UNIT-6 : SCIENCE AND TECHNOLOGY SET-UP IN INDIA

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6.1 LEARNING OBJECTIVES

After going through this unit, you will be able to :

- comprehend the science and technology system in India
- get a brief overview of the different branches of the science and technology system in India

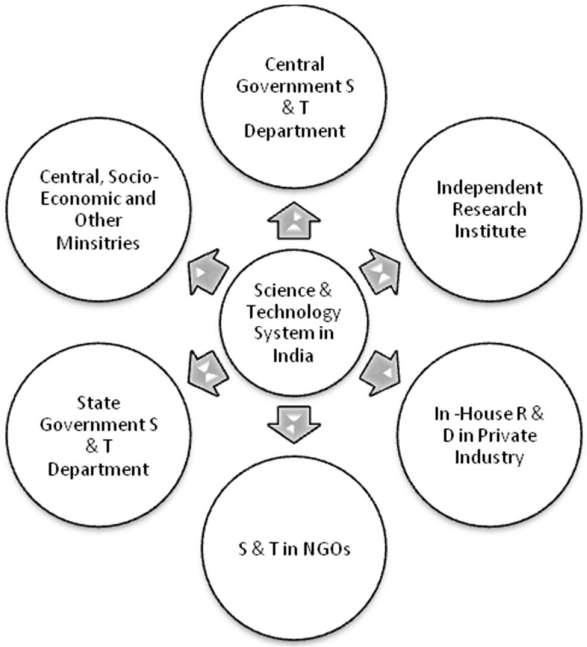
6.2 INTRODUCTION

India has a robust science and technology system in place in order to set the momentum for the growth of indigenous technology based industries and manpower. We have already come across the different science and technology policies of India with the latest policy being implemented in 2013. These policies have set the pace for the rapid expansion and growth of scientific institutions in different parts of the country along with development of manpower. In order to carry on research activities at a higher level and to imbibe scientific temperament in the minds of the people, several departments were set up by the Indian government. This has resulted in a broad-based and extensive S&T network. Along with the setting of the numerous

departments, emphasis was also given on developing adequate and trained manpower. Science and Technology infrastructure in India encompasses S&T organisations under the Central Government, State Government as well as public and private sectors working in areas as diverse as agriculture and healthcare on the one hand and nuclear and space research on the other.

6.3 SCIENCE AND TECHNOLOGY SYSTEM IN INDIA :

A brief overview of the science and technology system in India has been cited below-



Source : Department of Science and Technology, Ministry of Science and Technology, Government of India (www.dst.gov.in)

As is evident from the figure given above, India's science and technology system is divided into six different divisions- Science and Technology Department under the Central Government, Independent Research Institute, In–House Research and Development in Private Industry, Science and Technology system/departments in the non-governmental organisations, Science and Technology department under State Government and science and technology system under central, socio-economic and other ministries. The actual development of the science and technology movement took shape post Independence and Pt. Jawaharlal Nehru was instrumental in popularising science and technology. This resulted

in the setting up of many science and technology departments in the country in a phased manner. The departments of Atomic Energy, Science and Technology, and Space were thus among the first S&T departments set up in the country . Consequently, the Council of Scientific and Industrial Research expanded with the establishment of various institutions dedicated to the development of specific industries. There are different branches of the science and technology system in India which we shall describe in the following sub-heads.

6.4 Central Government Science and Technology Departments/Ministries

The Science and Technology departments functioning under the Central Government are : Department of Science and Technology (DST), Department of Scientific & Industrial Research (DSIR), Department of Atomic Energy (DAE), Department of Space (DoS), Department of Biotechnology (DBT) and Department of Ocean Development (DOD). Department of Science and Technology is mainly entrusted with the responsibility of formulation of Science and Technology policies and their implementation, identification and promotion of thrust areas of research in different sectors of science and technology; technology information, forecasting and assessment; international collaboration, promotion of science & society programmes and coordination of science and technology activities in the country.

