offered summer fellowship for student and teachers. Also, the academy invited teachers interaction with scientists in academy meetings. During 2023-24, three refresher courses were held for teachers to improve their background knowledge, teaching skills. 11 lecture workshops were held on carefully chosen topics at selected institutions.

5.22 Indian National Academy of Engineering (INAE), Gurugram

INAE continue to pursue excellence in engineering and technology through Fellowship in academia, industry and R&D organizations, Election of Fellows/Foreign Fellows. INAE -SERB Abdul Kalam Technology Innovation National Fellowship is one of the prestigious fellowship awarded by INAE jointly with SERB. SERB-INAE collaborative initiatives in engineering includes SERB-INAE conclaves on *Atmanirbhar* Technologies, workshop on writing R&D Grant Proposals for Women Engineers event held at Tezpur University under SERB-INAE Woman Engineers Program etc. Various events were held at NIT Manipur, University of

Ladakh and NIT Silchar under SERB-INAE Outreach Program for NE, J&K and Ladakh. Events are also to be held at NIT Srinagar and IIT Guwahati in March 2024 under this program.

INAE also organized its flagship events like National Frontiers of Engineers Symposium 2023 & Innovation in Manufacturing Practices 2023, Youth Conclave 2023, Engineers Conclave 2023 and Annual Convention 2023. Compendiums on "Landmark Achievements in Engineering and Technology in Independent India" and "Woman Engineers in India- Volume-I and Report of INAE Committee on "Technological Preparedness for dealing with National Disruptions" published as part of *Azadi ka Amrit Mahotsav* celebrations.

5.23 Indian National Science Academy (INSA), New Delhi

The Academy coordinated the Science20 (S20), one of the Engagement group summits of G20 under India's presidency in the year 2023. The S20 meetings have begun with the Inception meeting which was held at Puducherry on 30-31 January 2023 followed by three thematic conferences held in Agartala, Tripura on 3-4 April 2023, Lakshadweep on 1-2 May 2023 and in Bhopal on 16-17 June 2023. The summit successfully concluded in Coimbatore, India on July 21-22, 2023. The Academy published the final Science20 Communique on the theme "Transformative science for sustainable Development" and three sub-themes with the consensus from the G20 member academies.

50 candidates from different countries have been awarded the fellowship under the India Science and Research Fellowship (ISRF) call during 2023-24. 4th Yusuf Hamied Bilateral workshop was organized by INSA in collaboration with the Royal Society, UK from 24-25 July 2023 on the theme "Artificial intelligence and our world".

INSA collaborated with the National Centre for Good Governance (NCGG) and started a program called the Leadership Development Program in Science and Technology. It was a first-of-its-kind initiative for the scientific fraternity, the first edition was held from 12-18 July 2023 at INSA. A total of 44 scientists from different prestigious institutes participated in this program.

An initiative aimed at promoting science and fostering intellectual discourse by hosting eminent scientists and researchers who will share their insights with the wider community was introduced. INSA collaborated with ACS to initiate a series of activities in creating leadership at different levels of scientific/ Academic careers. The collaboration started with the first workshop held on Creating the Future Leaders from Nov 3-5, 2023 at INSA, New Delhi. Under the joint Science Education Programme of three academies (jointly with National Academy of Science and Indian Academy of Sciences), 696 students and 26 teachers were provided with summer research fellowship. 19 students and one teacher availed Focus Area Science Technology Summer Fellowship (FAST-SRF). Further 09 refresher courses for teachers and 42 lectures/ workshops for teachers and students were held.

5.24 Indian Science Congress Association (ISCA), Kolkata

The 108th Indian Science Congress, was organized by Indian Science Congress Association (ISCA) at Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur from January 3-7, 2023. This congress was inaugurated by the Hon'ble Prime Minister of India (Virtually) on 3rd January 2023. Approximately 10,000 audiences were present in this inauguration program which included invited guests, speakers, delegates, sponsors, students and officers. A Science Exhibition, 'the Pride of India Expo' was also organized as part of this Science Congress.

ISCA also organized joint collaborative programme with other organizations such as national conference/ workshop/lectures on Basics of Remote Sensing and GIS, Serological and Molecular Diagnostic Techniques; Lithium Ion Batteries and the Future Scope for Sustainable Development, International Conference on Smart Materials-Perspectives and Prospective (SMPP-2023); Millets: Fuel for the Future; Atomic Process, Laser Nanomaterial and Tetra hertz Technology for Optical Fibre Communication; etc.

