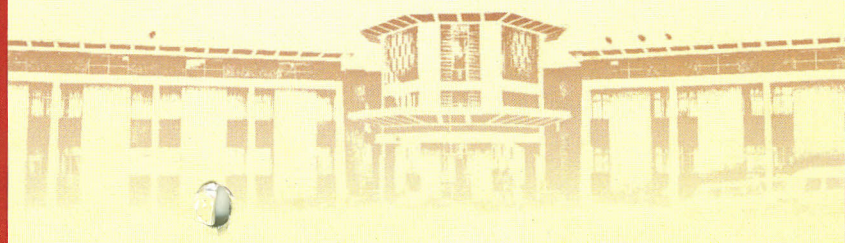




Convocation Address
by
Dr. Srikumar Banerjee
Chief Guest

First Convocation
of
Indian Institute of Space Science and Technology
28th June 2012



HIGHER EDUCATION-RESEARCH- INNOVATION LINKAGE

by

Srikumar Banerjee

Homi Bhabha Chair Professor

Bhabha Atomic Research Centre,

Department of Atomic Energy, Trombay, Mumbai 400085

Introduction:

Honorable Chancellor, Chairman, Board of Management, Director, Distinguished Faculty, Guests and Young Students of the Indian Institute of Space Science and Technology, Thiruvanthpuram, I feel deeply honored to be amongst you to deliver the first convocation address of your Institute. In a way, your institute is a pioneer in establishment of a knowledge system that provides the much needed Higher Education-Research-Innovation (HERI) linkage in our continued efforts to keep pace with the developed world. As our nation stands at a cross road of globalised economy and incessant thrust towards achievement of inclusive societal growth, there is a great necessity of excellence in the quality of our learning and inculcation of creative thinking in the education system. The acquisition of knowledge for inclusive growth is closely connected with socio-economic environment as well as identified national



technology thrust areas like space, strategic defense and atomic energy. The establishment of research universities of excellence like IIST, Homi Bhabha National Institute etc. under the aegis of mission oriented departments like ours is a timely step in the right direction.

Education has always been the key to sustainable development and successful nation building. It is necessary therefore, that our education system must lead to holistic knowledge acquisition through creation of a synergy between three critical components of the knowledge based economy namely higher education, research and innovation. In India, a possible mechanism for achieving this objective is to combine the best attributes of teaching from our traditional university system with the excellent culture of research and innovation from our national laboratories to establish what are commonly known as Research Universities. IIST is harbinger of this recipe indicating a paradigm shift in implementation of higher education, research and innovation policy.

When I look at your esteemed institution, I not only look at 100 acres of green campus, modern and environmentally friendly buildings, humming high performance cluster computing machines, high speed Wi-Fi internet, outstanding infrastructure and a great faculty, but also, I see the absolute commitment of ISRO, which guarantees all of you to learn in close collaboration with some of the best scientists and engineers of our country who have acquired knowledge through hands on experience and are ready to impart this



learning on to you.

It is a universal truth that every institution of learning develops a culture of its own by drawing from the cumulative wisdom of the men who built it and men who have passed through its corridors. Though young in age, IIST is the culmination of the wisdom drawn from a long list of luminaries who have left their indelible foot prints in the story of India's incredible achievements in space science and technology. While offering my sincere congratulations to all the young men and women who are graduating today, I must remind you of this rich heritage that you share and must cherish all your life. It is the heritage of nationalism, constructive nation building and spirit of self-reliance that is dear to us all.

Education and Nation Building :

There is no doubt that our nation has the potential to be a global technology leader. Despite the teeming masses, centuries of external subjugation and inadequate infrastructure for scientific research leading to new technologies, Indians have made great strides in a number of areas like agriculture, space, atomic energy, bio sciences, pharmaceuticals, automobiles, chemicals, manufacturing and information technology. To realise the full potential we must continue to scale our efforts incessantly. Some of the near term goals being sought are sustainable manned missions to space, development of solar and nuclear energy to improve per capita consumption to 5000 kWh, building smarter materials, robust gene reconstruction,



developing quantum computers, exploitation of nano technologies etc. The new millennium will be ruled by superior technologies that facilitate sustainable and equitable socio economic growth. In the context of role of science and technology in nation building, Dr. Homi Jehangir Bhabha had said, "The key to national prosperity, apart from the spirit of the people, lies in the modern age, in the effective combination of three factors i.e. technology, raw material and capital, of which the first is perhaps the most important. The creation & adoption of new scientific techniques can, in fact, make up for a deficiency of natural resources and reduce the demand on capital. But, technology can only grow out of a study of science and its applications".

Building a self reliant and prosperous nation we need creation and implementation of new scientific techniques to provide for basic needs like abundant food and water supply, outstanding and well distributed healthcare, distributed and sustainable energy systems, adequate infrastructure, high industrial production and a well placed national security protocol in the shortest possible time. The most critical precursor to this is a robust knowledge system. The key question that we must ask ourselves is whether we are able to consistently produce excellence in all components of our national life. This is why a paradigm shift in education system has become urgent and extremely important.

Higher Education and Research in India :

Over the past decade, new dynamics have emerged in the areas of



higher education-research- innovation (HERI) linkage due to the ever increasing imbalance of demand supply chain, changing needs of knowledge and skills, availability of wide spread opportunities and the necessity of linkages to socio economic environment. The scientific research and innovation is gradually becoming more pragmatic with a balance between mega science and societally relevant research. It has become paramount that education-research-innovation are linked to national development goals.

The policy of higher education and research in India has been built around a robust university system aimed at providing broad base fundamental knowledge to the recipients and make them ready for contributing to human society at large. However, Despite six decades after independence, our higher education system has a gross enrolment ratio at a paltry 12% (Global average >20%) and the number of universities at a paltry number of 504 against a projected requirement of about 2000 universities. Barring a few universities of excellence, most of the 500 odd universities are primarily engaged in rigid syllabus based teaching and examining students in a pre-set pattern. Additionally, there are few academic institutions of excellence like IITs, NITs., IISER, NISER that admit students after 10+2 education and shape them through a rigorous and slightly versatile education process. The major lacuna of the IIT system has been the disconnect with national scientific and technology development goals. The best of their graduates are lured away by multinational companies for jobs that have little to do with their training.



On the other hand, directed scientific research and technology development linked to national development goals have traditionally been served by the National Institutes and Mission oriented Departments such as Atomic Energy, Space, Defence Research & Development Laboratories and Laboratories of Council of Industrial Research. These departments have followed definite mandates with well formulated long term programs towards achievement of the national goals. Despite being severely handicapped by technology denial, they have been able to put in place a totally self reliant and indigenous science and technology infrastructure as good as the developed nations. Most importantly, they have painstakingly and in a sustainable manner created a strong base of skilled scientific manpower to carry on the programs.

Changing Dynamics in the New Knowledge Based Economy

As we enter the new millennium, the world is witnessing incredible advance of the Knowledge Based Society and its principal motive force, the Knowledge Economy. On the face of globalization and pervasive forces of new communication and information technologies, all nations have been forced to review and reorganize their capacities for accessing and benefiting from the high-level knowledge which shapes social change. For those with weak or nonexistent capacity in this area, are being marginalized rapidly. There is an urgent need for synergy



through the convergence of higher education, scientific research and innovation systems as the three strategic components of a Knowledge Economy. Today, the operating space available to each of these sectors have expanded radically and instead of being isolated entities, there is room for overlap and co-existence through mutual complementarities. Consequently the platforms on which these three components operate namely universities, research institutions, technology innovators and industries must work together towards creation of a new structure with distinctive traits from each of these.

By definition, a university is perceived as a place where new ideas germinate, strike roots, grow tall and sturdy. It is a unique space, which covers the entire universe of knowledge. It is a place where creative minds converge, interact with each other and construct visions of new realities. Established notions of truth are challenged in the pursuit of knowledge. It is also a place that dynamically adjusts and adapts to the changing needs of the society at large. Fundamentally therefore, the university structure has ample scope for open and directed research, dynamic syllabus consistent with changing societal conditions, developing a robust adjunct faculty system from industry and institutes to bring education closer to real time needs.

The dichotomy of Higher Education and Research; University versus National Institutes

During recent years, there has been a gradual loss of primacy of



universities with erosion of autonomy, lack of appropriate funding, undermining of undergraduate training and increasing isolation from real world problems in terms of a disconnect between theoretical training and practical problem solving. There is also a disconnect between the socio-economic problems at the common man's level and the academic interests of university faculties. Over the years, universities have become isolated from the society at large. The enormous student mass handled by them with limited number of faculty has compounded their problems

Research and Innovation is an integral aspect of higher education and without an introduction to the intricacies of research, higher technical education remains incomplete. Moreover, among developing nations, the technology gap between them and the developed nations must be bridged in the shortest possible time. In this scenario, acquisition of research aptitude and skill-sets during higher education itself becomes of paramount importance. However, the task of addressing wider access to post secondary education coupled with large investment in developing state of art research facilities has been a delicate balancing act hinging on visionary policies, political will and a large diversified funding base. This has resulted in universities becoming primarily busy in day to day routine rather than expanding their innovation space.

One of the solutions followed in USA in particular, has been in establishing world class research universities in the model of Caltech, MIT, Harvard as well as world class national laboratories like ANL, LLNL, Sandia with strong connections between them and scientists



having both research and teaching affiliations. Through this, the universities and national laboratories in USA have achieved assured quality in delivery of research, innovation and teaching. Since industries in USA are active participants in promotion of knowledge systems, these research universities have come closer to the idealised notion of a knowledge system than the national institutes that provide a somewhat restricted breadth of knowledge.

In this context, it is necessary to look at our own national laboratories as well as mission oriented departments as proponents of knowledge systems. They are universally considered 'prestigious' institutions dedicated to pursuit of research and innovation in pure and applied science, thanks to the initiatives taken by luminaries like Dr. Homi Bhabha, Vikram Sarabhai and Shanti Swarup Bhatnagar. Our national laboratories have developed a culture of excellence and good governance but limited to pursuing research in specialized areas. Laboratories belonging to CSIR, DAE, ISRO belong to this group. Since they have been established with a specific mandate in chosen areas such as medicine, agriculture, metallurgy, energy, defence, space, etc., they induct and train selected scientific manpower generated from the colleges/universities in the multi disciplinary and multi dimensional technologies and nurture their talents towards achievement of specific applied goals. This model has been highly successful in strategic domains such as defence, space and atomic energy, in which the institutions that developed or adapted technologies were also 'users' of those technologies. A number of spin



off technologies have been used in societal applications with great success. Use of isotopes and radiation in agriculture, food preservation and healthcare, communication and weather forecasting satellites, desalination and waste management technologies are few examples of the societal spin off areas.