The Government of India have different designated departments related to the field of science and technology under different ministries. Under the Ministry of Science and Technology, we have Department of Science and Technology, Department of Biotechnology and Department of Scientific and Industrial Research. Ministry of Earth Sciences (MoEs) which was earlier known as Ministry of Ocean Development came into being vide Presidential Notification dated the 12th July, 2006 bringing under its administrative control India Meteorological Department (IMD), Indian Institute of Tropical Meteorology (IITM) and National Centre for Medium Range Weather Forecasting (NCMRWF). It is worth mentioning here that initially Department of Ocean Development (DoD) was created in July 1981 which functioned as a nodal Ministry for organising, coordinating and promoting ocean development activities in the country. However, in February, 2006 the Department came to be known as the Ministry of Ocean Development which was later changed into Ministry of Earth Sciences. Under Ministry of Agriculture we have two autonomous organisations/body – Indian Council of Agricultural Research (ICAR) and Central Agricultural University and one company by the name of Agrinovate India Limited. Apart from the above mentioned ministries, there are also some departments which are related to the field of science and technology - Department of Atomic Energy (DAE) and Department of Space (DOS) . Apart from some of the important departments related to the field of science and technology, there are other ministries which makes use of technology in different fields

like Ministry of Food Processing Industries and Ministry of New and Renewable Energy. Let us analyse some of the important departments/ministries/organisations which have been engaged in undertaking research and development in different areas of science and technology

- **Department of Science and Technology** (**DST**) ,established in May 1971 ,is a department within the Ministry of Science and Technology in India. It tries to promote new areas of science and technology and to play the role of a nodal department for organising, coordinating and promoting Scientific and Technological activities in the country through a number of autonomous institutions and professional bodies. For instance , Institute of Advanced Study in Science and Technology (IASST) is one such autonomous institute situated in Guwahati which is engaged in research activities pertaining to the field of science and technology. Apart from that, the department is also responsible for providing funds to various approved scientific projects in India.
- **Department of Scientific and Industrial Research (DSIR)** which was set up on 4th January, 1985 under the Ministry of Science and Technology, carries out the activities relating to indigenous technology promotion, development, utilization and transfer. It has two autonomous organisations – **Council of Scientific and Industrial Research (CSIR) and Consultancy Development Centre (CDC).** CSIR is said to be India's largest research and development organization. DSIR also acts as the nodal department for granting recognition to in-house R&D units in Industry and Scientific and Industrial Research Organizations (SIROs). CSIR, constituted in 1942 is known for its cutting edge R&D knowledgebase in diverse S&T areas, is a contemporary R&D organization. CSIR covers a wide spectrum of science and technology – from radio and space physics, oceanography, geophysics, chemicals, drugs, genomics, biotechnology and nanotechnology to mining, aeronautics, instrumentation, environmental engineering and information technology. Consultancy Development Centre (CDC) is mainly meant for promotion and development of Consulting Profession with focus on capacity building, consulting human resources, Studies on State of Consulting Activities in certain domain areas, identifying opportunities for Export of Consultancy Services and facilitating availability of consultants and client organisations. DSIR has two important PSUs – National Research Development Corporation and Central Electronics Limited.
- **Department of Biotechnology (DBT),** set up in 1986 under the Ministry of Science and Technology is basically responsible for identifying and supporting specific R&D programmes in the field of biotechnology and biotechnology-related product manufacture. It also provides support and training of young scientists in the field of biotechnology at various universities and institutes. This department has made significant achievements in

the growth and application of biotechnology in the broad areas of agriculture, health care, animal sciences, environment, and industry. DBT has 15 autonomous institutions and 3 Public Sector Undertakings (PSUs). A few important autonomous institutions are National Institute of Immunology (New Delhi), National Brain Research Centre (Haryana), National Centre for Cell Science (Pune), Institute of Life Sciences (Bhubaneshwar) and Rajiv Gandhi Centre for Biotechnology (Kerala). The three PSUs are Bharat Immunological & Biological Corporation(Uttar Pradesh), Indian Vaccine Corporation Limited (New Delhi) and Biotechnology Industry Research Assistance (New Delhi).

North Eastern Region – Biotechnology Programme Management Cell (NER-BPMC) is a programme of the Department of Biotechnology, Ministry of Science & Technology, Government of India for development, coordination and monitoring of biotechnology programmes in the North Eastern States of India managed by the Biotech Consortium India Limited (BCIL), New Delhi. The NERBPMC which was established by DBT in 2009 helps to evolve and implement various new programmes in the area of biotechnology for the benefit of the north eastern states. In order to create an environment of training and research in Medical Biotechnology, the department provides support to 12 medical colleges in ths region. About 92 Biotech hubs have already been established at various institutions , universities and colleges to promote education, training and research in biological sciences including biotechnology.