5.25 National Academy of Science (NASI), Allahabad

In 2023-24, NASI published Proceedings of National Academy of Science (Sec. A & B) both in IV parts and National Academy Science Letters in VI parts. NASI organized many science communication activities like Teachers Training Workshops, Vigyan & Health Chaupals & Seminars, National Science Day, National Technology Day, National Mathematics Day, World Environment Day etc. under Aazadi ka Amrit Mohatsav and Atmanirbhar Bharat celebrations.

The Academy also organized many programmes on Technological Empowerment of Women, Atma Nirbharta, Skill Development & Capacity Building, Nutrition & Health, celebration of Poshan Mah etc.

NASI headquarter and its 22 Local Chapters spread all over India organized symposia/ seminars of different scientific topics of national importance. 93rd Annual Session and symposium on 'India secure @75' was organized during December 3-5, 2023 at BARC, Mumbai which was attended by more than 700 scientists from all over India. A few foreign Fellows of NASI also attended the event.

NASI awarded Fellowships and Membership to more than 125 scientists working in different parts of the country to recognize the outstanding scientific contributions of scientists.

6. SCIENCE AND ENGINEERING RESEARCH BOARD (SERB)

The Science and Engineering Research Board (SERB), a Statutory body of Department of Science and Technology (DST) has taken several significant steps in advancing R&D in frontier areas of science and engineering in the country. The SERB (Board) interventions mainly aim to support the R&D projects in core areas of science, engineering and its interdisciplinary fields, targeting the young scientists/researchers to start/initiate their research through specific calls and fellowship programmes in view of equity and inclusion. The ongoing schemes/ programmes of SERB for 2023-24 along with number of sanctions indicated inside the first parenthesis under the corresponding scheme/programme are as follows:

Core Research Grant (CRG) (950), Mathematical Research Impact Centric Support (MATRICS) (185), SERB Scientific and Useful Profound Research Advancement (SERB-SUPRA(24), Empowerment and Equity Opportunities for Excellence in Science (EMEQ) (266), Teachers Associateship for Research Excellence (TARE) (102), SERB-Promoting Opportunities for Women in Exploratory Research (SERB-POWER grant) (231), SERB POWER Fellowship (09), SERB-Technology Translation Award (SERB-TETRA) (01), SERB-Fund for Industrial Research Engagement (SERB-FIRE) (2), Start-up Research Grant (SRG) (488), Ramanujan Fellowship (19), SERB Research Scientists (SRS) (18), SERB National Postdoctoral Fellowship (NPDF) (235), Impacting Research Innovation and Technology (IMPRINT) (03), Visiting Advanced Joint Research (VAJRA) Faculty Scheme (19). Under Accelerate Vigyan, a total 281 and 152 applications were recommended for support for High-end Workshop and Training & Skill Internship, respectively.

SERB offers various Awards and Fellowships to exceptionally distinguished individuals through its schemes. Awards and Fellowships by SERB in 2023-24 are given below with number of sanctions indicated inside the first parenthesis under the corresponding award/ fellowship:

J C Bose Fellowship (25), Abdul Kalam Technology Innovation National Fellowship (10), National Science Chair (6), SERB Science and Technology Award for Research (SERB-STAR) (22), SERB Women Excellence Research grant (3), SERB-International Research Exposure (SIRE) (148).

As a part of assistance to Professional Bodies & Seminars/Symposia, 592 events were recommended for financial support across the country in various fields of Science and Technology. In addition, 20 applications were recommended for financial support to professional bodies/institutes/societies for publication of journals. In the reporting period, under International Travel Support (ITS) Scheme, 1644 participants recommended for

financial support under the scheme, among them 1287 were young scientists and 357 were senior scientists. SERB supported in 217 patent filling and 5110 publications in SCI indexed journals. Also 1724 JRF/SRF/others were supported through various programmes.

Major outreach activities by SERB during 2023-24 include: Professional Advancement Program for Indian Women Researchers in STEM; R&D funding opportunities and awareness workshop for researchers from North-East Institutions; SERB Digital Gaming Research Initiative; Women driving Science and Technology in India; Energy Conclave at Institute of Nano Science and Technology (INST), Mohali; Women in Science and Technology- Fostering innovation; VORTEX on present status and future prospects on preparedness of utilization of SERB national Cryo- Electron Microscopy.