Unfortunately the third partner in the education-research-innovation chain, namely, the Indian industries preferred to take up fully developed, scaled-up and tested 'ready to use' technologies from other countries rather than work with indigenous prototypes and ideas. As a result, industry has been flooded with imported and often outdated technologies and the much needed incentive to the research institutions has been lacking. The task of innovation, technology development and prototyping has been left to the mission oriented departments. These departments today have to develop every aspect of technologies needed in their respective domains.

The Need of the Hour - Emergence of Research Universities

It is apparent that, in the last few decades, there has been a disconnect amongst university, research institute and industry, each one operating oblivious of the other. Though there has been consistent attempts on the part of research institutions to involve both industries and universities to participate in their programs, the synergy has had very limited success. The concept of a "research University" embodies the basics of a university education with broad base open knowledge acquisition across disciplines and societal interactions. They are



characterized by cutting edge research, vigorous technology development and transfer, abundance of resources, concentrated and directed talent as well as favorable governance with mechanism for creative growth of individual and teams. Our national education policy needs to be refined to create a foundation for emergence of such universities that could be feeders to our national programs and industrial necessities. The primary modus operandi of a model research university would be the following :

1. Provision of adequate research and development funding to generate new fundamental knowledge in natural and applied sciences.
2. Capacity-building towards creation of a highly skilled group to be used both in research and teaching.
3. Development and introduction of new technology products sustainable in the market
4. Quality assurance in research and development as well as teaching.
5. Policies in inculcating creativity in education and innovation in research
6. Market sustainability through networking, continuous interactive learning, incubation of new ideas, commercialization of appropriate knowledge.
7. Involvement of Undergraduates in R & D projects

Keeping this in mind, the Yash Pal committee on Renovation and Rejuvenation of Higher Education has made a number of recommendations to strengthen the University system in a holistic



manner. Some of these include conversion 1500 of our colleges into universities, designation of a single authority for the entire university system, combining all natural sciences, vocational education and humanities with greater mobility across disciplines, greater autonomy for universities, increased focus on under graduate courses, continuous up gradation of faculty with compulsory emphasis on research, greater number of Inter University Centres to provide common R & D infrastructure , capacity building for skills and managing research challenges to serve societal needs. However, Pending implementation of these recommendations, the national thrust areas are being starved of trained manpower.

Paradigm Shift in HERI: Directed Research Universities

In view of the burgeoning enrolment, the Indian universities today are burdened with massive student strength, daunting tasks of completing the syllabus, conducting tortuous examinations followed by evaluation, screening and admissions. This fully occupies the faculty resulting in severe erosion in the skill levels, quality of the knowledge product and preparedness of the student to get in to a research and innovation mould. As a result, the quality of manpower inputs to national science missions like Atomic Energy, Space, Defence, CSIR. ICAR have been severely affected.

The creation of Deemed universities like IIST or HBNI or the CSIR Academy must be viewed in this context. IIST and HBNI are deemed universities conceived and created by Institutes of Excellence engaged



in integrated development of all aspects of space technology or nuclear energy. By virtue of being associated with research laboratories, they have excellent teaching and research infrastructure. The required knowledge base in multiple disciplines is easily drawn from the multidisciplinary human resource base available in their respective institutions. Students get access to excellent laboratory facilities and cumulative wisdom of active researchers. The syllabus is far from being static consisting of foundation courses as well as specialised courses offered by various faculty in their respective areas. The students also get a much better interaction with industry through technology development and transfer programs. These are early days for such research universities. With experience and continuous value addition from peers, they have the potential to reach the national expectations.

In recent years, a number of counter viewpoints have criticised the establishment of these deemed universities. The protagonists of this argument fear that if this becomes a general trend, it will considerably dilute higher education by narrowing down the scope of education where with every deemed university teaching topics of their specialisation and students get to perceive only one part of the proverbial elephant. The main arguments centre around the consequent dilution of both the institutional as well as university system, narrow perspective of the mission oriented departments, erosion of teaching quality by researchers who are not full time professional teachers, bureaucratic set ups of government



departments and possibilities of severe inbreeding that is harmful to growth of knowledge systems. Some of these concerns are legitimate and needs to be addressed by the national deemed universities cum research institutes.

Synergy is the key :

Perhaps, the criticism to the establishment of research universities like HBNI, IIST etc are a little premature. In contrast to the traditional universities, these institutes have continuously updating course contents, sufficient freedom to the teachers in placing due emphasis to subject areas of relevance, the opportunities for students to take part in research, research oriented faculty with broad field experience spanning across the range of the syllabi and an assured career plan for the students. The greatest asset is the ambience that gives a taste of research at an early age and helps to inculcate the culture of "learning the act of learning itself". However, one must take note of the inherent dangers associated with specific mission oriented universities falling in to the trap of getting overly biased towards user requirements instead of building a broad foundation of knowledge.

The changing face of the higher education-research-innovation linkage demands that all the three components must be versatile, vibrant and robust. There is enough space for the university system to expand, flourish and incorporate research-innovation components either within themselves or through tie ups with institutes. Research institutes, on the other hand, are in a unique position to incorporate a teaching component that will also improve the level of understanding



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in their own research staff and create a sustainable and skilled manpower pool required by them. It is absolutely necessary that the traditional university system be strengthened through infusion of capital, better faculty in terms of tie up with institutions and industry, better laboratory facilities through establishment of common consortiums and finally periodically upgraded syllabi. The large student mass can be lessened by following recommendations regarding creating more universities around excellent teaching institutions. The university system must reemphasize practical work instead of being theory-centric. The strengthening of the university system towards a holistic knowledge system would benefit all of us including organisations like IIST and Homi Bhabha National Institute.

Science and Technology Education as Instruments of Nation Building:

A nation is a large group of people with strong bonds of identity typically based on shared values, cultures, religion, history, language or ethnicity. As a Nation, India is unique. It is one of the most incredible wonders on earth with large diversity in cultures, religion, language, ethnicity and economic strata spanning across the entire country. At the same time, it has always been strongly bound through the commonality of a long and eventful history, shared wisdom of ancient philosophies and an extremely rich heritage. The uniqueness of the Indian Nation lies in a timeless quality that combines the wisdom of the past, accomplishments of the present and dreams of the future. To quote the French philosopher, Romaine Rolland; "If



there is one place on the face of earth where all the dreams of living men have found a home from the very earliest days when man began the dream of existence, it is India!"

It is in this context, that the new paradigm shift in Higher Education-Research-Innovation synergy must be looked at. India is not only a country but part of an ancient and wise civilization that has absorbed and assimilated multitude of philosophies, religious thoughts and highly disparate ways of life to always emerge stronger, wiser and more resilient. It is our inherent obligation with traditions of scholarship, original thinking and great cultural heritage to participate fully in the march of science and create a veritable knowledge system for our youngsters and enable them to be active protagonists in the task of nation building.

Let me once again congratulate all of you; the graduating students, the prize winners and teachers of this unique institution on the occasion of the first convocation day.

Thank you very much



Dr. Srikumar Banerjee is an internationally renowned nuclear scientist and metallurgical engineer. He is presently Homi Bhabha Chair Professor. He retired as the Chairman Atomic Energy Commission of India - (AECI) and the Secretary of Department of Atomic Energy ('DAE') on April 30, 2012. Earlier he was the Director of Bhabha Atomic Research Centre (BARC). He is one of the leading experts in material science and nuclear technology in India and has made outstanding contributions to many areas, both basic and application oriented.



In the course of his distinguished professional career, Dr. Banerjee has published more than 300 scientific papers in reputed international and national journals. Some of these publications are regarded as landmark contributions in the field of materials science. In recognition of Dr. Banerjee's important research contributions, he has been the recipient of many awards and honours. These include Indian National Science Academy (INSA) Young Scientist Medal (1976), National Metallurgists' Day Award (1981), Shanti Swaroop Bhatnagar Prize in Engineering Sciences (1989), Materials Research Society of India (MRSI) Medal (1990), G.D. Birla Gold Medal of The Indian Institute of Metals (1997), INSA Prize for Materials Science (2001), MRSI-Superconductivity and Materials Science Prize (2003), Indian Nuclear Society Award (2003).

Notable among the international awards received by him are Acta Metallurgical Outstanding Paper Award (1984) and Humboldt Research Award (2004). Dr. Banerjee is a Fellow of a number of august academic bodies including Indian National Science Academy, Indian Academy of Sciences, Indian National Academy of Engineering, The National Academy of Sciences, India and Asia Pacific Academy of Materials.

In recognition of Dr. Banerjee's distinguished contribution, he has been honoured with Government of India's prestigious civilian award, Padma Shri, in 2005





Indian Institute of Space Science and Technology

(Declared as Deemed to be University under section 3 of the UGC Act, 1956)

Valiamala, Thiruvananthapuram





Welcome Address

by

Dr. K. Radhakrishnan

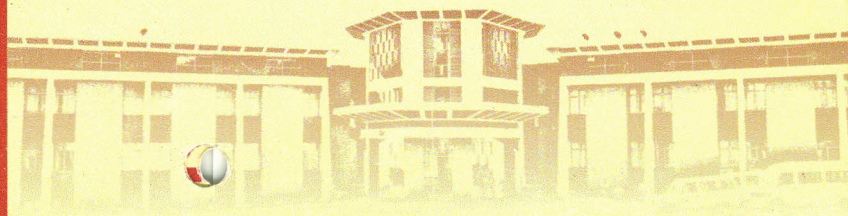
Chairman, Board of Management, IIST

First Convocation

of

Indian Institute of Space Science and Technology

28th June 2012



Welcome Address

by

Dr. K. Radhakrishnan

Chairman, Board of Management, IIST

Most Respected and Beloved Chancellor of the Indian Institute of Space Science and Technology, Dr. A P J Abdul Kalam;

Dear Dr. Srikumar Banerjee, DAE Homi Bhabha Chair Professor, Former Chairman, Atomic Energy Commission, and Our Chief Guest today;

Distinguished Members of the Founding Governing Body of the Institute;

Respected Dr. S C Gupta, Former Director of Vikram Sarabhai Space Centre;

Shri P S Veeraraghavan, Director, VSSC;

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Director of IIST, Dr. K S Dasgupta;

Former Director, IIST, and Prof. Vikram Sarabhai Distinguished Professor, Dr. B N Suresh;

Directors, Associate Directors and Distinguished Scientists and Engineers of various Centres and Units of the Indian Space Research Organisation, Department of Space;

The Registrar, Erudite Deans, Members of the Council, Faculty and Officials of IIST;

Students and **Graduates** of IIST;

