भारत सरकार
अंतरिक्ष विभाग

Government of India
Department of Space

सत्यमेव जयते

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY

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

Valiamala P O, Thiruvananthapuram- 695 547, Kerala

ANNUAL REPORT 2015-2016

Annual Report
2015-2016

Indian Institute of Space Science and Technology

[Declared as Deemed to be University under Section 3 of the UGC Act 1956]

Valiamala P. O., Thiruvananthapuram 695 547, Kerala, India

VISION & MISSION

Vision

To be a world class educational and research institution contributing significantly to the space endeavors

Mission

- ★ Create a unique learning environment enriched by the challenges of the space programme.
- ★ Nuture the spirit of innovation and creativity.
- ★ Establish Centres 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.

Prof. U R Rao
CHANCELLOR

Shri. A S Kiran Kumar
SECRETARY, DoS & Chairman, ISRO
PRESIDENT, Governing Body, IIST
CHAIRMAN, Governing Council, IIST

Dr. K. S. Dasgupta
DIRECTOR & CHAIRMAN BoM

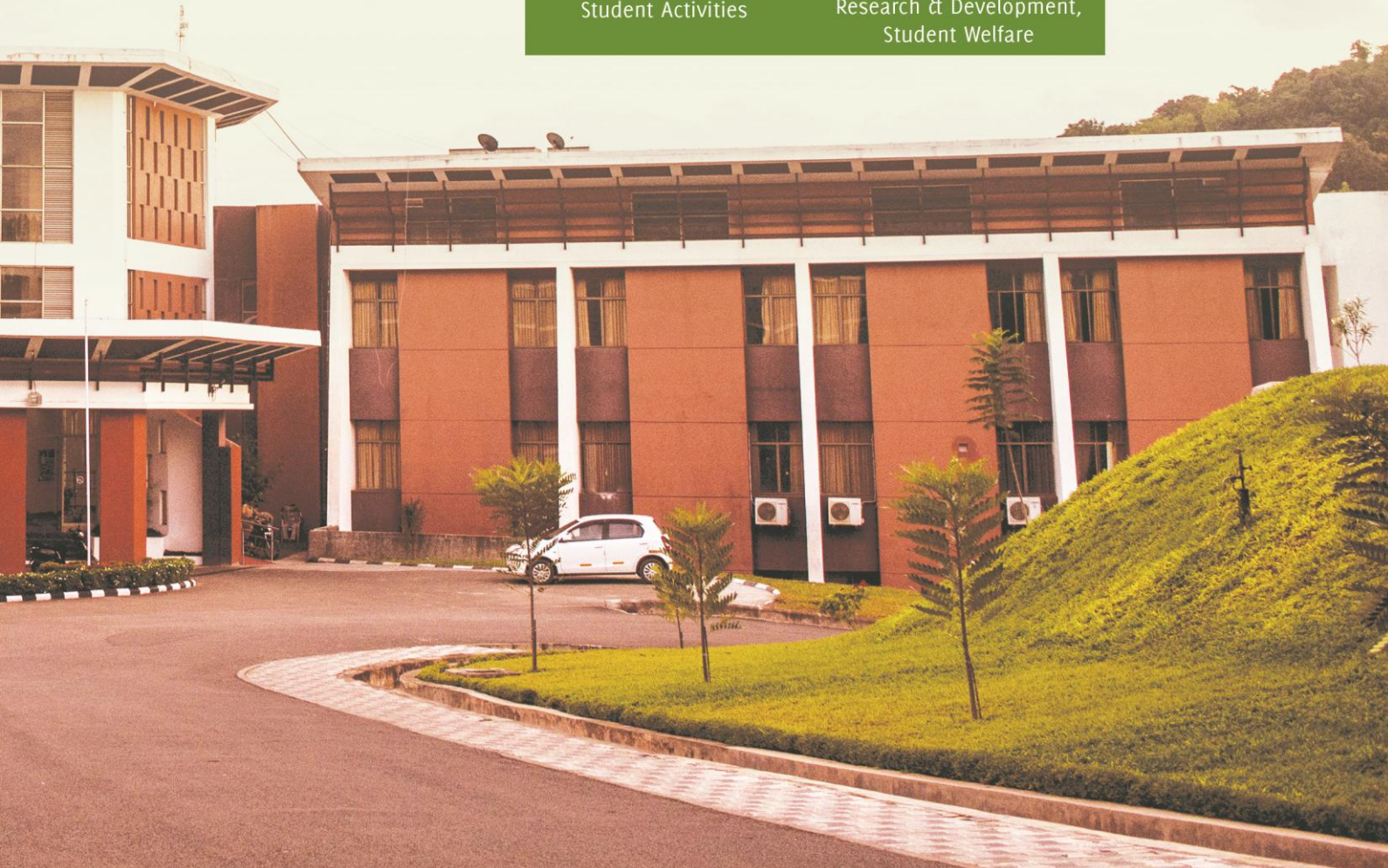
DEANS

Dr. A. Chandrasekar
Academics & Registrar

Dr. Kurien Issac
Intellectual Property Rights & Continuing Education

Dr. Kuruvilla Joseph
Student Activities

Dr. Raju K. George
Research & Development, Student Welfare



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FOREWORD

It gives me immense pleasure to present the Annual Report of IIST for the academic year of 2015-2016. IIST has moved to the ninth year in its journey forward. The institute achieved excellent credentials and has done meritorious activities during this time span.