7. ANUSANDHAN NATIONAL RESEARCH FOUNDATION (ANRF)

The Union Cabinet in June 2023 had approved a proposal of the Department for introduction of a Bill in the Parliament with an aim to establish the Anusandhan National Research Foundation (ANRF) as a Statutory body. Subsequently, the Anusandhan National Research Foundation Bill 2023 has been passed by the Parliament in the monsoon session of 2023. The ANRF is to provide high level strategic direction for research, innovation and entrepreneurship in the fields of natural sciences and scientific and technological interfaces of humanities and social sciences and also to promote, monitor and provide support as required for such research. The aims and objectives of ANRF include seeding, growing and facilitating research at academic and research institutions; funding competitive peer-reviewed grant proposals; assisting in setting up research infrastructure and environment; supporting translation of research undertaken into capital intensive technologies; evolving nationally coordinated programmes; coordinating across the Central Government, State Governments, public authorities, industries, and research institutions, to document and analyse the expenditure on scientific research and their outcomes; evolving participation in international collaborative projects and fostering exchange of scientific information etc.

ANRF targets to forge collaborations among the industry, academia, and government departments and research institutions, and create an interface mechanism for participation and contribution of industries and state governments in addition to the scientific and line ministries. It will focus on creating a policy framework and putting in place regulatory processes that can encourage collaboration and increased spending by the industry on R&D.

The ANRF is governed by a Governing Board chaired by the Prime Minister of India and an Executive Council chaired by the Principal Scientific Advisor to Government of India. A budgetary provision of ₹50,000 crore during a five-year period (2023-28) is estimated for the ANRF including ₹14,000 crore from Central Government. Remaining amount will be sourced from industry, philanthropist foundations etc. DST is the administrative department of the ANRF.

The rollout of ANRF is in progress.

8. SURVEY AND MAPPING CAPABILITY

8.1 Survey of India

Survey of India (SoI), the National Survey and Mapping Organisation of the country setup in 1767 is the oldest scientific organisation in the country. The following are the main activities and achievements during the year:

- **Continuously Operating Reference Station (CORS) Network:** Pan India CORS network with more than 900 stations has been launched on 12th October, 2023. This enhances the capability to provide centimetre level positioning services in realtime.
- **Geoid Model:** In line with the National Geospatial Policy, 2022 aimed to have a high accuracy Geoid for the entire country by year 2025, the Geoid model has been completed for 10 states i.e. Punjab, Haryana, Delhi, UP, Bihar, West Bengal, Jharkhand, Telangana, Kerala and Goa.
- **SVAMITVA Scheme:** Under the SVAMITVA scheme, the Survey of India has completed drone-based survey of Abadi areas of more than 2.8 lakhs villages.
- **MoU with states for Large Scale Mapping:** Survey of India has signed MoUs with the States of Andhra Pradesh, Haryana, Karnataka and Andaman & Nicobar Islands for Large Scale Mapping. Recently, two more state/UT namely Uttarakhand and Puducherry have also signed MoUs with Survey of India for Large Scale Mapping. Survey of India has completed mapping of more than 1 lakh square kilo meters area in these states.
- **Mapping of Salt Pane Land Areas:** Survey of India has completed high resolution mapping of Salt Pane Land areas for Department for Promotion of Industry and Internal Trade (DPIIT).
- **Administrative Boundary Database:** Survey of India has initiated harmonization and updation of administrative boundary database with the database of the Registrar General of India.
- **National Fundamental Geospatial Data Themes:** The draft of Spatial Data Model Structure has been prepared by SoI. Further, as mandated by the National Geospatial Policy, 2022, Survey of India has constituted five Thematic Working Groups on National Fundamental Geospatial Data Themes namely, Geodetic Reference Frame, Orthoimagery, Functional Areas, Toponymy & Elevation.
- **Toponymy:** Survey of India has taken the initiative in consultation with the Ministry of Home Affairs to automate name change notification process.

- **Training and Capacity Building:** The syllabus of different courses of the National Institute for Geoinformatics Science & Technology, the Training Institute of Survey of India, has been revised. Additionally, about 30 Standard Operating Procedures have been prepared for use of modern technology for training. NIGST has entered into partnership with the Capacity Building Commission to provide learning opportunities for Civil servants in Geospatial Science & Technology.