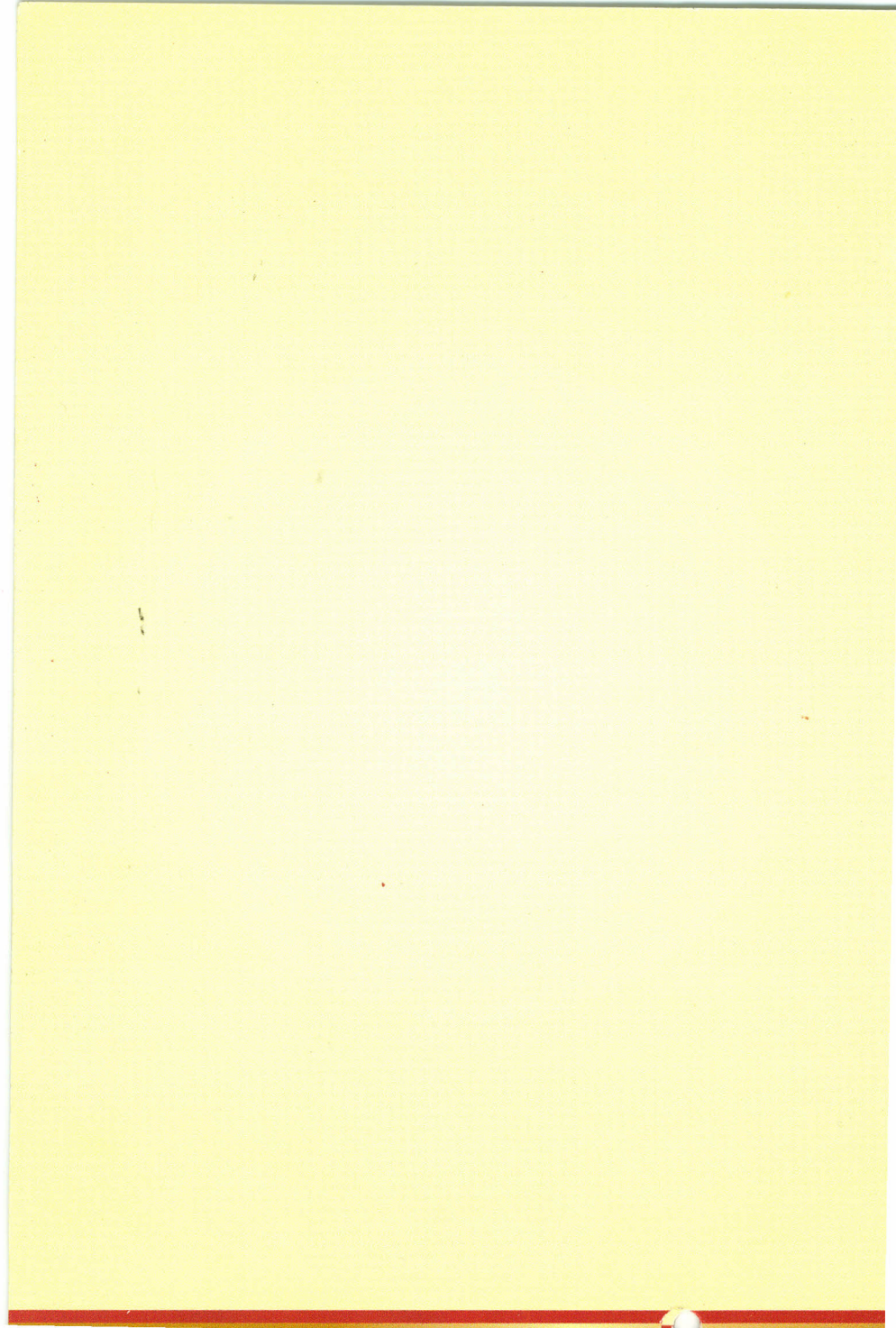
Distinguished Invitees, Ladies and Gentlemen;

On this momentous First Convocation of the Indian Institute of Space Science and Technology, I, in the capacity as the Chairman of the Board of Management of this unique Institute, have the great honour and pleasure to welcome you all to this august and historic event. As Asia's first Space Institute to offer a complete range of undergraduate, post graduate, doctoral programmes with specific focus on space science, technology and applications; this Institute represents the fruition of a long-cherished vision of

space exploration with renewed interest in planetary exploration. A global system of Earth Observation Systems came up to enhance delivery of benefits to society in the areas of agriculture, water, weather, climate, environment, ecosystems, biodiversity, health, and disaster management. Space-based global navigation systems have gained impetus with multiple service providers in the field. Novel concepts of hypersonic space transportation systems, low-cost access to space with reusable launch vehicle technology and air-breathing propulsion are the new challenges. We are proud to see India as a front runner in the global comity playing pre-eminent roles in the International forums of space agencies and space faring nations. I am sure you will have exciting and challenging tasks waiting for you, and you will really enjoy contributing in this collective endeavour.

As I conclude, I would again like to congratulate the graduating students, and also your teachers who provided the ambience and shaped your intellect for you to achieve this coveted academic distinction. I would like to express my profound gratitude to all dignitaries for gracing this august occasion with their presence.





Dr. K. Radhakrishnan, Chairman of Board of Management of Indian Institute of Space Science and Technology; Chairman of Space Commission; Secretary, Department of Space, Government of India and Chairman of ISRO; is a technocrat par excellence; a dynamic and result-oriented Manager with very fine personal and inter-personal qualities; an astute Institution-builder with a strategic vision; an able Administrator with a positive attitude; and an inspiring Leader credited with nurturing leadership skills in the younger generation. He has had a distinguished career adorned with accomplishments that spans beyond 40 years in space technology, applications and space programme management.



Dr. Radhakrishnan was born on 29 August, 1949 at Irinjalakuda, Kerala. He graduated in Electrical Engineering from Kerala University (1970), completed his PGDM from IIM Bangalore (1976) and was awarded Doctorate for his thesis titled "Some Strategies for Indian Earth Observation System" from IIT Kharagpur (2000).

Starting his career as an Avionics Engineer in 1971 at ISRO's Vikram Sarabhai Space Centre, Trivandrum; he commendably held several decisive positions in ISRO such as Project Director for setting up Regional Remote Sensing Centers (1987-89); Director of Budget & Economic Analysis for entire ISRO (1987-97); Director of National Natural Resources Management System-Regional Remote Sensing Service Centers (1989-97); Mission Director of Integrated Mission for Sustainable Development and Deputy Director of National Remote Sensing Agency (1997-2000); Director of National Remote Sensing Agency (2005-08); Director of Vikram Sarabhai Space Centre (2007-09); and Member, Space Commission (October 2008-October 2009)) with some responsibilities in concurrence. During 2000-05 he had a stint in the Ministry of Earth Sciences as the Founder Director of Indian National Centre for Ocean Information Services and the first Project Director of Indian National Tsunami Warning System. He also held several important positions at the international level including Vice Chairman of Intergovernmental Oceanographic Commission (2001-05), Founder Chairman of Indian Ocean Global Ocean Observing System (2001-06) and Chairman of the Working Group of the Whole UN-COPUOS STSC (2008-2009).





Indian Institute of Space Science and Technology

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Valiamala, Thiruvananthapuram





Chancellor's Address

by

Dr. A P J Abdul Kalam

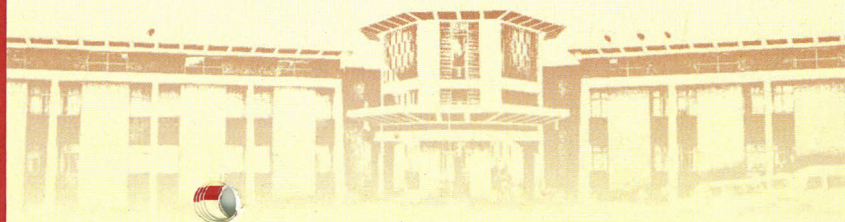
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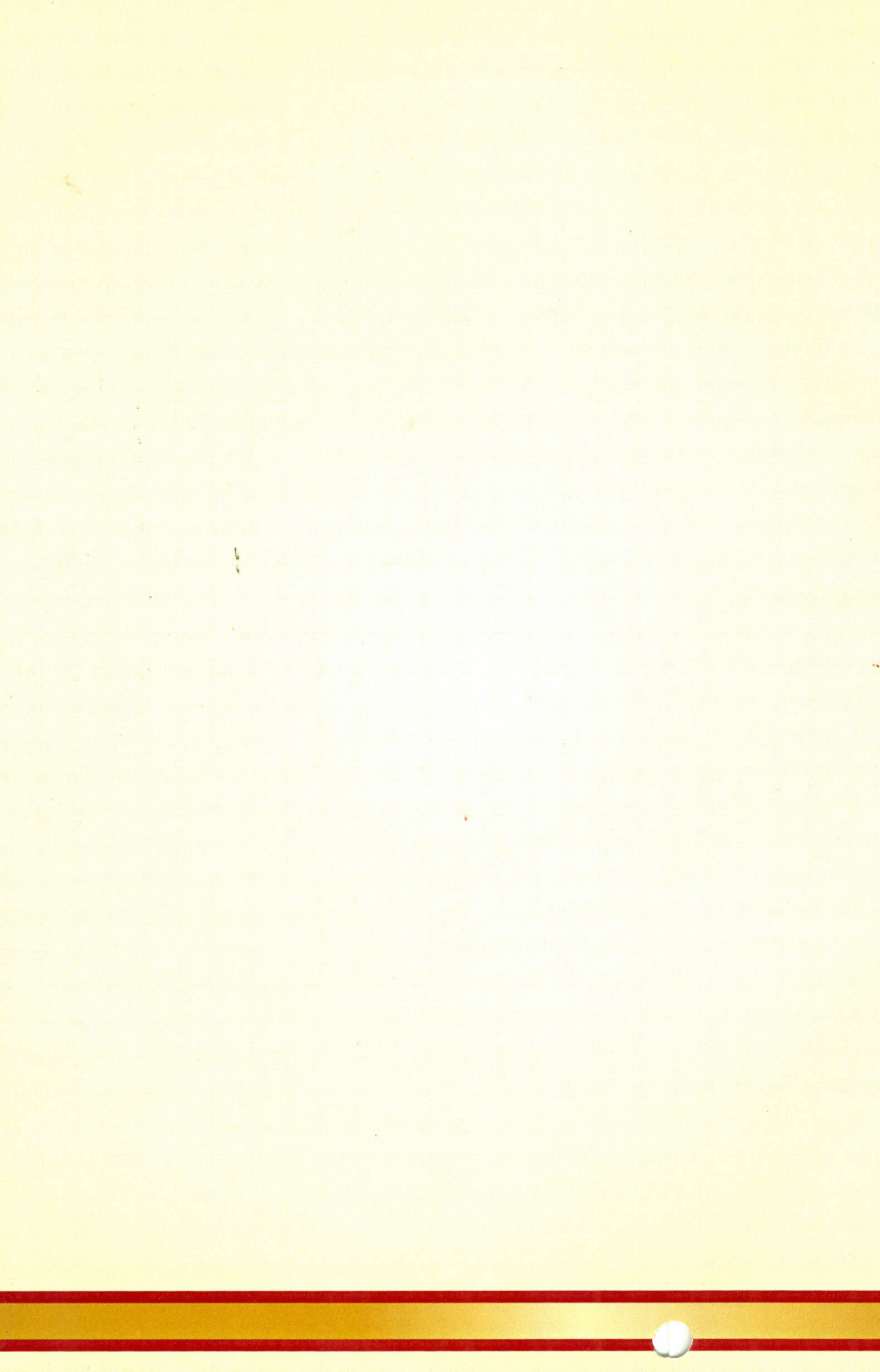
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Birth of ISRO Vision 2030

Imagination leads to creativity

by

Dr. A P J Abdul Kalam

Chancellor, IIST

I am indeed delighted to participate in the 1st Convocation of Indian Institute of Space Science and Technology, Thiruvananthapuram. I congratulate the graduates from IIST for their academic performance and the faculty members for shaping the young minds. Dear young friends, today when I am with you, I would like to share few thoughts on the topic **Birth of ISRO Vision 2030**.