The sudden demise of our beloved Chancellor Dr. A. P. J. Abdul Kalam on July 27, 2015 was a huge loss to IIST as it was for the entire nation. He left us quite untimely at the age of 84, while busily engaged in his favourite activity of interacting with students. Dr. Kalam played a very significant role in the establishment and growth of the institute since its inception. He cared deeply for the education and intellectual growth of the nation's younger generation and wanted IIST to be a forerunner in that regard. I pay my humble tributes to our beloved chancellor, and trust that the institute would strive, in the coming years, to nurture his great legacy.

This annual report year saw 138 students joining our three undergraduate programs and 89 students joining our 14 post-graduate programs in various highly sought after specializations. In the same period, 134 students graduated from the B. Tech. programmes, 57 from post graduate programmes and 9 earned their doctoral degree.

During 2015-16, the institute welcomed five new members with outstanding academic record and research credentials to its faculty pool. With this, the strength of faculty members at IIST stands at 92. Our faculty members continue to make valuable contributions towards teaching, along with advancing their areas of research. More than 140 referred research publications came out in the reporting period from our faculty and research scholars.

This year, IIST organized seven national level workshops and conferences in various areas of space science, space technology, culture and humanities. Our students are vigorously involved in research projects within the institute and also in collaboration with various ISRO centers. Many eminent personalities of international repute visited our institute during this period to engage with students and staff on various scientific discussions and for knowledge sharing. The Advanced Space Technology Development Cell (ASTDC) was incorporated in IIST in October 2015 with the objective of facilitating collaborative research between IIST and various ISRO centres and SCL.

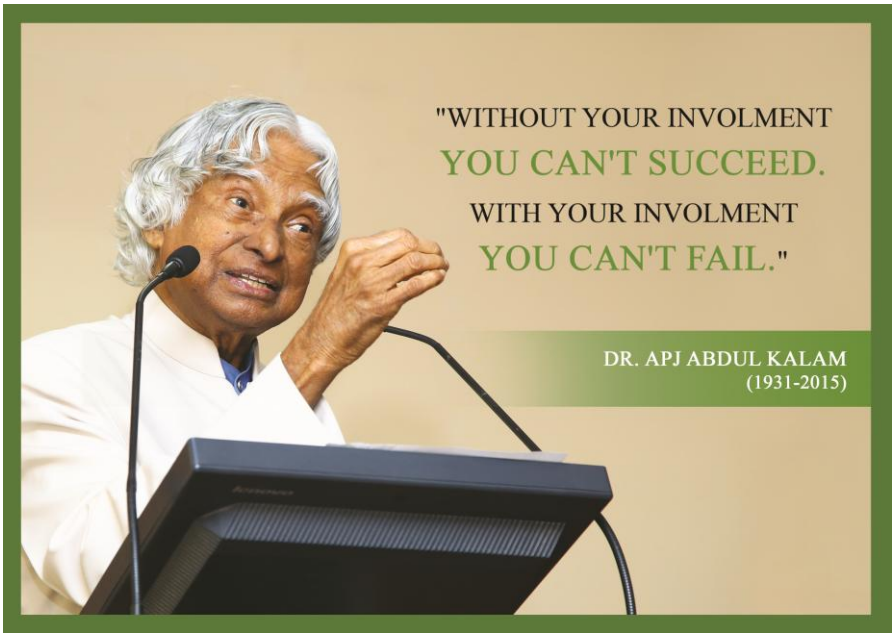
I am also greatly delighted to report that IIST was placed in the 8th position by the National Institutional Ranking Framework instituted by the Ministry of Human Resource Development (MHRD) among universities across the country. The award was based on a wide set of parameters including teaching and research output, student placements, laboratory and library resources, gender equity, faculty-student ratio, and interface with other institutions and industry. It came as a great appreciation and honor for our hard work, given that we are still a very young institute.

Along with the curricular activities, IIST has been giving great thrust to the culture and

sports. The institute in collaboration with SPIC MACAY hosted an odissi dance performance by the renowned artist Smt Sujata Mohapatra on November 5th, 2015. The state festival of Onam was celebrated with gaiety on August 27th 2015. The annual inter-collegiate cultural festival – *Dhanak*, the technical Fest – *Conscentia*, both organized by students, and the annual sports meet were also grand successes. To impart the knowledge of Yoga and its relevance to healthy living, the institute regularly conducting month long training sessions for students and staff on Yoga theory and practice

IIST has to conquer more heights and achieve more glories in its onward journey. Our vision for the coming years will be to make IIST a national hub for research.