- **Department of Atomic Energy (DAE) came into being on** August 3, 1954 under the direct charge of the Prime Minister through a Presidential Order. This department has been engaged in the development of nuclear power technology, applications of radiation technologies in the fields of agriculture, medicine, industry and basic research. DAE comprises of six research centers, three industrial organizations, five public sector undertakings and three service organizations. It has under its aegis two boards for promoting and funding extra-mural research in nuclear and allied fields, mathematics and a national institute (deemed university). It also supports eight institutes of international repute engaged in research in basic sciences, astronomy, astrophysics, cancer research and education. It also has in its fold an educational society that provides educational facilities for children of DAE employees. The main Research & Development centres under DAE includes Bhabha Atomic Research Centre (Mumbai), Indira Gandhi Centre for Atomic Research(Kalpakkam), Raja Ramanna Centre for Advanced Technology (Indore), Variable Energy Cyclotron Centre (Indore), Global Centre for Nuclear Energy Partnership (Gurgaon) and Atomic Minerals Directorate for Exploration and Research (Hyderabad).Some of the important DAE aided institutions include Tata Institute of

Fundamental Research(Mumbai), Saha Institute of Nuclear Physics (Kolkata), Institute of Physics (Bhubaneshwar) and Institute of Mathematical Sciences (Chennai).

- The Government of India constituted the Space Commission and established the **Department of Space (DOS**) in June 1972 and brought Indian Space Research Organisation under DOS in September 1972. This department has been created with the prime objective of promoting development of space science & technology towards achieving self-reliance and for space applications facilitating all-round development of the country. It also manages several agencies and institutes related to the field of space exploration and space technologies. DOS operates through a major set-up, the Indian Space Research Organisation, which is responsible for planning and executing a viable space programme to develop satellites and launch systems and provide space-based services in the areas of communication, meteorology, resources survey, management and sustainable development. Different programmes are implemented by the Department of Space (DOS) through, mainly, Indian Space Research Organisation (ISRO), Physical Research Laboratory (PRL), National Atmospheric Research Laboratory (NARL), North Eastern-Space Applications Centre (NE-SAC) and Semi-Conductor Laboratory (SCL). The Centres of Indian Space Programme are situated in 23 places all over India including one in Shillong known as the North Eastern Space Application Centre. These centres undertake research activities in the field of space technology. RESPOND (Research Sponsored) programme started in the 1970s, aims at encouraging academia to participate and contribute in various space related activities. Under RESPOND, projects are taken up by Universities/academic institutions in the areas of relevance to Space Programme. Apart from this, ISRO has also set up Space Technology Cells at premiere institutions like Indian Institute of Technologies (IITs) - Bombay, Kanpur, Kharagpur and Madras; Indian Institute of Science (IISc), Bengaluru and Joint Research Programme with University of Pune to carry out research activities in the areas of space technology and applications.
- **Department of Agricultural Research and Education (DARE)** under Ministry of Agriculture was established in December, 1973. **The Indian Council of Agricultural Research (ICAR)** is an autonomous organisation under the Department of Agricultural Research and Education (DARE). Formerly known as Imperial Council of Agricultural Research, it was **established on 16th July 1929** and is responsible for co-ordinating, guiding and managing research and education in agriculture including horticulture, fisheries and animal sciences in the entire country. With 100 ICAR institutes and **70 agricultural universities** spread across the country this is one of the largest national agricultural systems in the world. ICAR has also been instrumental in ushering Green Revolution across the country. It is engaged in cutting edge areas of science and

technology development under the guidance of the internationally renowned scientists. Apart from ICAR, there is one more autonomous body under Department of Agricultural Research and Education known as the **Central Agricultural University** in Imphal. Established in 1993, the university has integrated programmes of teaching, research and extension education with its jurisdiction spread over Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Sikkim and Tripua. Department of Agricultural Research and Education also owns a company by the name of Agrinovate India Limited which is a registered company under the Companies Act, 1956. The company aims to work on the strengths of ICAR and promote the development and spread of research and development outcomes through IPR protection, commercialization and gorging partnerships both within and outside the country.