When I see you all, I was asking myself, what type of missions you young graduates will get focused and what type of innovative revolution you will create in space science and technology. Will you give leadership and new knowledge for spacecraft to reach geosynchronous orbit at an economic cost. Hundreds of Indian communication satellites, meteorological satellites will be dominating in the geosynchronous orbit? Will you work for the



creation of Space Satellite Service Stations for extending the life of satellite through in-orbit maintenance? Will you be responsible for building the launch vehicle to launch the spacecraft to reach Mars and Moon for studying the possibility of new human habitats? Will you be responsible for building reusable launch vehicles that will result into reduced orbital cost of US\$500 per kg instead of today's US\$6000 per kg as reported in the latest book **A Brief History of Rocketry in ISRO**? Of course, the challenges in space-science and technology are many and you are uniquely fortunate, when India has established high amount of credibility as a space faring nation. All these missions will need convergence of technologies, basic research to enhance competitiveness, generating a dynamic vision map and above all an inspiration to achieve something great which will make a difference to the society.

Convergence of Technologies

The information technology and communication technology have already converged leading to Information and Communication Technology (ICT). Information Technology combined with biotechnology has led to bio-informatics. Similarly, Photonics is grown out from the labs to converge with classical Electronics and Microelectronics to bring in new high speed options in consumer products. Flexible and unbreakable displays using thin layer of film on transparent polymers have emerged as new symbols of

entertainment and media tools. Now, nano-technology has come in. It is the field of the future that will replace microelectronics and many fields with tremendous application potential in the areas of medicine, electronics and material science. I am sure about the use of nano-robot for drug delivery.

When Nano technology and ICT meet, integrated silicon electronics, photonics are born and it can be said that material convergence will happen. With material convergence and biotechnology linked, a new science called Intelligent Bioscience will be born which would lead to a disease free, happy and more intelligent human habitat with longevity and high human capabilities. Convergence of bio-nano-info technologies can lead to the development of nano robots.

Nano robots when they are injected into a patient, my expert friends say, it will diagnose and deliver the treatment exclusively in the affected area and then the nano-robot gets digested as it is a DNA based product. I saw the product sample in one of the labs in South Korea where best of minds with multiple technology work with a target of finding out of the box solution.

Let me give an example.

Science is reciprocating: Last year, I was in the Harvard University where I visited laboratories of many eminent professors from the Harvard School of Engineering and Applied Sciences. I recall, how Professor Hongkun Park, showed me his invention of nano



needles, which can pierce and deliver content into individual targeted cells. That's how nano particle sciences is shaping the bio sciences. Then I met Professor Vinod Manoharan, who showed on the other hand bio sciences is in turn shaping nano material science as well. He is using DNA material to design self assembling particles. When particular type of DNA is applied on a particle at the atomic level, he is able to generate a prefixed behavior and automatic assembly from them. This could be our answer to self assembly of devices and colonies in deep space without human intervention as envisioned by Dr K Erik Drexler. Thus, within a single research building, I saw how two different sciences are shaping each other without any iron curtain between the technologists. This reciprocating contribution of sciences to one another is going to shape our future and industry needs to be ready for it. Friends are you ready to bring down the iron curtain existing between various technological groups.

Now, a new trend is emerging. The aspect being introduced is that of Ecology. Globally, the demand is shifting towards development of sustainable systems which are technologically superior. This is the new dimension of the 21st century knowledge society, where science, technology and environment will have to go together. Thus, the new age model would be a four dimensional bio-nano-info-eco based.



Friends, a nation's Economic development is powered by competitiveness. Competitiveness is powered by knowledge power. Knowledge power is powered by Technology and innovation. That's real challenge for scientific community that can take results of technology and enrich the life of rural 750 million people.

Innovation is the capital

When I was studying the Global innovation report for the year 2011, I found that as per Global Innovation Index Switzerland is ranked 1; Sweden 2; Singapore-3; Hong Kong-4; and India 62. There is a relationship between innovation index and competitiveness. While India is 62 in innovation index, our ranking in global competitiveness index is 56 in 2010-11. If India has to graduate from the present ranking in competitiveness index of 56 and become equal to economically developed nations (within the top 10), it is essential that building indigenous design capability and leading to innovative index to better than 5 through research and technological development. The present growth has been achieved by the use of technologies essentially developed elsewhere based on scientific discoveries and patents generated before 10 to 15 years. Definitely, latest technologies resulting from latest scientific results are not available from developed countries to India at least for a decade. Hence, research is very vital, particularly, basic science which will result in the latest technology required for



meeting Global Competitiveness by Indian organizations, institutions and industry and also resulting in benefit to the common man. This is an important message for Indian Institute of Space Science and Technology to take up basic research in space science, so that we will have cost effective technologies for our growth.

Research – Teaching – Research

Friends, space science and technology education in India, in the present century will be in a competitive environment where research and teaching are to be the focus. In this environment, engineering institutions have to work for promoting research teaching research. Good teaching emanates from research. The teachers' love for research and their experience in research are vital for the growth of the institution. Any University is judged by the level and extent of the research work it accomplishes. This sets in a regenerative cycle of excellence. Experience of research leads to quality teaching and quality teaching imparted to the young in turn enriches the research. I am sure, IIST has developed this environment of research teaching research right from the under-graduate level.

Dynamic visualization of Space programme (2012 – 2030)

Friends, in the last five decades, Indian Space, Missile and



Critical Technologies for space missions

The real value of future societal space missions as mentioned above can take place only, when mankind builds fully reusable space transportation systems with very high payload efficiencies. Several technologies are critical and need to be developed such as:

- In-Flight Air Collection and Oxygen Liquefaction Technology
- Ram/Scramjet Engines
- Ascent Turbojet /Turbofan Ramjet Engines
- Advanced light weight High Temperature Materials

Multi-Role System Architecture

It is essential that these new technologies are flight-tested comprehensively over the entire speed and height regimes that are common to the role of trans-atmospheric vehicles in space transportation. A multi-role system architecture is required and the flight test vehicle designed with such a system would have to comprehensively demonstrate in flight, all the special attributes of fully reusable space transportation for safe, affordable flight to space, as well as those attributes related to intercontinental passenger aviation. I am sure, IIST will focus research areas



specified and also can be instrumental in promoting the birth of ISRO vision 2030.

Conclusion

Friends, History has proven that those who dare to imagine the impossible are the ones who break all human limitations. In every field of human Endeavour, whether science, medicine, sports, the arts, or technology, the names of the people who imagine the impossible are engraved in our history. By breaking the limits of their imagination, they changed the world. With this background, I would like to ask you, what would you like to be remembered for? You have to evolve yourself and shape your life. You should write it on a page. That page may be a very important page in the book of human history. And you will be remembered for creating that one page in the history of the nation – whether that page is the page of invention, the page of innovation or the page of discovery or the page of creating societal change or a page of removing the poverty or the page of fighting injustice or planning and executing mission of networking of rivers.

I am sure, you would like to do something different – out of box missions, what are they?

- 1 Will you be remembered for a visionary action for the nation, like Prof. Vikram Sarabhai or Prof.



Brahmprakash, or Prof Satish Dhawan in the field of space science?

- 2 Will you be remembered for better crop productivity by enhancing the spatial utilization of the farmland, characterizing the soil content, agro climatic variations and changing weather conditions of the farmland? Can we manage the information from end-to-end for the crop cycle?
- 3 Will you be remembered for mapping the water content of all water bodies, their silting status and their potential to bring welfare to the farmlands?
- 4 Will you be remembered for designing, developing and launching reusable low-cost of access to space launch vehicles?
- 5 Will you be remembered for establishing a space-factory on lunar surface?
- 6 Will you be remembered for identifying “hot spots” for local energy generation capacity. This can include energy from waste, energy from bio fuels which can be grown in wastelands and small scale hydro plants for use by local communities?
- 7 Will you be remembered for accurately mapping the carbon balance of different regions, particularly India?



- 8 Will you be remembered for identifying optimal locations for renewable energy at a small scale, like wind, solar and cultivation of bio fuels?
- 9 Will you be remembered for generating fly ash map and municipal waste map in different regions of the country which can facilitate effective utilization of these resources?
- 10 Will you be remembered for predicting natural calamities like hurricanes, volcanic eruptions and earthquakes (using the research on under surface temperature variations) etc?
- 11 Will you be remembered for designing a system on chip which really meets one of the dreams of having guidance, control, navigation and processing on a single chip?

Let me once again congratulate all the graduating students. My best wishes to all the members of Indian Institute of Space Science and Technology success in capacity building mission for future space programmes.

May God Bless you.