K. S. Dasgupta
Director
Chairman, Board of Management



Remembering Our First Chancellor: Dr. APJ Abdul Kalam

Indian Institute of Space Science and Technology (IIST) was indeed very fortunate to have Dr. APJ Abdul Kalam as its first Chancellor and his very presence in the campus made the Institute always very vibrant. We at IIST were thrilled to hear his appointment in 2007, as our first Chancellor. Within minutes of his receiving the letter of his appointment as Chancellor IIST, he called me at my office and I could gauge his excitement particularly to work closely with IIST-ISRO and also with the younger generation. I also could notice his enthusiasm to build this Institute as a world class Institution and he narrated his broad vision on how to achieve this objective. He also stressed that IIST should become an extended wing of ISRO to undertake the long term complex research problems. This whole discussion took more than half an hour over phone. As all of us know that after demitting his office as President of India he spent most of his time in addressing the millions of students all over India, which he loved. Therefore he told me once that he is quite happy to take up the role as Chancellor of IIST and closely interact with IIST students and even teach them.

In spite of his very busy engagements, he scheduled his visit to Institute within a few days of his phone call. He was very particular that every minute he spent at IIST during his visit, to be very productive and hence we have to put forth a lot of efforts to chalk out a well-structured programme to his satisfaction. Entire Institute, particularly first batch of students got ecstatic to hear the news of his arrival. His two days interaction with faculty and students at the Institute was very vibrant and he dealt with a whole range of topics including the academics, innovation, research, collaboration with other universities, ISRO centres etc. He was able to infuse a lot of enthusiasm and inspiration in the Institute. He continued such visits more often whenever he got an opportunity.

He expressed to me that in one of his such visits he wanted to take regular classes to all three batch of first year students separately. He selected one topic each for

each of the branches in line with their curriculum well in advance and communicated the same to some of the selected students to study the topics in detail and send their response in terms of the questionnaire. He always believed in such close interactions and this interaction continued for almost a month. Based on these efforts he prepared lectures in each of the chosen topics and delivered excellent lectures to all three batches of students at different timings. There were very intense interactions in the class and the feedback from the students were excellent. It was indeed a dream come true for all our first batch students.

Once he attended the IIST Board meeting held at Thiruvananthapuram and sat through the whole meeting. He gave very constructive suggestions to improve the Institute particularly in innovation and research. He mooted the idea of starting at least one Centre of excellence in each of the Departments. The Institute took the idea very seriously and worked with a lot of vigour. I am happy that Centres of excellence in nano materials and advanced propulsion areas have made good progress.

He acted as a very good ambassador for the Institute both nationally and internationally and he attempted to project the Institute in all his trips abroad particularly to foreign universities where he was invited to give special lectures. He extended his help in setting up the Satish Dhawan Fellowship scheme with Caltech, USA and it has been very successful. He was always bubbling with new ideas. He was very passionate to pursue the solar power to meet the Country's power requirements. He wanted IIST to take the lead in this area and he discussed this issue with our faculty members during one of his visits.

As Chancellor he used to get many representations on various matters time to time on IIST from different people across the Country and he used to check each one of them with me irrespective of how trivial the matter is. If it is a vital issue he used to discuss with me in detail and many times he used to guide me too. He also made it a point to send them suitable reply wherever it is essential. I can say for sure that as a Chancellor he left a very lasting impression on IIST and his direct and indirect support and guidance have helped immensely the Institute to achieve the present levels. I must consider myself lucky to work under the guidance of such great personality in setting up this prestigious Institute. I am very certain that his name will remain immortal in IIST history.

BN Suresh
Founder Director, IIST

DEPARTMENTAL STRUCTURE

IIST at a glance 2015-16

Department	Academic Faculty	Technical/Scientific Staff
Aerospace Engineering	22	6
Avionics	20	3
Earth and Space Sciences	16	-
Chemistry	10	-
Humanities	5	-
Mathematics	11	-
Physics	12	1

STAFF

IIST at a glance 2015-16

Staff (143)

Teaching (120)	
Academic	96
Scientific	1
Technical	23
Support (23)	
Officers	14
Administrative	9

STUDENTS

B. Tech.

Course	2012	2013	2014	2015	Total
Aerospace Engineering	50	55	54	60	219
Avionics	55	59	57	58	229
Physical Sciences/ Engineering Physics	23	35	31	20	109
Total	**128**	**151**	**143**	**138**	**557**

M. Tech.

Course	2014	2015	Total
Machine Learning & Computing	6	4	10
Optical Engineering	6	5	11
Solid State Technology	4	6	10
Materials Science and Technology	7	6	13
Aerodynamics & Flight Mechanics	7	7	14
Thermal & Propulsion	8	8	16
Structures & Design	8	8	16
Control System	6	6	12
Digital Signal Processing	8	6	14
R F& Microwave Engineering	7	7	14
VLSI & Microsystems	7	10	17
Geoinformatics	5	6	11
Earth System Science	5	4	9

M.S.

Astronomy and Astrophysics	4	6	10
Total	**88**	**89**	**177**

Ph.D

Department	Full Time scholars	Part Time scholars	Total
Aerospace Engineering	22	12	34
Avionics	16	10	26
Chemistry	19	3	22
Earth and Space Sciences	17	1	18
Humanities	9	2	11
Mathematics	12	1	13
Physics	21	2	23
Total	**116**	**31**	**147**

1 THE INSTITUTE

The Indian Institute of Space Science and Technology (IIST), a 'Deemed to be University' under Section 3 of the UGC Act 1956 was established by the Department of Space(DOS), Government of India, in 2007. It offers undergraduate, post-graduate, doctoral and post-doctoral programmes in broad areas of space science, technology and applications. The institute is committed to excellence in teaching, learning and research. IIST fosters state-of-the-art research and development in space studies and provides a think-tank to explore new directions for the Indian space programme.