- **The Indian Council of Medical Research (ICMR),** New Delhi is another apex body in India which has been set up for the formulation, coordination and promotion of biomedical research. Funded by the Government of India through the Department of Health Research, Ministry of Health & Family Welfare, this Council conducts research in different fields like control and management of communicable diseases, maternal and child health, control of nutritional disorders, developing alternative strategies for health care delivery, research on non-communicable diseases and drug research. In fact, the Council promotes biomedical research in the country through intramural as well as extramural research.
- **Defence Research and Development Organisation (DRDO)** is the Research and Development arm of the Ministry of Defence, Government of India. Set up in 1958, DRDO today has 46 laboratories which are situated in the length and breadth of the country. On the basis of the R & D work carried out by the laboratories, its activities can be grouped into seven technology clusters – Armament and Combat Enginering Systems (ACE), Aeronautical Systems (AERO), Missiles and Strategic Systems (MSS), Naval Systems and Materials (NS & M), Electronics and Communication Systems (ECS), Micro Electronic Devices and Computational Systems 9MED & CoS) and Life Sciences (LS). Thus, the main mandate of DRDO is to provide assessment and advice on scientific aspects of weapons, platforms and surveillance sensors; to develop cutting edge technologies to be used in the production of state-of-art sensors, weapon systems, platforms and allied equipment for our defence services.
- The Ministry of Earth Sciences was established in the year 2006 by bringing all the agencies of meteorological and ocean development activities under one umbrella. The Earth System Science Organization (ESSO) addresses holistically various aspects relating to earth processes for understanding the variability of earth system and for improving forecast of the weather, climate and hazards. The ESSO is also responsible for

development of technology towards the exploration and exploitation of marine resources in a sustainable way for the socio-economic benefit of the society. The policies and programmes of the ESSO are pursued through mission mode projects through its centres, viz. India Meteorological Department (IMD), National Centre for Medium Range Weather Forecasting (NCMREF), Indian Institute of Tropical Meteorology (IITM), National Centre for Antarctica and Ocean Research (NCAOR), National Institute of Ocean Technology (NIOT), Indian National Centre for Ocean Information Services (INCOIS), National Centre for Earth Science Studies (NCESS), Centre for Marine Living Resources and Ecology (CMLRE) and Integrated Coastal and Marine Area Management (ICMAM).

- Research & Development activities of **the Ministry of New and Renewable Energy** aim at resource assessment, technology development, demonstration and commercialization. The Ministry supports Research, Design, Development and Demonstration (RDD&D) to develop new and renewable energy technologies, processes, materials, components, sub-systems, products & services, standards and resource assessment so as to indigenously manufacture renewable energy devices and systems. The underlying purpose of RDD&D efforts is to make industry competitive and renewable energy generation supply self-sustainable/profitable and thereby contribute to increase share in total energy mix in the country.

  A comprehensive policy on Research, Design, Development and Demonstration (RDD&D) is in place to support RD&D in new and renewable energy sector, including associating and supporting RD&D earned out by industry for market development. The said policy includes complete RDD&D perspective in solar energy envisioned in Jawaharlal Nehru National Solar Mission (JLNNSM), which envisages India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible.

- **Department of Electronics and Information Technology** (DeitY) is an important department under the Ministry of Communications & IT, Government of India . The vision of this department is to promote e-Governance for empowering citizens, promoting the inclusive and sustainable growth of the Electronics and IT , enhancing India's role in Internet Governance, promoting Research and Development and innovation, enhancing efficiency through digital services and ensuring a secured cyber space. Three important areas have been identified for the purpose of Research and Development - Information Technology, Convergence Communications & Broadband Technologies, and Electronics.

- **Ministry of Environment, Forest and Climate Change :** Since its inception in 1985, the Ministry of Environment, Forest and Climate Change has been funding research through grant-in-aid projects to many research institutions in different areas under the broad ambit of environmental protection and management. The Ministry has taken a number of new initiatives to strengthen scientific research in the area of environmental sciences. Research and Development takes place through different programmes like Environmental Research Programme (EnvRP), Ecosystems Research Programme (EcRP), Research Programmne in Socio-Economic Issues of Environment (RPSE). There are also a few research based autonomous organizations under the Ministry like Govind Ballabh Pant Institute of Himalayan Environment and Development, Indian Council of Forestry Research and Education, Indian Institute of Forest Management, Indian Plywood Industries Research and Training Institute and Wildlife Institute of India. These organizations carry out different research activities related to environmental issues.