8.2 National Atlas & Thematic Mapping Organisation (NATMO), Kolkata

The National Atlas & Thematic Mapping Organisation (NATMO) in Kolkata engages in various thematic mapping activities. Major activities and achievements during the year are as under:

- **District Planning Map Series (DPMS)** – Published 11 district planning maps for different districts, covering themes like administrative divisions, railway maps and places of tourist interests, etc.
- **Golden Map Service (GMS)** – focuses on digitally capturing physical connectivity and identifying locations for creating web map services. Published the map for Bela Pratapgarh and preparation of map for six cities is ongoing.
- **Thematic Maps**: One of the mandates of NATMO included generation of thematic maps and standardization of thematic information. NATMO has published 03 thematic maps on India- Administrative, India-National Highways and India- Airways. The preparation of thematic map for Solar Parks is ongoing.
- **Commemorative Volume of National Atlas of India –**A Special Volume for the National Atlas of India, showcasing India's 75 years of Independence is under preparation.
- **Braille Mapping** – Published India-Administrative map in Hindi Braille Script. Preparation of 9 atlases on state and national level for visually impaired is under progress.
- **NATMO Geo-Portal and Geospatial Data** – The regular updating of geo-portal has been taken up by NATMO where maps and atlases are converted to digital formats and uploaded. In 2023-24, the geospatial data layers of five maps have been uploaded on the Geo-portal. Further, geospatial data of land use/land cover maps of Nagaland, Meghalaya, Manipur and Jharkhand has been shared with other Government Departments.
- **State Administrative Map** – NATMO has prepared the State Administrative Map of West Bengal showing different administrative levels and preparation of maps for 5 other states is ongoing.
- **Monographs** – The monographs prepared by NATMO combine the geospatial information with exhaustive literature based on intensive research. Currently, NATMO is

in the process of preparation of 6 Monographs on the subjects of Indian Major Scheduled Tribes, India's Shaktipiths and Indian Economy.

- **Training, Skill development and Outreach Activities:** Imparted training to 38 employees **on various subjects** related to GIS, administration, etc. A total of 14 papers were presented by NATMO officials in national/ international seminars/conferences. NATMO participated in 28 exhibitions/ book fares and also International Congress (INCA).

9. TECHNOLOGY DEVELOPMENT BOARD

Technology Development Board (TDB) is a statutory body under Department of Science & Technology with a mandate to provide financial assistance to the industrial concerns and other agencies attempting development and commercial application of indigenous technology or adapting imported technology for wider domestic application.

In pursuance to its mandate, TDB accepts applications for financial assistance throughout the year from all sectors of economy such as Health & Medical, Engineering, IT, Chemical, Agriculture, Telecommunications, Road Transport, Energy & Waste Utilization, Electronics, Defence, Civil Aviation, Textile etc.

Agreements Signed during 2023-24

During the fiscal year 2023-24 (upto December, 2023), TDB has signed ten (10) agreements for providing financial support to various industrial concerns, supporting diverse projects across industries. A substantial ₹77.09 crore investment underscores TDB's commitment to ground breaking collaborations. Following are few key supports:

- M/s WellRx Technologies in Rewari, Haryana for development of next-gen Oil & Gas technologies to enhance hydrocarbon production and contribute to India's energy sector.
- M/s Alchemy Recyclers Private Limited in Bharuch, Gujarat, revolutionizing waste management with an integrated plant, recovering precious metals from various waste sources.
- M/s Noccare Robotics in Pune, Maharashtra, pioneers healthcare innovation with a Digitally Enabled Advanced Universal ICU Ventilator.
- M/s TIEA Connectors in Bangalore, Karnataka, makes significant strides in electronics by commercializing harsh environment connectors, enhancing India's global tech presence.
- M/s Chemlife Innovations in Doddaballapur, Karnataka, focuses on the chemical sector, emphasizing the commercialization and manufacturing of bio-trace minerals for animal feed, aligning with TDB's support for sustainable M/s agriculture.

New Initiatives

In the fiscal year 2023-24, TDB propelled four international collaborations, each strategically designed to foster innovation, global partnerships and sustainable development with UK, Singapore, Sweden and Spain.

National Technology Week – 2023

TDB organized National Technology Week 2023 to commemorate the 25th anniversary of India's landmark technological achievements. The event took place from May 11th - May 14th, 2023 and was inaugurated by the Honorable Prime Minister, Shri Narendra Modi. With a central theme of 'School to Startup' - Igniting Young Minds to Innovate,' the event aimed to celebrate and promote innovation and entrepreneurship in India.

The National Technology Week witnessed an extraordinary turnout with over 5,000 young minds, 1500 visitors, 800 exhibitors, 200 student exhibitors and 100 startups converging from all corners of the nation. The event featured more than 10 technical sessions, strategically designed to encourage the transition from technopreneurs to entrepreneurs.