1.1 GOVERNING BODY

A S Kiran Kumar
Secretary, Department of Space
Chairman ISRO, Bangalore – President

A Vijay Anand
Additional Secretary,
Department of Space, Bangalore

Y V N Krishnamurthy
Scientific Secretary, ISRO HQ, Bangalore

K Sivan
Director, Vikram Sarabhai Space Centre, (VSSC) Thiruvananthapuram

S Somanath
Director, Liquid Propulsion Systems Centre, (LPSC) Valiamala, Thiruvananthapuram

K S Dasgupta
Director, IIST

A Chandrasekar
Dean (Academics), IIST

Raju K George
Dean (R&D) & Student Welfare, IIST

Kuruvilla Joseph
Dean (Student Activities), IIST

M S Chandrashekar
Deputy Director, Personnel Policy and Programme Management (PP&PM), ISRO Headquarters, Bangalore

A Chandrasekar
Registrar, IIST- Secretary

1.2 GOVERNING COUNCIL

A S Kiran Kumar
Secretary, Department of Space/Chairman ISRO, Bangalore – Chairman

A Vijay Anand
Additional Secretary, Department of Space, Bangalore

Y V N Krishnamurthy
Scientific Secretary, ISRO HQ, Bangalore Member

S Kumaraswamy
Joint Secretary (Personnel), Department of Space, Bangalore

Chintamani Manohar Sane
Joint Secretary (Finance), Department of Space, Bangalore

K S Dasgupta
Director, IIST- Member Secretary

1.3 BOARD OF MANAGEMENT

K S Dasgupta
Director, IIST- Chairman

A Vijay Anand
Additional Secretary, Department of Space, Bangalore

Y V N Krishnamurthy
Scientific Secretary, ISRO HQ, Bangalore

Partha Pratim Chakrabarti
Director, IIT Kharagpur

Bhaskar Ramamurthi
Director, IIT Madras

A Ajayaghosh
Director, NIIST, Thiruvananthapuram

A Chandrasekar
Dean (Academics) IIST

Raju K George
Dean (R&D) & Student Welfare, IIST

Kuruvilla Joseph
Dean (Student Activities)

K Kurien Issac
Dean (Intellectual Property Rights and Continuing Education)

A Chandrasekar
Registrar, IIST- Secretary

1.4 FINANCE COMMITTEE

K S Dasgupta
Director, IIST- Chairman

A Vijay Anand
Additional Secretary, Department of Space, Bangalore

H N Madhusudhana
Director, BEA, ISRO Headquarters, Bangalore

A Chandrasekar
Registrar, IIST

Raju K George
Dean (R&D) & Student Welfare, IIST

Gopalakrishna U
Head Accounts/IFA, LPSC, Valiamala

R Hariprasad
Deputy Registrar (Finance) /Finance Officer- Member Secretary

1.5 ACADEMIC COUNCIL

K S Dasgupta
Director, IIST - Chairman

A Chandrasekar
Dean (Academics) IIST

Raju K George
Dean (R&D) & Student Welfare, IIST

Kuruvilla Joseph
Dean (Student Activities), IIST

K Kurien Issac
Dean (Intellectual Property Rights and Continuing Education) IIST,

C.S. Narayanamurthy
Sr.Professor, Department of Physics, IIST

Abdusamad Alias Salih
Head, Department of Aerospace Engineering, IIST

N Selvaganesan
Head, Department of Avionics, IIST

Nirmala Rachel James
Head, Department of Chemistry, IIST

Anandmayee Tej
Head, Department of Earth and Space Sciences, IIST

K S Subrahamanyan Moosath
Head, Department of Mathematics, IIST

V Ravi
Head, Department of Humanities, IIST

S Murugesh
Head, Department of Physics, IIST

N.Sabu
Professor, Department of Mathematics, IIST

C V Anil Kumar
Associate Professor, Department of Mathematics, IIST

B S Manoj
Associate Professor, Department of Avionics, IIST

S Anup
Associate Professor, Department of Aerospace Engineering, IIST

L Gnanappazham
Associate Professor, Department of Earth and Space Sciences, IIST

K Sudhakar
Former Professor, IIT, Bombay

K R Ramakrishnan
Professor, IISc, Bangalore

A Ajayaghosh
Director, NIIST, Thiruvananthapuram

A Chandrasekar
Registrar, IIST - Secretary


Levi's

2 STAFF

(as on 31.03.2016)

Academics

Director

Dr. K S Dasgupta

Deans

Academics: Dr. A.Chandrasekar
Research & Development, Student Welfare: Dr. Raju K.George
Student Activities: Dr. Kuruvilla Joseph
Intellectual Property Rights and Continuing Education: Dr. Kurien Issac

During 2015-16, five faculty members joined and at present institute is having 96 Faculty members.