6.5 Science and Technology in NGOs

Non-Governmental Organisations (NGOs) also serve as important organisations for carrying out research activities in the field of science and technology. They contribute to different stages of the research cycle, fostering the relevance and effectiveness of the research, priority setting, and knowledge translation to action. They play a key role in stewardship (promoting and advocating relevant issues of research), resource mobilization for research, generation, utilization and management of knowledge, and capacity development.

People's Science Institute is an NGO situated in Dehradun which has been working in the fields of community-led watershed-based livelihoods development, environmental quality monitoring, disaster-safe housing and dissemination of appropriate technologies. Research is undertaken to improve the implementation of field projects, identify new areas of work and to innovate new technologies and social processes.

Applied Environmental Research Foundation is another NGO based in Pune. The foundation uses makes use of research techniques in order to plan, prioritise and manage activities within its programmes. The research based strategies enable the foundation to improve management practices, make informed decisions and aid local people in managing their resources better.

6.6 Science and Technology Departments/Councils in the State Government

Even though there are numerous departments at the centre to monitor and look into the science and technology sector, yet for proper implementation of development goals, the need to establish State Councils for Science and Technology was stressed on. As such, the initiative to establish State Councils for Science & Technology was first taken way back in 1971 when Shri C Subramaniam, the then Minister for Science and Technology and Chairman, National Committee for Science and Technology (NCST) wrote to Chief Ministers of all the States implying the importance of focusing on the States in order that the development goals are attained. The end of the Fifth five year plan saw the establishment of State S & T Councils in Karnataka, Kerala, Uttar Pradesh and West Bengal. However, it was felt that a sustained effort was necessary in order to develop more State Councils for Science and Technology. As such, the subsequent five year plans laid emphasis on the development of such State Councils through the plan programme 'Assistance for development of State Councils for Science and Technology'. This gradually led to the setting up of several State Science and Technology Councils in all the States and Union Territories. The State Councils are usually chaired by Chief Ministers of respective States or by an eminent scientist.

It is worth mentioning here that the Department of Science & Technology (DST), Government of India played a positive role in facilitating the setting up of the State Science and Technology Councils. DST's support has facilitated State S&T Councils to embark upon novel initiatives resulting in a number of success stories.

Let us take the example of Assam's Science & Technology Department in order to understand the working of the different functionaries. The Science and Technology Department of Assam which was established in 1983 is the nodal Department for the promotion of Science and Technology in the State. The main objective of the department is to initiate, support, promote and co-ordinate research and development projects which can be utilised for the overall development of the State. The Department also tries to implement various schemes of the Indian Government, North Eastern Council and other public bodies relevant to the areas of science, technology and environment . The Department also implement various schemes/programme through its subordinate organisations institutions like Assam Science and Technology council (ASTEC), Assam Energy Development Agency (AEDA), Centre of Plasma Physics- Institute for Plasma Research (CPP – IPR) and Institute of Advanced Study in Science and Technology (IASST) .

6.7 Recognised in-house R & D units

Apart from the above mentioned departments and ministries of the government of India, there are also other in-house research and development units of both private and public sector. As per the March, 2023 directory of the Department of Scientific and Industrial Research, there are 831 Scientific and Industrial Research Organisations recognised by DSIR which are engaged in the research and development activities. These centres channelize their research activities towards product development, process development, commercialisation of indigenous technologies and absorption and up-gradation of imported technologies. There are also about other scientific and industrial research organisations in the country which have been engaged in research and development in the field of natural and applied sciences, agricultural sciences, social sciences and medical sciences.

Apart from the above mentioned various departments, research and development activities under the private industries , R & D activities in the NGOs, and state science and technology departments have been established to carry out research work pertaining to the field of science and technology.

Thus, we can say that the science and technology system in India is a robust one with different government sectors, institutions, agencies, NGOs, departments engaged in undergoing research and development activities in various fields. It is worth mention9ing here that as per the national research and development survey carried out in 2011, there were about 4533 R & D institutions out of which 50 % of the institutions were found to be in the Private Sector, 20% in State Sector, 14% in Central Sector, 12% in Universities and the remaining 4 % in the Public Sector.