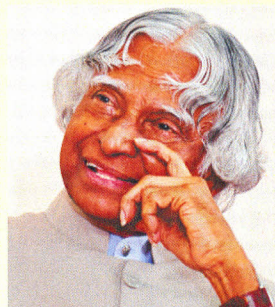


Oath for graduating students

1. Engineering and Technology is a life time mission. I will work, work and work and succeed.
2. Wherever I am, a thought will always come to my mind. That is what process or product I can innovate, invent or discover.
3. I will always remember that “Let not my winged days, be spent in vain”.
4. I realize I have to set a great technological goal that will lead me to think high, work and persevere to realize the goal.
5. My greatest friends will be great scientific and technological minds, good teachers and good books.
6. I firmly believe that no problem can defeat me; I will become the captain of the problem, defeat the problem and succeed.
7. I will work and work for removing the problems faced by planet earth in the areas of water, energy, habitat, waste management and environment through the application of engineering and technology.
8. I will work for making the district in which I work as a carbon neutral district.
9. My National Flag flies in my heart and I will bring glory to my nation.



The Indian Institute of Space Science and Technology is proud to have **Dr A P J Abdul Kalam** as its Chancellor. Dr. Avul Pakir Jainulabdeen Abdul Kalam, specialized in Aeronautical Engineering from Madras Institute of Technology. Dr. Kalam made significant contribution as Project Director to develop India's first indigenous Satellite Launch Vehicle which successfully injected the Rohini satellite in the near earth orbit in July 1980 and made India an exclusive member of Space Club. He was responsible for the evolution of ISRO's launch vehicle programme.



After working for two decades in ISRO and mastering launch vehicle technologies, Dr. Kalam took up the responsibility of developing Indigenous Guided Missiles at Defence Research and Development Organisation as the Chief Executive of Integrated Guided Missile Development Programme. He also gave thrust to self-reliance in atomic energy utilization and defence systems development.

As Chairman of Technology Information, Forecasting and Assessment Council (TIFAC) and as an eminent scientist, he led the country with the help of 500 experts to arrive at Technology Vision 2020 giving a road map for transforming India from the developing status to a developed nation.

In his literary pursuit, four of Dr. Kalam's books - "Wings of Fire", "India 2020 - A Vision for the New Millennium", "My journey" and "Ignited Minds - Unleashing the Power within India" have become household names in India and abroad. These books have been translated into many languages.

Dr. A P J Abdul Kalam is one of the most distinguished scientists of India with the unique honour of guiding the nation as the President of India. He has been awarded the highest civilian award Bharat Ratna in 1997. He is recipient of several honorary doctorates, awards and Fellowship of many professional institutions. Dr Kalam is the inspiration to the youth of the country and his focus is on transforming India as a role model for the world.





Indian Institute of Space Science and Technology

(Declared as Deemed to be University under section 3 of the UGC Act, 1956)

Valiamala, Thiruvananthapuram





REPORT ON IIST

by

Dr. K. S. Dasgupta

Director, IIST

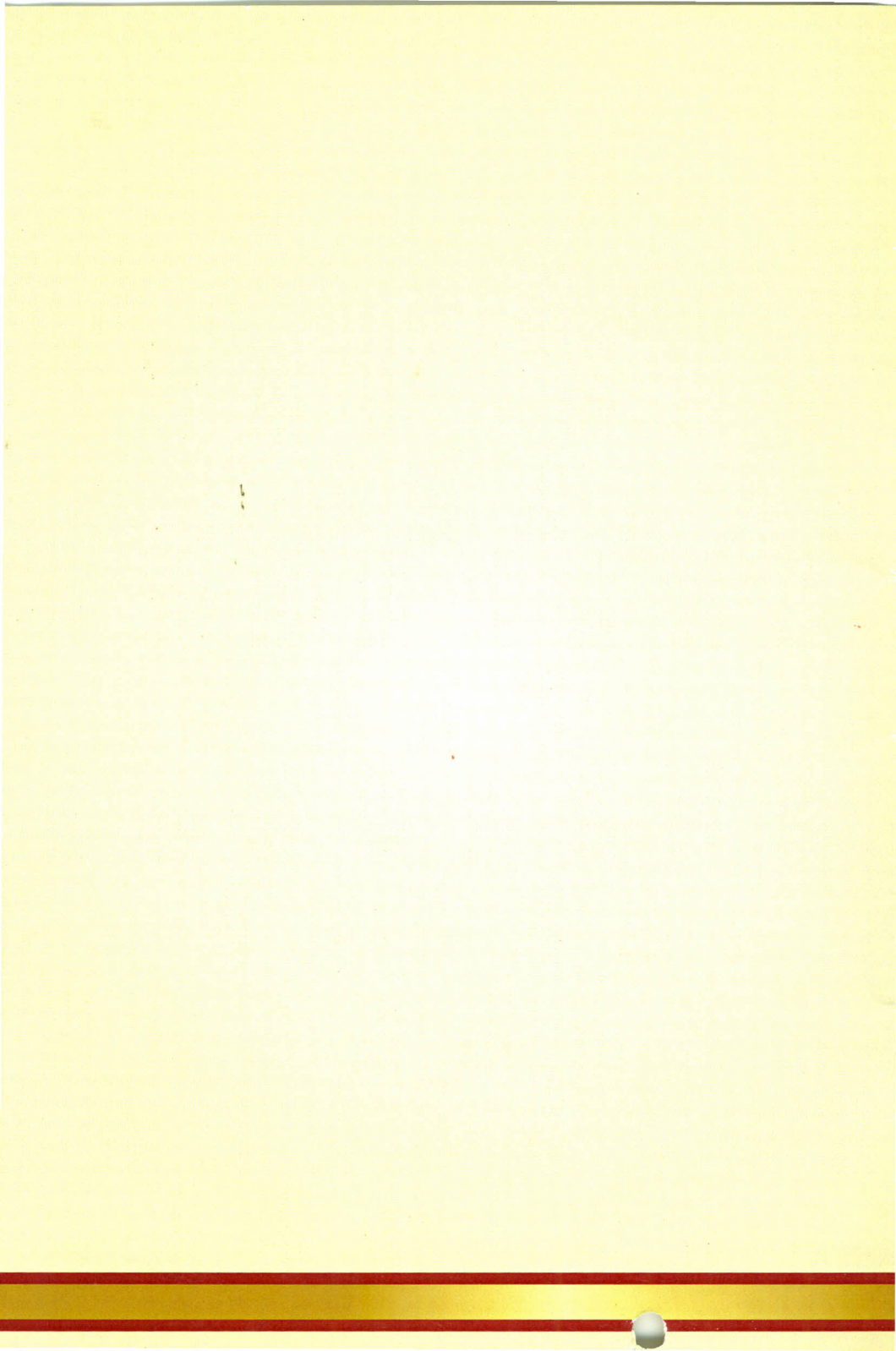
First Convocation

of

Indian Institute of Space Science and Technology

28th June 2012





REPORT ON IIST

by

Dr. K. S. Dasgupta

Director, IIST

Respected and Beloved Chancellor of the Indian Institute of Space Science and Technology, Dr. A P J Abdul Kalam;

Honorable Chief Guest, Dr Srikumar Banerjee, Homi Bhabha Chair Professor, and the Former Secretary of Department of Atomic Energy (DAE);

Dr K. Radhakrishnan, Chairman, Board of Management, IIST;
Respected Dr. S C Gupta, Former Director of Vikram Sarabhai Space Centre;

Dr B.N. Suresh, our former Director of IIST, Dr. Veeraraghavan, Director, VSSC;

Shri K Jayakumar, Chief Secretary, Government of Kerala;
Members of Board of Management, Members of IIST Council, Degree recipients, Distinguished Guests, Colleagues, Dear students,
Ladies and Gentlemen, Good Morning.



It is indeed a great privilege for me to present to you all a brief report highlighting our activities, aspirations, achievements and future plans in this First Annual Convocation of the Indian Institute of Space Science and Technology (IIST). We are highly honored and pleased to have with us Dr Srikumar Banerjee, as the Chief Guest on this solemn occasion to address and encourage the graduates receiving their degrees today.

Dr Srikumar Banerjee is currently holding the prestigious Homi Bhabha Chair Professorship. He has recently relinquished charge as the Chairman AECI and the Secretary, DAE on April 30, 2012. Prior to his stint as Chairman, DAE, he was the Director of Bhabha Atomic Research Center (BARC). Dr Srikumar Banerjee is considered as one of the leading experts in materials science and technology in India and has made outstanding contributions in the area of advanced materials science.

Dr Banerjee, obtained his B.Tech degree with honours in Metallurgical Engineering from the Indian Institutes of Technology (IIT) in Kharagpur in the year 1967. Thereafter, Dr Banerjee underwent training at the Training School of BARC. Subsequently, Dr Banerjee joined the erstwhile Metallurgy Division of BARC in 1968 and spent his entire scientific career in this establishment. On the basis of the work carried out by Dr Srikumar Banerjee in the first few years of his career in BARC, he was awarded the Ph.D. degree in Metallurgical Engineering by IIT, Kharagpur, in the year 1974.

In the course of his distinguished professional career, Dr. Srikumar Banerjee has published more than 300 scientific papers in reputed international and national journals. Some of these scientific research

publications are regarded as landmark contributions in the field of materials science.

In recognition of Dr. Banerjee's important research contributions, he has been the recipient of many awards and honours within and outside the country, including the prestigious Shanti Swaroop Bhatnagar Prize in Engineering Sciences in 1989. Dr. Banerjee is on the Board of Nuclear Power Corporation of India Ltd. since October 8, 2004. Subsequently, he was honored by the Government of India with the prestigious civilian award, Padma Shri, in the 2005 for his distinguished contribution to research and dedicated service to the nation. Dr Banerjee also received D.Sc(Honoris Causa) from the Bengal Engineering and Science University, Shibpur, West Bengal at its annual convocation on 16 February 2010.

Before, I get started with the important task of presenting our institute's activities; I wish to pose the following question. Why do universities need students? The best answer to the above question was given by none other than the famous physicist John Archibald Wheeler, who said and I quote "Universities need students in order to educate the Professors" unquote. True, Wheeler spoke from personal experience as his student was none other than the famous physicist Richard Feynmann.

For the benefit of our Chief Guest and other dignitaries, let me give a brief genesis of this institute. The institute was formally inaugurated on 14 September 2007. This institute is the first of its kind in the country, to offer high quality education at the undergraduate, post-graduate, doctoral and post-doctoral programmes on areas with special focus to space sciences, space technology and space applications. In little less than a year of its establishment, IIST received the recognition of UGC as a 'Deemed to be University' under Section 3 of UGC Act, 1956. IIST



functioned from its Thumba VSSC campus from 14 September 2007 to 14 August 2010 and then moved to its own campus at Valiamala, Thiruvananthapuram on 15th August 2010. The present campus at Valiamala of around 100 acres boasts of several modern and environmentally friendly buildings which blend beautifully with the thick wooded campus located in a valley, surrounded with scenic hills, thick foliage and vegetation situated on the foot hills of Sahyadri mountains.