DEPARTMENT OF AEROSPACE ENGINEERING

HOD

Abdusamad Alias Salih, PhD - IIT, Kharagpur

SR. PROFESSOR

Kurien Issac K, PhD– IIT, Madras

ADJUNCT PROFESSORS

R V Ramana, Ph D – University of Kerala
P Raveendranath, Ph.D – IIT, Kharagpur

ASSOCIATE PROFESSORS

Anup S, PhD - IIT, Madras
Chakravarthy P, PhD - IIT, Madras
Deepu M, PhD – NIT, Calicut
Aravind.V, PhD -University of Florida, USA
Manoj T Nair, PhD- IIT, Kanpur

ASSISTANT PROFESSORS

Shine S R, PhD - IIST, Trivandrum
Bijudas C R, PhD – IIT, Bombay
Girish B S, PhD-Anna University, Chennai
Vinoth B R, PhD- IIT, Kanpur
Pradeep Kumar P, PhD – IIT, Bombay
Satheesh K, PhD – IISc, Bangalore
Prathap C , PhD - IIT, Delhi
Praveen Krishna I R, PhD - IIT, Madras
Arun C O, PhD - IIT, Madras
Rajesh S, PhD - University of Karlsruhe, Germany
Sooraj V S, PhD-IIST, Thiruvananthapuram*

VISITING FACULTY

Devendra Prakash Ghate, Ph D – University of Oxford, UK*

READER (on Contract)

Sam Noble

*Sooraj V S Joined on 10.06.2015

*Devendra Prakash Ghate Joined on 29.03.2016

DEPARTMENT OF AVIONICS

HOD
Selvaganesan N, PhD - Anna University, Chennai

ADJUNCT PROFESSORS
Sam K Zachariah

ASSOCIATE PROFESSORS
Lakshmi Narayanan R, PhD- IIT, Madras
Basudeb Ghosh, PhD-IIT, Roorkee
Deepak Mishra, PhD- IIT, Kanpur
Manoj B S, PhD- IIT, Madras
Priyadarshnam, PhD - IIT, Bombay

ASSISTANT PROFESSORS
Sheeba Rani J, PhD – Anna University, Chennai
Rajesh Joseph Abraham, PhD - IIT, Kharagpur
Seena V, PhD - IIT, Bombay
Rajeevan Puthan Purayil, PhD- IISc, Bangalore
Chinmoy Saha, PhD -University of Calcutta
Harsha Simha M S, PhD - IIT, Bombay
Palash Kumar Basu, PhD - Jadavpur University, Kolkata
Anindya Dasgupta, PhD- IIT, Kanpur
Sanjeev Kumar Mishra, PhD-IIT, Bombay
Sooraj R, PhD- GIST, South Korea*

VISITING FACULTY
Vineeth B S, Ph D – IISc, Bangalore*

READER
Vani Devi M

READER (on Contract)
Chris prema

*Sooraj R Joined on 01.07.2015
*Vineeth B S Joined on 15.07.2015

DEPARTMENT OF CHEMISTRY

HOD
Nirmala Rachel James,PhD - Pune University

SR PROFESSOR
Kuruvilla Joseph, PhD- M G University, Kottayam

ASSOCIATE PROFESSORS
Honey John, Ph D – CUSAT#
Sandhya.K.Y, PhD - University of Kerala
Prabhakaran K, PhD- University of Kerala
Gomathi N, PhD- IIT, Kharagpur

ASSISTANT PROFESSOR
Sreejalekshmi K G, PhD - University of Kerala
Mary Gladis J, PhD- University of Kerala
Jobin Cyriac, PhD - IIT, Madras

DST INSPIRE FACULTY
Mahesh S, Ph D - CUSAT

#Honey John Relieved on 31.07.2015

DEPARTMENT OF HUMANITIES

HOD
Ravi. V, PhD - IIT, Delhi

ASSOCIATE PROFESSOR
Lekshmi V Nair, PhD- University of Kerala

ASSISTANT PROFESSORS
Gigy J Alex, PhD- M G University, Kottayam
Babitha Justin, PhD- University of Hyderabad
Shaijumon C S, PhD- University of Kerala

DEPARTMENT OF EARTH AND SPACE SCIENCES

HOD Anandmayee Tej, PhD- Gujarat University **SR PROFESSOR** A Chandrasekar, PhD- IISc, Bangalore **ASSOCIATE PROFESSORS** Samir Mandal, PhD- Jadavpur University, Kolkata Rajesh VJ, PhD - Yokohama National University, Japan Gorti R K S S Manyam, PhD-IIT, Madras Jagadheep D, PhD-Cornell University, USA Gnanappazham L, PhD – University of Madras	Rama Rao Nidamanuri, PhD-IIT, Roorkee Sarita Vig, PhD-TIFR, Mumbai Muvva Venkata Ramana,Ph D- M G University, Kottayam / Space Physics Laboratory (ISRO), VSSC, Trivandrum[#] Anand Narayanan, Ph D- Pennsylvania State University, USA **ASSISTANT PROFESSORS** Resmi L, PhD - IISc, Bangalore Govindan Kutty M, PhD - IIT, Kharagpur V Poompavai, Ph D – Anna University, Chennai[#] **DST INSPIRE FACULTY** Ambili K M, Ph D – University of Kerala* **READER (on Contract)** A M Ramiya