In the field of basic research, the country has done notably and has established major research groups with world-class capabilities in various emerging and frontline areas of Science & Technology. Some examples are the areas of Molecular Biophysics, Molecular Biology, Neuro-biology, Liquid Crystals, Biomedical Devices, Superconductivity, Condensed Matter Physics, Astronomy and Astrophysics, Powder Processing and Advanced Materials, Organic Chemistry, Solid Sate and Surface Chemistry, Numerical Weather Prediction, Parallel Processing and Atmospheric Sciences.

India occupies a unique position in the world having formulated its own nuclear programme and cultivated self-reliance in areas of reactor technology and its entire associated fuel cycle. The country designs, constructs and operates nuclear reactors, fabricates the required fuel --

reprocesses it, and treats the waste generated in the entire fuel cycle in a comprehensive manner by a totally indigenous effort.

Yet another achievement which speaks of the high level of S&T capability of India is the development of supercomputers which only a few advanced countries have this capability today.

A large number of technologies have been developed and commercialized for various chemicals, including petrochemicals and agrochemicals; industrial catalysts; drugs and pharmaceuticals; biomedical devices; food processing; leather processing and products; engineering materials and equipment; electronic equipment and construction materials, to cite a few. Many of these technologies have also been marketed abroad, an indication of their global competitiveness.

CHECK YOUR PROGRESS

Q.1 : When was the Department of Science and Technology established ?

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Q.2 : Name the two autonomous under Department of Scientific and Industrial Research (DSIR).

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Q.3 : What is the function of NER-BPMC programme?

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Q.4 : When was the Ministry of Earth Sciences established?

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6.8 LET US SUM UP

- Department of Scientific and Industrial Research (DSIR) which was set up on 4th January, 1985 under the Ministry of Science and Technology, carries out the activities relating to indigenous technology promotion, development, utilization and transfer.
- Department of Biotechnology (DBT), set up in 1986 under the Ministry of Science and Technology is basically responsible for identifying and supporting specific R&D

programmes in the field of biotechnology and biotechnology-related product manufacture.

- The Indian Council of Agricultural Research (ICAR) is an autonomous organisation under the Department of Agricultural Research and Education (DARE).
- The Indian Council of Medical Research (ICMR), New Delhi is another apex body in India which has been set up for the formulation, coordination and promotion of biomedical research.
- Defence Research and Development Organisation (DRDO) is the Research and Development arm of the Ministry of Defence, Government of India.
- The Science and Technology Department of Assam which was established in 1983 is the nodal Department for the promotion of Science and Technology in the State.

6.9 FURTHER READING

1) Heptulla, Najma (1986) , *India's progress in science and technology*, Oxford and IBH Pub. Co.

2) Nanda, J.N (2004), *Science and Technology in India's Transformation*, Concept Publishing Company, New Delhi

3) Singh, Ashok Kumar (2008*), Science and Technology for Civil Services Examinations,* Tata McGraw-Hill, New Delhi

6.10 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q.No 1 : May 1971

Ans to Q.No 2 : Council of Scientific and Industrial Research (CSIR) and Consultancy Development Centre (CDC).

Ans to Q.No 3 : North Eastern Region – Biotechnology Programme Management Cell (NER-BPMC) is a programme of the Department of Biotechnology, Ministry of Science & Technology, Government of India for development, coordination and monitoring of biotechnology programmes in the North Eastern States of India managed by the Biotech Consortium India Limited (BCIL), New Delhi. The NERBPMC which was established by DBT in 2009 helps to evolve and implement various new programmes in the area of biotechnology for the benefit of the north eastern states.

Ans to Q.No 4 : 2006

6.10 POSSIBLE QUESTIONS

A. Short Questions (Answer each question in about 150 words)

Q.1 : What are the main activities that are carried out by the Department of Scientific and Industrial Research?

Q.2 : How do the Non-Governmental Organisations (NGOs) serve as important organisations for carrying out research activities in the field of science and technology?

B. Long Questions (Answer each question in about 300-500 words)

Q.1 : Give a brief overview of the science and technology system in India.