Number of innovative exhibits displayed at the event, ranging from AI-assisted road safety solutions to advancements in medical technology, underscored India's potential as a global technological leader.

National Technology Awards 2023

For the year 2022-23, the Technology Development Board (TDB) presented National Technology Awards to recognize outstanding contributions to indigenous technology development and commercialization.

10. ADMINISTRATION AND FINANCE

10.1 Parliament Work

Parliament Unit serves as central coordinating point for all parliamentary work of the Department. It is responsible for coordinating entire parliamentary work of the Department, viz. preparing answers to Parliament Questions, fulfilling assurances, analyzing reports of Parliamentary Committees etc. It ensures that the parliamentary work pertaining to the Department of Science & Technology is accomplished as per the prescribed schedule and procedures.

The Unit liaisons with the Ministry of Parliamentary Affairs, Secretariats of Lok Sabha/ Rajya Sabha, other Ministries/Departments (including Scientific Departments) with a view to fully discharge the parliamentary obligations of the Department of Science & Technology.

The Unit coordinates work relating to consideration of Detailed Demand for Grants by the Parliamentary Standing Committee and also coordinates the visits of the Parliamentary Committees to various scientific institutions which are under the administrative control of this Department.

The Unit developed a software application, which is a repository of Parliament Questions, recent Cabinet Notes, Acts of Parliament and Gazette Notifications of the Department. The software application was launched by Hon'ble Minister of State (Independent Charge) of Ministry of Science and Technology. This application serves as a referral point and guide to the newly recruited officers in preparing replies to Parliament Question and Cabinet Notes.

10.2 Vigilance

The Vigilance Unit handles vigilance related cases of the Department, its subordinate offices and aided institutions including that of complaints received directly from complainants, the Central Vigilance Commission (CVC), Central Bureau of Investigation (CBI) and other sources. It plays an active role in ensuring the prompt disposal of these complaints. The vigilance unit also handles vigilance disciplinary proceedings and maintains a regular touch with the CVC and when necessary, with the CBI. During 2023 (as on 31.12.2023), Vigilance Unit dealt with the following number of complaints:

Source	Opening Balance	Recd. During the year	Total	Disposed	Balance
CVC	1	20	21	21	0
Others	17	59	76	76	0

This year, a Vigilance Clearance Portal has been created to provide online Vigilance Clearance. In accordance with the directives of the CVC to spread awareness about transparency, accountability and corruption free governance, Vigilance Awareness Week was observed in DST from 30th October to 5th November 2023 in association with the Department of Scientific and Industrial Research (DSIR).

10.2 Data & Strategy Unit (DSU)

The Data & Strategy Unit was established in the Department to enable the creation of well-integrated monitoring and data systems while ensuring adequate focus on data quality and security. It also encompasses creating mechanisms for regular data analysis within the Department to inform policy decisions. Coordinating with programme divisions within the Ministry/Department as well as with required external partners such as States, other Ministries/ Departments, research organizations, leading private players and academic institutions for taking necessary steps in the direction is also one of their key responsibilities along with an in-depth review of the Data Governance Quality Index (DGQI) action plan developed by the Department under the guidance of the NITI Aayog.

DSU-DST secured the 1st rank in the DGQI ranking framework among all the Scientific Ministries/Departments and achieved an impressive 8th rank out of 66 Ministries/Departments with an outstanding score of 4.67/5.00.

DST-DSU has also been engaged in creating a shared space within the Department to have an open conversation pertaining to Data and its importance through “Lecture Series” with speakers from various fields, Institutions and within the Department.

The Unit promotes DST scheme awareness with weekly thematic posters/data infographics at Technology Bhawan. The DSU has also been creating dashboards for all the schemes of DST since 2017-18. It is in the process of developing a separate dashboard for each of the programs of DST to be used as a tool for monitoring and evaluation by the Programme Divisions. Apart from this, an analysis of DST’s new projects (FY: 2022-23) was published which outlines funding distribution across states, institutions and gender categories, providing a quick yet insightful overview of DST’s strategic initiatives.

The Unit also has an Internship Programme, where interns from different academic institutions are encouraged to bring fresh and innovative ideas to meet the objectives of the unit.