[#] Muvva Venkata Ramana Relieved on 15.01.2016

[#]V Poompavai Relieved on 31.08.2015

*Ambili K M Joined on 30.04.2015

DEPARTMENT OF MATHEMATICS

HOD Subrahamanian Moosath K S, PhD- University of Hyderabad **SR PROFESSOR** Raju K George, PhD- IIT, Bombay **PROFESSORS** N Sabu, PhD- University of Madras **ASSOCIATE PROFESSORS** Anilkumar C V, PhD - CUSAT Deepak T G, PhD - CUSAT	**ASSISTANT PROFESSORS** Natarajan E, PhD - IIT, Madras Sarvesh Kumar, PhD- IIT, Bombay Kaushik Mukherjee, PhD- IIT, Guwahati Sumitra S, PhD - Sheffield University, England Prosenjit Das, PhD - Indian Statistical Institute, West Bengal **DST INSPIRE FACULTY** K Sakthivel, Ph D – Bharathiar University, Coimbatore

DEPARTMENT OF PHYSICS

HOD	ASSISTANT PROFESSORS
Murugesh S, PhD - University of Madras	Pramod Gopinath, Ph D – CUSAT[#]
SR PROFESSOR	Naveen Surendran, PhD- University of Madras
Narayanamurthy C S, PhD- IIT, Madras	Apoorva Nagar, PhD - Tata Institute of Fundamental Research, Mumbai
ASSOCIATE PROFESSORS	Kuntala Bhattacharjee, PhD - Institute of Physics, Utkal University, Odisha
Rakesh Kumar Singh, PhD-IIT, Delhi	Jinesh K B, PhD - Twente University, PhD - Leiden University, Netherland
Sudheesh Chethil, PhD - IIT, Madras	Jayanthi S, PhD - IISc, Bangalore
Umesh R.Kadhane, PhD- Mumbai University	J Solomon Ivan, PhD - Homi Bhabha National Institute, Mumbai

[#] Pramod Gopinath Relieved on 03.03.2016

Administration

Registrar
A.Chandrasekar

Deputy Registrars
V Sennaraj
R Hariprasad

Computer System Administrator cum Manager
Mohan Sukumar

Sr. Administrative Officers
Bindya K R
S Ramanathan

Sr. Purchase and Stores Officers
Subashchandran M B
Rakesh R Menon

Sr. Manager Canteen Services
Vinod Kaimal K P

Sr. Manager Hostel Services
Bipin P Varghese

Sr. Accounts Officers
A Rajeena Beegam
Reny Thomas

Hindi Officer
Jayapal R

Library Officer
Abdunnasar A

3 STUDENTS

IIST offered three undergraduate and fourteen post graduate programmes during 2015-16.

3.1 B. Tech Programmes

- **Aerospace Engineering**
- **Avionics**
- **Dual Degree Programme with B.Tech degree in Engineering Physics**

The Aerospace engineering program offers a mechanical engineering perspective to space technology. The students learn topics in mechanical design, flight mechanics, aerodynamics, thermal and propulsion systems, and space dynamics. The Avionics discipline covers electronics related to space systems. The course is a hybrid of electrical engineering, electronics and communication engineering and computer science. The first year is common for all the three undergraduate programmes that covers basic courses in science engineering. The second and third years of the Dual Degree programme comprises mainly of foundation courses in Physics and Engineering. In the fourth year, the student pursues one of the four postgraduate specializations that will lead to a M.S (Astronomy and Astrophysics/Earth System Science/ Solid State Physics) or M.Tech. Degree (Optical Engineering). The fifth year of the programme is dedicated to a research project work.

Admission for all the three undergraduate programmes for the academic year 2015-16 was completed through direct counseling of students based on their performance in JEE (Main) conducted by CBSE and performance in Class XII School Board Exam as well as JEE (Advanced) Examination conducted by IITs.

138 students were admitted for the academic year 2015-16 in the three branches

Branch	General	OBC	SC	ST	PwD	Total
Aerospace Engineering	28	17	9	5	1	60
Avionics	28	18	9	3		58
Engineering Physics	9	6	3	2		20
Total						**138**

3.2 M.Tech. and M.S. Programme (2 years)

The various departments of the Institute offer post-graduate programmes in emerging and highly sought after specializations in their respective areas. These programmes are meant to provide and in-depth understanding of specialized topics. Applications for M.Tech and M.S. programmes are screened based on GATE score and the admission is through test and interview. The total number of seats in each programme is ten, out of which six seats are reserved for open merit candidates and the remaining four for DOS/ISRO employees.