Admissions to various UG programmes are merit based and are based on an All-India entrance examination (IIT-JEE for the first three years 2007-2009), and with the institute's own national level admission examination (ISAT) of same standard as IIT-JEE since 2010. The courses offered by the institute under the various UG programmes in areas such as Aerospace Engineering, Avionics and Physical Science are extremely relevant to space studies, as well as up-to-date and need based. The present intake of students at the UG level for Aerospace Engineering and Avionics is 60 while the UG intake for Physical Science is 36. The academic programmes have been formulated to strengthen the fundamentals, experience the realities through practical work, and to enhance the knowledge and understanding in the areas of interest. Also, the programmes so envisaged will give exposure in the emerging fields and will lead to experience in knowledge synthesis. The curriculum, courses, practical, electives and the projects have been developed and continuously upgraded to meet these goals by all the departments.

Let me take this opportunity to enlighten the august gathering on the unique educational model which our institute is presently offering. The institute provides assistantship to the tune of Rs.49,000/- per semester

per undergraduate student to cover the cost of statutory tuition fees, statutory amenity fee, establishment, hostel, dining as well as student medical cover together with a book grant of Rs.3,000/- per semester. Hence, it can be safely mentioned that the education is “totally free” in every sense for the B.Tech students of our institute. Furthermore, upon successful completion of their B.Tech degree, the students are directly recruited as scientists/engineers into one of the many centers of ISRO/DoS, subject to meeting a certain minimum academic standards as per ISRO/DoS recruitment norms.

This unique opportunity of employment in the nation's space research organization and to be involved in its many ambitious projects is a highlight for students and their parents, the main stakeholders of the institute. Unlike other Govt. funded academic institutions, where the return of investment to the society at large is indirect, the investment towards this institute results in high quality manpower educated in Space Science, Space Technology and related areas, who directly contribute to the ongoing national space programme.

Our institute is committed to provide excellent human resource to meet national research and development needs and global expectations in the areas of Space Science, Space Technology and other related areas. IIST is a niche institution, and is one of its kinds with no similar peer institution within the country. Hence it is no wonder that our institute happens to be a dream destination for those who wish to be leaders in the space science related technology areas. IIST is slowly getting recognized for delivering excellent education at the undergraduate and postgraduate levels, which can be gauged from the number of aspiring students who take our All India Admission Test (about a lakh candidates for 156 UG seats). Our institute is also endeavouring to become a reputed research



institution. Also, our institute aspires to provide equal importance (footing) to both engineering and science disciplines and hence does not discriminate one against the other, as we firmly believe that an academic programme where engineering students learning science courses and science students being taught engineering courses will enrich the scientific reasoning and engineering skills of the students.

I would like to share with everyone present here a report on our institute's activities prepared by a UGC team led by Proj Ajit Kembhavi, Director, IUCAA who visited our institute for two days during middle of January 2012 and had detailed deliberations with our faculty members, UG, PG and PhD students along with our non-teaching academic and administrative staff. I am happy to announce to all those present here, that the institute received a very encouraging and a positive report from the above UGC team. I have no doubt that the above positive report from UGC is a reflection of both the scholarship of the faculty and students of IIST. Also, our institute submitted its self study report to National Assessment and Accreditation Council (NAAC), a body set up by UGC to monitor the development of deemed universities about three months back.

Our institute takes pride in our teaching traditions, and we take our teaching function at all levels most seriously. We take special pride in the traditions that we have built over the last five years for providing an education to our students which not only helps them become great scholars and specialists in their subjects of study, but also transform them into inspiring and resourceful people fully sensitive to societal needs and aspirations. Over the years, we have



also built a strong research tradition, which is easily seen in the impressive statistics that the Institute can boast of in terms of various research indicators. With a present strength of 81 faculty members and Sixty plus PhD students, we have continuously improved on our credentials in research as evidenced by way of publications and the number of Ph.D. enrollment of research scholars. Amongst the degree recipients this year, we have 125 B.Tech students from the three branches of Aerospace Engineering, Avionics, and Physical Science. Our target of continuously searching for and significantly increasing the intake of quality candidates into our Ph.D. programmes is on the right course and we have grown by almost 50% in this direction over the last 2 years.

For an institute in its infancy, setting up of state-of-the-art teaching and research infrastructure does require enormous financial resources. We are grateful and take this opportunity to thank Department of Space, Government of India for their unstinted financial support and funding which have ensured that the institute can boast of excellent physical infrastructure.

To encourage our meritorious B.Tech degree students, the institute has constituted various gold medals which will be given away in today's ceremony. These include the (i) the Chairman, Board of Management's Gold Medal to the best outgoing B.Tech student among all the graduating students today who has the best academic performance, (ii) the Director's Gold Medal to the best All-Rounder among all the B.Tech students who has excelled in both academics as well as in extra-curricular activities, and (iii) Three Topper Gold Medals to the best outgoing B.Tech student among all the graduating students today who has the best academic performance in each of the three B.Tech branches of



Aerospace Engineering, Avionics and Physical Science.

International Collaboration

The growing visibility of our Institute has been steadily increasing, leading to an enhanced role in enduring partnerships within and outside the country. The Institute has been actively involved in collaborative programmes with national and international organizations/universities to remain at the forefront in scientific and technological development and to share the knowledge for mutual benefits. The institute presently has a MOU with Universities Space Research Association (USRA), USA, while an MOU with California Institute of Technology, USA is on the anvil. The main objectives of collaboration through the MOU mode is to provide for exchange of students and faculty, initiate joint research on mutually accepted areas, and provide fellowships for training and research at doctoral and post-doctoral levels. Five of our B.Tech degree students (among those who will be receiving their degrees today) spent three months in USRA institutes/universities (three Physical Science students at Lunar Planetary Institute, Houston and one Aerospace Engineering and one Avionics student at University of Texas, Arlington) during 2011 and did part of their project work in USA as part of the institute's MOU with USRA.

Over the last five years, the institute has expanded its teaching and research interests in a wide range of areas of national importance and current relevance, related to space science, space technology and other areas. The major research facility creation in areas like Nanoscience & Technology, Virtual Reality and Advanced Propulsion & Laser Diagnostics are on the anvil which will provide a thrust to advanced research in these emerging interdisciplinary fields. These major research



facilities are to emerge as Centers of Excellence in the near future.

At present the institute's campus has a well equipped FIRST-AID Medical Centre to provide medical aid. M/s. Ananthapuri Hospitals and Research Institute situated in Thiruvananthapuram city has been recognized by the institute for specialized OPD consultation and it has provision to admit our students as inpatients. The institute provides Comprehensive medical coverage through a special scheme which is free of cost (extent of coverage).

FACULTY

At the institute, we strongly believe that the quality of an academic institution largely rests on its faculty. Our greatest asset is the presence of 81 highly qualified faculty, emeritus professors, emeritus fellows, visiting professors. Some of our faculty are among the finest in the country and are recognized nationally and internationally for their quality of research and teaching. The faculty members also contribute greatly towards national development by being associated with decision making bodies. Many of our faculty members serve on the editorial Boards of reputed journals, undertake peer-review for journal papers, serve on committees for recruitment of professionals, and are on the Boards of many institutions and organizations. The strength of our faculty members has almost doubled in the last two years. These new additions to our faculty community have enhanced our competence in several emerging areas, while bringing new energy into our academic endeavors.

Searching, recruiting and retaining of bright faculty for our institute is one of our most important missions, according to us, since therein lies the future of the Institute. In this connection our Board of Management has played a very positive and constructive role in approving policies, which empower the faculty to deliver their best in both teaching and



research. On our part, we are trying to reach out to the potential faculty members through a variety of means, including round-the-year search and recruitment in national newspaper advertisement, web-based advertisements, advertisements in internationally recognized peer journals and on-line submission and processing of applications. For the benefit of prospective faculty members based abroad, the institute has provision to interview them using skype interaction. The institute provides a relocation allowance of up to Rs 1 lakh for a faculty member to join the institute within India, while for those based abroad, the above relocation allowance offered is Rs 3 lakhs.

Understanding the importance of attracting talented faculty members, the institute aims at providing a congenial academic and research atmosphere through the following proposals. The institute provides direct research funding to faculty members amounting to Rs.1521.29 lakhs based on approval of research proposals by peer-review experts. The institute in addition provides funding for fast-track research projects to the tune of Rs. 10 lakhs to encourage newly joined faculty members to initiate their research plans. Ten faculty members have been funded under the above fast track project programme this year. The institute puts no financial limits for faculty members to attend international/national conferences. Also, the institute covers all publication journal charges for all accepted manuscripts of faculty members and students. The institute also provides for a cash award of Rs. 20000 for outstanding publication by the faculty members and students. We encourage the faculty members to organize/participate in international and national conferences.

During the past five years the faculty members of our institute have published 368 peer-reviewed international publications. The faculty members of our institute have also presented a similar number of papers



in national and international conferences. Besides, they have also published a few books and several book chapters in the last few years.

ACADEMIC ACTIVITIES

Post Graduate Programne

The institute has been offering two post-graduate courses since 2010 in Soft Computing & Machine Learning and Chemical Systems wherein the present strength is 29. From this academic year 2012-13, the institute will offer four new M.Tech courses in (i) Aerospace Propulsion, (ii) Radio Frequency and Microwave Engineering, (iii) Digital Signal Processing, and (iv) Optical Engineering, with ten seats for each programme. While the first and last MTech courses listed above are to be offered by Department of Aerospace Engineering and Department of Physics, the other two M.Tech programmes are being offered by Avionics department. The admission to the M.Tech and PhD programmes are also based on national level selection procedures which comprise a written test and an interview.

Research

IIST envisions the integration of Space Technology and Space Science educational programs with basic and applied research for meeting the national R&D requirements of science and technology in general and of the Indian Space Programme in particular. To achieve this goal the Institute provides a vibrant research atmosphere and offers doctoral and Post-Doctoral programmes. The institute offers an attractive fellowship for PDFs amounting to Rs 40,000 per month for a period of one year, extendable to another year on satisfactory research output.



The Institute encourages all its faculty members to guide and supervise young scholars for the PhD programme as well as for Post-Doctoral programmes. The institute provides for a limited number of high valued (ISRO-IIST) fellowship as well as large number of regular fellowship as per UGC Norms. The institute also offers a limited number of high-valued ISRO-IIST fellowships amounting to Rs 35,000 per month.