10.3 Status Note on Cyber Security Guidelines

Following activities/measures were undertaken towards compliance of cyber security guidelines during the period:

- The guidelines of CERT-In have been circulated to all divisions of DST and the Autonomous Bodies/Attached & Subordinate Offices for strict compliance.
- CERT-DST has been constituted by DST vide order dated 06.03.2023. Regular meetings of CERT-DST are conducted for monitoring the compliances of the CERT-In guidelines.
- A new IT Cell has been set up in the Department vide order dated 21.12.2023. This cell will, inter-alia, function as Cyber Cell under the supervision of CISO, DST.
- Exercise to remove administrative privileges from all Users' PCs have been completed.
- New PCs with Windows 11 have been procured to replace all PCs with Windows 7/8/8.1.
- MAC binding implemented on all ports.
- Replaced Obsolete L2 switches and upgraded to the latest OS.
- Endpoint Detection and Response **(**EDR) solution was installed in all Desktops.
- One training session on Cyber Security Awareness was also conducted in DST through the training section.
- Browsing access of all OTT platforms have been removed in Technology Bhawan NIC Network.
- All obsolete machines were detached from DST LAN.
- Implemented network segmentation in Technology Bhawan LAN.

10.4 Finance

STATEMENT SHOWING BUDGET & EXPENDITURE FOR THE CALENDAR YEAR 2023

(Rs. in crore)

Department of Science and Technology	BE 2022-23	RE 2022-23	Expenditure during the quarter January- March, 2023
REVENUE	5919.50	4865.05	1210.93
CAPITAL	82.70	42.12	19.37
TOTAL	**6002.20**	**4907.17**	**1230.30**

Brief Statement of Activities 2023-24

Department of Science and Technology	BE 2023-24	RE 2023-24	Expenditure during the quarter April- December, 2023
REVENUE	7843.95	4851.59	2761.94
CAPITAL	88.30	41.39	11.61
TOTAL	**7932.25**	**4892.98**	**2773.55**

11. AUDIT OBSERVATION

Annexure-I

Position as on 15.01.2024

Detailed position of Action Taken Notes (ATNs) as per Audit Para Monitoring System (APMS) portal to be included in the Annual Report for the year 2023-24 as given below:

Sl. No.	Year	No. of Paras/ PA Reports on which ATNs have been submitted to PAC after vetting by Audit	Details of the Paras/PA reports on which ATNs are pending.		
			No. of ATNs not sent by the Ministry even for the first time.	No. of ATNs sent but returned with observations and Audit is awaiting their resubmission by the Ministry	No. of ATNs which have been finally vetted by audit but have not been submitted by the Ministry to PAC
	Nil	Nil	Nil	Nil	Nil

Annexure-II

Position as on 15.01.2024

Summary of important Audit Observations pertaining to DST: **Nil**

ABBREVIATION

ANRF	Anusandhan National Research Foundation
ASEAN	Africa, Association of Southeast Asian Nations
BRICS	Brazil, Russia, India, China and South Africa
CERI	Clean Energy Research Initiative
CERN	European Organization for Nuclear Research
CVC	Central Vigilance Commission
DSU	Data & Strategy Unit
FIST	Fund for Improvement of S & T Infrastructure in Universities and Higher Educational Institutions
GERD	Gross Expenditure on R&D
GLP	Good Laboratory Practice
IISF	India International Science Festival
INSPIRE	Innovation in Science Pursuit for Inspired Research
INSPIRE-MANAK	Million Minds Augmenting National Aspiration and Knowledge
WISE-KIRAN	Women in Science and Engineering - Knowledge Involvement in Research Advancement through Nurturing)
WISE-PDF	WISE Post-Doctoral Fellowship
LHC	Large Hadron Collider
LIGO	Laser Interferometer Gravitational-wave Observatory
NATMO	National Atlas & Thematic Mapping Organisation
NIDHI	National Initiative for Developing and Harnessing Innovations
NLP	Natural Language Processing
NMIS	National Manufacturing Innovation Survey
NMSHE	National Mission for Sustaining the Himalayan Ecosystem
NMSKCC	National Mission on Strategic Knowledge for Climate Change
NSDI	National Spatial Data Infrastructure
NSM	National Supercomputing Mission
NSTEDB	National Science and Technology Entrepreneurship Development Board
NSTMIS	National Science &Technology Management Information System
PURSE	Promotion of University Research and Scientific Excellence
QKD	Quantum Key Distribution
SAIF	Sophisticated Analytical Instrument Facilities
SATHI	Sophisticated Analytical & Technical Help Institutes
SCCCs	State Climate Change Cells
SHE	Scholarship for Higher Education
TDB	Technology Development Board
TIHs	Technology Innovation Hubs
TMT	Thirty Meter Telescope
TRC	Technical Research Centres
WLCG	Worldwide Large-Hadron-Collider Computing Grid

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