IIST offers M.Tech. and M.S. programmes in the following disciplines:

Sl No.	DEPARTMENT	POST GRADUATE PROGRAMMES
1	Aerospace Engineering	1. M.Tech. Aerodynamics & Flight Mechanics
		2. M.Tech. Thermal & Propulsion
		3. M.Tech. Structures & Design
2	Avionics	1. M.Tech. R F& Microwave Engineering
		2. M.Tech. Digital Signal Processing
		3. M.Tech. Control System
		4. M.Tech. VLSI & Microsystems
3	Chemistry	1. M.Tech. Materials Science and Technology
4	Earth & Space Sciences	1. M.Tech. Earth System Science
		2. M.Tech. Geoinformatics
		3. M.S. Astronomy and Astrophysics
5	Mathematics	1. M.Tech. Machine Learning & Computing
6	Physics	1.M.Tech. Optical Engineering
		2. M.Tech. Solid State Technology

Category-wise details of students admitted during the report period across various M.Tech. and M.S. Programmes of IIST are as follows:

Admission 2015-2016							
Sl.No.	**Name of the M.Tech. and M.S. Programme**	**Gen**	**OBC**	**SC**	**ST**	**Sponsored from DOS/ISRO**	**Total**
1	Thermal and Propulsion	3	2	1	-	2	8
2	Aerodynamics and Flight Mechanics	3	2	1	-	1	7
3	Structures and Design	4	-	1	1	2	8
4	RF and Microwave Engineering	2	1	1	1	1	6
5	Digital Signal Processing	3	2	1	-	1	7
6	VLSI and Microsystems	4	1	1	-	4	10
7	Control Systems	3	1	1	-	1	6
8	Machine Learning and Computing	2	1	-	-	1	4
9	Materials Science and Technology	3	1	1	-	1	6
10	Earth System Sciences	2	1 (PwD)	1	-	-	4
11	Geoinformatics	3	2	1	-	-	6
12	Astronomy and Astrophysics	5	-	1	-	-	6
13	Optical Engineering	5	-	-	-	-	5
14	Solid State Technology	3	2	1	-	-	6
Total		**45**	**16**	**12**	**2**	**14**	**89**

3.3 Doctoral Programmes

Admission was based on test and interview and is restricted to those candidates who qualified GATE/UGC/CSIR NET-JRF/JEST or equivalent exams. During this period, twenty five students registered for PhD, the details of which are given below:

Department	Full Time	Part Time	Total
Aerospace Engineering	5	-	5
Avionics	4	2	6
Chemistry	1	-	1
Earth and Space Sciences	1	1	2
Humanities	-	-	-
Mathematics	5	-	5
Physics	6	-	6
Total	**24**	**3**	**25**

3.4 Student Assistanceship Package

Department of Space Assistanceship covers full cost of education (ie, course fee, Hostel fee, Books & Hostel charges and medical expenses) for all undergraduate students of the Institute.

1	Statutory Semester Fee	₹ 20,000/-
2	Students Amenity Fee	₹ 4000/-
3	Hostel charges including dining	₹ 14,400/-
4	Establishment charges	₹ 8,000/-
5	Medical Cover	₹ 2000/-
6	Book Grant	₹ 3000/-
	Total Amount	₹ **51,400/-**

3.5 Collaborative Academic Programmes Abroad

IIST has entered into international collaborations which provide ample opportunity for the students to study and carry out research in foreign universities and establishments.

California Institute of Technology (CALTECH), USA

CalTech is a world-renowned university located in Pasadena, California,USA. Every year one student of B.Tech. Aerospace Engineering is admitted for a Master of Science degree in Space Engineering at the Graduate Aerospace Laboratories of CalTech (GALCIT). Support for study will be funded by Professor SatishDhawan Fellowship. This award will cover full tuition and mandatory fees. Travel expenses and visa fees are met by IIST.

Pranav Nath, topper in B.Tech. Aerospace Engineering for the academic year 2014 completed his M.S degree in 2016.

Anand Kumar, topper in B.Tech. Aerospace Engineering in 2015 is pursuing his M.S degree in the 2015-16 session.

Universities Space Research Association (USRA), USA

USRA is an independent, nonprofit research corporation where the combined efforts of in-house talent and university-based expertise merge to advance space science and technology. USRA works across disciplines including biomedicine, planetary science, astrophysics and engineering integrating these competencies into applications ranging from fundamental research to facility management and operations.

USRA and IIST have jointly established an undergraduate student Summer Research programme (under Exchange Visitor Programme) which provides research opportunities at USRA Institutes and other Universities to outstanding students at IIST. USRA will provide for the housing expenses and per diem. Travel expenses and visa fees will be paid by IIST.

Jet Propulsion Laboratory (JPL), USA

The Jet Propulsion Laboratory is a federally funded research and development center and NASA field center located in La Canada Flintridge, California, United States. JPL is managed by the nearby California Institute of Technology (CALTECH) for NASA.

JPL has offered an 8 week internship programme for three students of B.Tech. in each branch viz, Aerospace Engineering, Avionics and Physical Sciences/Engineering Physics who are in their third year. Students will receive a generous stipend to cover their entire expenses. The expenditure towards airfare, medical insurance coverage, VISA fees and SEVIS fees will be met by IIST.

The students who have been selected for this programme for the period from 01.06.2015-30.07.2015. are

Divesh Soni
(Aerospace Engineering)

Suraj Kumar
(Avionics)

Harshavardhan Singh
(Physical Sciences)

Lockheed Martin's Undergraduate Student Visitation Program

Lockheed Martin, the American global aerospace, defense, security and advanced technology company with worldwide interests has an Undergraduate Student Visitation Program at the LM Advanced Technology Centre (LM ATC) located at Palo Alto, California.