Currently Sixty plus highly motivated PhD Scholars are pursuing their research in streams related to Aerospace Engineering, Astronomy & Astrophysics, Atmospheric Sciences, Avionics, Chemistry, Earth System Science, Humanities, Mathematics, Physics, and Remote Sensing. We have recently advertized for the PhD Programme admissions for session starting February 2012. To take research activities to the next level, IIST has initiated a Post-Doctoral Programme, initially in five areas; namely, Theoretical Molecular Physics, Development of Electro active polymers for space applications, Star Formation, Delay Tolerant Networking, and Hyper spectral Remote Sensing. The students, who have enrolled in the PhD program, are expected to undergo courses such as Research Methodology and Advanced Mathematics in addition to courses stipulated by their respective Doctoral Committee.

As an important annual event, IIST conducts Research Scholars' Day, to encourage the Research Scholars to interact with their peers and other researchers pursuing similar interests, and to provide inspiration from veterans in field through Lead Lectures. During the event held in December 2011, 25 Research papers from IIST Research Scholars, and 39 Research papers from Research Scholars from various IITs, NITs, IISERs, were presented and several lead lectures from luminaries in the fields of Engineering, science and Humanities were arranged.

Conferences/Workshops/Seminars organized by our institute

While the institute organized five conferences/workshops last year including one international conference, the institute has already organized three workshops in 2012 and has plans to organize three more workshops during the month of July 2012. The details of the various conferences/workshops organized by the departments of the Institute in the last few years are given below:

- I. An International Conference on Recent trends in Material Science and Technology (ICMST) was organized jointly between IIST and Material Research Society of India (MRSI) between October 28-31, 2010.
- II. An International Symposium on Contemporary Trends in Optics and Optoelectronics was organized jointly between IIST and Optical Society of India between January 17-19, 2011.
- III. A Short Term Course On Computational Methods In Fluid Flow And Heat Transfer was organized by Department of Aerospace Engineering, IIST between 12–16 July 2010.
- IV. A Short term course in “Control System Design –CSD2010” was organized by Department of Avionics, IIST between August 3-5, 2010.
- V. A Workshop on “Space Instrumentation, Planetary Remote Sensing and Data Assimilation” was organized by Department of Earth and Space Sciences, IIST between 31 August – 2 September 2010.



- VI. A Workshop on “Biologically Inspired Computing” was organized by Department of Mathematics, IIST between 4-7 July 2011.
- VII. A Self Development and Successful Communication Seminar for Young Scientist of ISRO was organized by Department of Humanities, IIST between 17-19 July 2011.
- VIII. A National Seminar on Frontiers in Chemistry was organized by Department of Chemistry, IIST between 7-8 December 2011.
- IX. A Short-Term Course in “Soft and Evolutionary Computing” was organized by Department of Avionics, IIST between December 19-21, 2011.
- X. A Workshop on “Multi-wavelength astronomy with ASTROSAT” was organized by Department of Earth and Space Sciences, IIST jointly with ISAC, Bangalore between January 9-12, 2012.
- XI. A workshop on “Adaptive Finite Element Methods” was organized by Department of Mathematics, IIST between March 16-25, 2012.
- XII. A National workshop on “Geospatial Technologies for coastal resources management” was organized by Department of Earth and Space Sciences, IIST between May 28-29, 2012.



INFRASTRUCTURE DEVELOPMENT

Academic

It is our institute policy to remain continuously engaged in the modernization of the Institute academic infrastructure. The institute sets aside adequate funds from its financial resources to the Departments for up-gradation of laboratories and creation of new facilities. This has significantly helped in the improvement of quality of teaching and research. The major facilities created/developed by some of the Departments in the previous few years are highlighted below:

- I. The Department of Aerospace Engineering has installed major facilities such as Static and stability analyzing apparatus, Table top CNC milling machine, Jet engine test rig, Pulse jet/Ram jet test rig and Creep and Rupture Testing Machine and accessories.
- II. The Department of Avionics has installed major facilities such as Solar array simulator, RF and Microwave workbench, Power electronic trainer, unmanned aerial vehicle system, HEXAPOD and VLSI/FPGA design tools.
- III. The Department of Chemistry is in the process of acquiring the following major facilities such as XRD, AFM, Glove Box, Particle Size Analyzer and Electro spinning machine. SEM, Plasma Reactor and TEM.
- IV. The Department of Avionics has installed major facilities such as vibrational isolation tables, Adaptive Optics Systems, Spatial light modulators, high power lasers like Nd: Yag lasers, atomic and molecular experimental systems



for ion thrusters.

- V. The Department of Earth and Space Sciences has installed major facilities such as 14-inch optical telescope, celestial sphere, CCD camera, Cloud Condensation Nuclei instrument, Condensation particle counter instrument, Microtops, Aethalometer, Differential GPS, and Spectroradiometers,

Central Library

The library in the institute boasts of an excellent collection of books and electronic journals. The online and Internet services in the library are available throughout the institute campus on a 24x7 basis. The library in the institute is presently housed temporarily in one of the academic blocks but is likely to move to its own building shortly. The institute is an active member of INFLIBNET consortium and presently eight INFLIBNET e-resources are currently being subscribed in the library. The major e-resources are ACM Digital Library, AIAA, AIP, APS, Annual Reviews, ASME, Cambridge Online, IEL Online (IEEE), JSTOR, Optic Infobase, Oxford Journals, Royal Society of Chemistry, and Science Direct. While the institute has purchased books for the library worth Rs.1.51 crores in the last four years, e-journals have accounted for an expenditure of Rs.2.57 crores since inception. The annual cost of e-journal subscription in the library is presently Rs.1.38 crores.

Computer Services Centre (CSC)

The campus has an advanced computing facility, adequate number of terminals, a campus wide Wi-Fi network and 1GBPS high speed

internet facility. IIST makes extensive use of automation in all our administrative functions. In addition to our administration which utilizes automation in all its functions, our institute's library is fully computerized in all its in-house operations, and uses the open library management software, KOHA. This software provides facilities for users to search any available document and reserve the same, if the same is currently on issue.

Furthermore, IIST has developed special software, tailor-made to ensure smooth and systematic conduct of the counseling process for UG admission, after giving due thought to the various processes involved in the exercise.

The following are the highlights:

- (I) Computing Facility: High Performance cluster server having 3 Terra flop speed (32 HP Blade servers having 64 Dual Quad Processor). Storage -1.20 TB SAN Storage with NAS Header. Tape Library with Backup software.
- (ii) Campus Automation Servers: 8 Servers with 4CPU/Dual CPU High Performance Computing Lab: High-end Work Stations (Quad Core Processor with 72 GB RAM , 4GB NVIDIA Graphic Card Memory and 30 inch LCD Monitor), installed with several advanced engineering and scientific software.
- (iii) Programming Lab: A programming lab for UG students with 64 Desktop Computers and Digital Printers
- (iv) Internet lab: An internet lab for the use of UG students with Desktop Computers and Digital Printers



(v) Internet and campus network connectivity:

BSNL is the Internet service provider for the institute and facilitates 34MBPS through the National Internet Backbone (NIB). Institute also has 1GBPS internet connectivity through the National Knowledge Network (NKN). Institute has a Campus Wide Area Network based on a 1GBPS Backbone Network and 100/1000 MBPS Distributor Networks and 802.11 n Wireless Networks. Institute extends all its ICT resources to students and faculty through this Campus Network.

Physical Infrastructure

The present campus has about 100 acres; half of which comprises four academic blocks, library, hostels, dining rooms, administrative block and student activity center while the other half will provide for faculty and staff housing and two large stadiums for cricket and football. The institute's academic blocks have a carpet area of 19,141m². The Institute is currently engaged in a massive exercise of expansion of its physical infrastructure of its Valiamala campus. Besides planning and building new academic blocks, new hostels, new administrative blocks and new library, the Institute is also engaged in building student's activity center, and sports facilities. A quick overview of some of the works completed, in progress and expected to be taken up at a later stage are as follows:

Completed Works

- I. Aerospace Block
- II. Physical Sciences Block
- III. Ten hostel blocks



Works in Progress

- I. Interdisciplinary Block,
- II. Avionics Block
- III. Administrative block and the library
- IV. Students Activity Centre

Works expected to be taken up at a later stage

- I. Sports facilities
- II. Guest house facilities
- III. Faculty housing and staff quarters

STUDENTS' ACTIVITIES

The Dean (Student Activities) of IIST heads the Student Activity Board (SAB), consisting of the Registrar, all heads of the departments, Chairmen of various institute committees and student representatives from all batches and branches. The student representatives provide feedback and suggestions on all aspects concerning student issues on campus (curricular and co-curricular). Under the SAB the following committees exist, such as the Sports committee, Technical Committee, Cultural Committee, Hostel and Canteen committee. Each of these committees has student representatives. The institute has a separate "Women's Cell" to provide for counseling and guidance to women students.

In addition to the conventional practical experiments, one of the unique opportunities that IIST provides is that the students are also exposed and get to do experiments at various ISRO/DoS centers. This provides a valuable experience to the students of the institute to have their hands on



real life experiments which have design links with ISRO's launch vehicle, space craft and application programmes. Students also undertake summer internship program as well as their final semester project dissertations work in ISRO/DoS centers and other organizations and work on projects relevant to ISRO/DoS. The students of the institute are encouraged to present seminars/ short presentations on a few current aspects relevant to their courses. Students weak in English are given the benefit of Neuro- Lingusitic Programme (NLP) and communicative English programmes. To expose students to programming languages, soft skills training programmes are imparted after regular class hours. Furthermore, once in a week the afternoon session on Wednesdays are earmarked to carry out innovative experiments in the field of basic science/seminars in advanced topics/invited lectures from eminent academicians and researchers.

The institute provides value based education through lectures on “Ethics and Values”, “Tradition”, “Culture” and “Social responsibility”. The written feedback by students of the institute on teaching and evaluation are collected from every class at the end of the semester. The student-feedback is used to assess teaching practices and implement changes in the course structure and classroom teaching.

The institute has several student programmes for the overall personality development of students. There are student clubs on various subject areas like astronomy, physics, chemistry, mathematics, robotics, remote sensing etc. The physics department has been organizing every week a program where students showcase their innovations through scientific experiments and models which they have developed. For the overall personality development of students and for moulding their outlook towards society, the institute has organized several events such as visit to



orphanages and tribal schools, participation in community festivities like the 'Pongala' etc.

The institute has strong public outreach programmes with the specific objective of enabling students to deliberate on social issues in the context of their education. As part of the course on social science and ethics, students of the institute are required to do a project on any of the tribal settlements in the State of Kerala which includes a study of their lifestyles and the challenges they face in terms of their basic needs, access to education, health care and the impact of environmental in their ways of life.

The students of this institute organize a unique inter-collegiate cultural festival named “Dhanak” as well as an inter-collegiate technological festival named “Conscientia” every year. These provide a platform for the students to showcase their talents and creativity both in the cultural as well as in the technological domains. The institute celebrates “Sports Day” wherein students and faculty members of the institute compete in several sporting events and win medals and prizes. The institute has constituted a trophy for the “Best All-Rounder of IIST” and is given every year to the best-all rounder student of the institute who is proficient in academics, sports as well as in cultural activities. The institute also conducts yoga classes regularly for the benefit of students. The above yoga classes are also available to all staff members of the institute.

The following are two students' project carried out under the guidance of IIST Faculty and the ISRO Scientists, with a view to provide knowledge and hands-on experience to the students to design, develop and build space systems and to work in teams in a project mode. The



status of the projects are given below:

VYOM is the Sounding Rocket designed by the B.Tech students of Indian Institute of Space Science and Technology (IIST), Thiruvananthapuram, under the guidance and supervision of the experts from Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram and the Faculty Members of IIST. Vyom is the first rocket designed and realized by students in India. A payload has been designed to monitor the acceleration, velocity and altitude of the rocket and it is being fabricated at VSSC. CFD simulations have been carried out to verify the aerodynamic data of the rocket. The maiden flight of the rocket was successfully launched on May 11, 2012 from the Thumba Equatorial Rocket Launching Station at VSSC with excellent performance as designed. VYOM has helped students to learn many lessons, much beyond what is written in text books on rocket propulsion, aerodynamics and flight dynamics, payloads, manufacturing, integration and launch operations and above all the concepts of systems engineering and the spirit of team work.

Nano-Satellite Project: The IIST students have conceived a 3-axis stabilized nanosatellite of mass around 5 kgs. The conceptual design of the satellite has been completed and the payload and components have been identified, based on the functional requirements and availability. The nano-satellite is proposed to be launched in a polar sun synchronous orbit of about 670 kilometers altitude as a piggyback payload in PSLV (Polar Satellite Launch Vehicle) of ISRO.

Institute Social Responsibility

The institute has started an annual educational outreach activity called



IIST@Schools from 2010. Two such programmes were held in 2010 and 2011. This program brings together more than 100 students of classes 8 and 9 for a three day activity oriented workshop on science and technology. The students are selected from government, government-aided and private schools from all districts of the state with special emphasis on reaching out to village and tribal schools.

Vision and Mission of the Institute

The institute has defined its Vision in the following terms:

“To be a world class educational and research institution contributing significantly to space endeavors”.

In the pursuit of this vision, IIST has put in place its mission statement in the following terms

- Create a unique learning environment enriched by the challenges of the Space Programme.
- Nurture the spirit of innovation and creativity.
- Establish the centers of excellence in niche areas
- Provide ethical and value based education.
- Promote activities to address societal needs.
- Network with national and international institutions of repute.

Like any aspiring institute, our institute also strives to be the best at most things, which we often succeed. However, it is important that the institute has its feet firmly grounded and does not get carried away and lose sense of its larger goals and objectives – which is to offer a good quality education to all its students. We, at the institute are very clear



that the true value of any institute lies in creating responsible and good human beings who will then take on the onerous task of nation building and development. It is true, that quite often such an objective leads to difficulties; however, we are convinced that our core values will drive us collectively to the right path, whenever we face them.

IIST attempts not only to teach students, but also to make them wise. It is important that the students not only achieve extra-ordinary excellence in both academics and extra-curricular endeavours, but it is even more important that there is coherence and a sense of joy in the overall educational experience. We sincerely hope that we have succeeded in achieving the above in some measure at least, since the initial feedback from the employers of our first batch (ISRO/DoS centers) has been exceedingly positive and encouraging.

One would expect that when any alumni of an institute meet for their annual reunion, they would remember some of their best teachers and possibly talk to one another of their best college experiences. Very rarely will one expect the alumni to remember and talk about what they learnt from their best teachers in their classes during their reunion. We at the institute sincerely hope that our alumni will not only talk about their best teachers but also talk about what they learnt from them. Also, we hope that our alumni will always concur with one another that their few years at this Institute provided them with the most valuable learning experience of their life. When the above happens, we at the institute can take some satisfaction that we had definitely done something the right way, even if it hard to identify what that is, in a tangible manner.

So, even though as an academic and research university, we wish to be



engaged with the frontiers of knowledge, as we often do, we also recognize the importance of providing value based education, of making judgments about the relative importance of different subjects, and of giving equal importance to the issues of character and morality. We at the institute are convinced, however, that we need not and should not follow the crowd, but shall make every effort to defend the principles that make us unique, which we realize are the source of our true strength. These principles, based on the values of freedom of thought, scholarship and sensitivity to societal needs, help us in forming our policies and are deeply ingrained in all of us, especially our faculty, and provide us ways and means to evaluate alternatives and choices, through critical and independent thoughts, on all issues that confront us. In future, the institute, true to its mission of space exploration would take off to higher realms of glory, wherein the open sky could only be the limit.

The Institute provides intensive knowledge in specialized fields of knowledge and maintains a holistic approach towards education and offers:

1. A platform for unique and diverse research. Challenging opportunities for innovative research in niche areas of space science.
2. Opportunities to take up challenging and exclusive courses. Opportunity to teach a composite slice of inquisitive and brilliant minds from all over India.
3. Opportunity to be part of the dynamic network of research scholars and skilled faculty members.
4. Opportunities for peer interactions with research institutes



and universities in India and abroad. IIST is the right platform for Intellectual research & academic collaborations and exchanges with scientists all over the world, Nobel Laureates and Astronauts

5. An opportunity for cutting edge research and to utilize the state-of-the-art facilities of a variety of national labs across India.
6. Unique opportunities for career advancement and growth
7. A locale that provides immersive education in a non-traditional environment where an opportunity is given to apply learning in a hands-on situation
8. An occasion to provide ethical and value based education. We help students to enhance communication and leadership skills and refine collaborative and decision-making skills, while increasing understanding and awareness of ethical issues. Here, Students often collaborate on large projects, but each student is treated as an important individual, with unique goals, drives and needs

We are all actively working towards creating a unique and path breaking Institution which will i)encapsulate education with creativity, innovation and research. Ii)encourage learning mechanisms that Promote masterly or deep learning, iii)help personalized learning based on learning style, iv) cater to the needs of Indian Space & other related national programmes, v) promote collaboration which is key to success in a competitive or dedicated work environment, vi) enhance knowledge base, intellectual resources, talents and synergize complementary

expertise and abilities.

Our Goal is

- To move “engineering” away from experience based hand-book to one being centrally based on first principle of science.
- To excel in teaching very bright, highly motivated students in an intense, rigorous, and frequent “hands-on” environment.
- To construct shared, distributed, reflective practices where experiences are collected, vetted, clustered, commented on, and tried out in new contexts.
- To Create a “learning about learning” environment - a boot strapping operation in which faculty and, along with students, are learning among and between themselves.

Let me conclude my report, by quoting Steve Jobs who during his convocation speech delivered on 12 June 2005 at Stanford University, extols the graduating students with the following exhilarating words, “And most important, have the courage to follow your heart and intuition. They somehow already know what you truly want to become. Everything is secondary”.

ACKNOWLEDGEMENTS

We would like to acknowledge the support received in abundant measure from the Department of Space, Government of India for their unstinted support and funding. I personally acknowledge the support and encouragement I have received from Dr APJ Abdul Kalam, our beloved Chancellor, Dr K. Radhakrishnan, Chairman, Board of Management and Members of our Board of Management, and from all



my colleagues, and extend my appreciation to the students for their exemplary behavior and their contributions towards enriching the campus life.

Finally, I conclude by conveying my heartiest congratulations and best wishes to each one of the 125 B.Tech graduates receiving their degrees, and the student toppers receiving the gold medals for their special achievements at the first Convocation of the Institute. We are confident that your stay with the Institute has helped you to continue the process of lifelong learning and to take up challenging tasks in your respective careers.

We are also confident that you will give the right leadership that the country and the world expect from you. We wish you success in whatever you choose to be. Keep in touch with your alma mater, support it in whatever way you can, and keep the IIST flag flying high. I am sure that you would work for a better world where science and technology are used in socially responsible ways, and in harmony with nature.

I once again thank Chief Guest Dr Srikumar Banerjee, our beloved Chancellor Dr APJ Abdul Kalam, Dr K. Radhakrishnan, Chairman, Board of Management, and all the distinguished guests for being with us today. Thank you all!

Jai Hind!



Dr. K.S. Dasgupta, presently Director of Indian Institute of Space Science and Technology, (IIST) Thiruvananthapuram since December 2010, is known for his outstanding contributions in the areas of Digital Signal Processing, Digital Communication, Computer Networking and Satellite Communication. Prior to his assuming charge at IIST, Dr Dasgupta was Director, Development and Educational Communication Unit (DECU) and Deputy Director – SatCom Navigation Payload Area (SNPA) of Space Application Center, Ahmedabad. Dr Dasgupta has served ISRO/DoS with distinction for the last 38 years.



As Director, DECU, Dr Dasgupta lead a group of engineers, producers and social research scientists who were involved in the design, configuration and installation of EDUSAT Tele-education and Tele-medicine network, as well as in the content generation for Tele-education and Science mission. The above group also investigated the social impact of EDUSAT and SATCOM network for social applications. As Deputy Director, SNPA, Dr. Dasgupta lead a group of Engineers/Scientists who were involved in the design and development of i)Satellite Programme, ii)Satcom Projects, iii)Technology Transfer, iv) Technology Development-TDP / R&D Programme, and v)Institute collaborative programmes. Dr Dasgupta and his group were intimately involved in the design, development and delivery of Communication Transponders for GEOSAT Programme as well as in the design, development and delivery of payloads for IRNSS Programme

In the course of his distinguished professional career, Dr. Dasgupta has published a large number of scientific papers in reputed international and national journals. Dr Dasgupta is a senior member of IEEE, a Fellow of IETE and a Life member of Computer Society of India. Dr Dasgupta has co-authored a chapter titled “Review of Wireless Technologies and Generations” in a book titled “Handbook of Research in Mobile Business: Technical, Methodological and Social perspective” (2 volumes) published by Group Reference, Hershey, London, Melbourne and Singapore in April, 2006. Dr Dasgupta has already guided five PhD students and is presently guiding six PhD students. Dr. Dasgupta has continued on the good work of his predecessor and the institute (IIST) has benefited immensely from his able stewardship. In recognition of Dr. Dasgupta's important research contributions, and his services to ISRO/DoS and to the country, he was awarded the ISRO Performance Excellence Award in the year 2011.





Indian Institute of Space Science and Technology

(Declared as Deemed to be University under section 3 of the UGC Act, 1956)

Valiamala, Thiruvananthapuram