This program is administered by the binational Indo US Science and Technology Forum (IUSSTF), New Delhi. The goal of this programme is to create, nurture and support techno-entrepreneurial ecosystems. The duration for the programme will be for eight weeks during summer. The visitation program will cover accommodation, local transportation, international air travel support. The students (B.Tech. Avionics) of IIST who had the opportunity to be selected for this program. (03.03.2015- 08.04.2015) are

Gulshan Gupta
(Avionics)

Sourajit Debnath
(Avionics)

3.6 Learning Abroad Programmes

B.Tech

Shri Shashank Nitundil, Department of Aerospace Engineering attended a fully funded summer research internship in the University of Alberta, Edmonton organised by the Mitacs Globalink Foundation, Canada, 11.05.2015 to 04.08.2015.

The Mitacs Globalink Research Internship is a competitive initiative for international undergraduates from Brazil, China, France, India, Mexico, Saudi Arabia, Tunisia and Vietnam. From May to September of each year, top-ranked applicants participate in a 12-week research internship under the supervision of Canadian university faculty members in a variety of academic disciplines, from science, engineering and mathematics to the humanities and social sciences. Over 45 universities across Canada are hosting Mitacs Globalink Research interns in the summer of 2015. The entire expenditure towards air fare, accommodation, living stipend, medical insurance, student registration fees is met by Mitacs Globalink Reseach Foundation.

Ph.D

1. Ms Sonu Tabitha Paulson, Department of Physics attended an International Young Astronomers School on Large Ground based 21st Century Radio Instruments: ALMA/NOEMA-SKA/LOFAR/NenuFAR at the Observatoire de Paris, 16.11.2015 to 20.11.2015
2. Ms Veena V S, Department of Earth and Space Sciences participated in the 6th European Radio Interferometry School (ERIS 2015) at Garching, Germany, 06.11.2015 to 10.11.2015
3. Ms Vijaylakshmi C G, Department Earth and Space Sciences participated in a 'Career Development Workshop for Women in Physics' conducted by International Centre for Theoretical Physics (ICTP), Trieste, Italy, 12.10.2015 to 16.10.2015
4. Shri Najeeb Punnakayathil, Department of Physics participated in Sakura Science Program of the Japan Science and Technology Agency (JST) at Tokyo Metropolitan University (TMU) and visited Atomic, Molecular and Optical Physics Laboratory, RIKEN Wako campus in Japan, 21.01.2016 to 28.02.2016

M.Tech. Internship done in other organizations

Sl No:	Name	Year of Joining	Branch	Course	Internship
1	Abhilash	2014-2016	Avionics	VLSI & Microsystems	INTEL
2	Merin Mary Meyn	2014-2016	Avionics	VLSI & Microsystems	INTEL
3	Satish Verma	2014-2016	Avionics	VLSI & Microsystems	Analog Devices
4	Vandana Rajan	2014-2016	Avionics	DSP	INTEL and Analog Devices (accepted INTEL)
5	Gayathri	2014-2016	Avionics	DSP	Analog Devices
6	Shreeja	2014-2016	Avionics	DSP	Analog Devices
7	Blessey	2014-2016	Avionics	DSP	Analog Devices
8	Vaisakh S	2014-2016	Mathematics	Machine Learning and Computing	INTEL
9	Shiyas Azeez	2014-2016	Mathematics	Machine Learning and Computing	INTEL
10	Nithin	2014-2016	Chemistry	Material Science and Technology	NFTDC
11	Sujith	201-2016	Avionics	DSP	TCS

3.7 Placement

3.7.1 Absorption to DOS/ ISRO

B.Tech

Students of 2011 batch who completed the B.Tech. course with the required CGPA were placed at various ISRO centres as Scientist/Engineer 'SC'.

ISAC, Bangalore	15	PRL, Ahmedabad	07
ISTRAC, Bangalore	05	SAC, Ahmedabad	09
LPSC(Valiamala)	10	SCL, Chandigarh	10
MCF, Hassan	04	SDSC, Sriharikota	08
NARL, Gadanki	02	VSSC, Thiruvananthapuram	19
IPRC, Mahendragiri	07	**Total**	**101**
NRSC, Hyderabad	05		

Ph.D

Having completed their research work and awarded Ph.D five research scholars have been absorbed as Scientist/Engineer 'SD' in various ISRO Centres.

Jalaja K	SAC, Ahmedabad
Richa Sharma	SAC, Ahmedabad
Ameya Anil Kesarkar	SAC, Ahmedabad
Litesh Nandakishor Sulbhewar	ISAC, Bangalore
M Sreenivasa Raju	SAC, Ahmedabad

3.7.2 M.Tech. Placement Record for the Year 2016

Sl. No	Name	Department	Branch	Company
1	Abhilash Chadhar	Avionics	VLSI and Microsystems	Intel Technologies Pvt Ltd.
2	Merin Mary Meyn	Avionics	VLSI and Microsystems	Intel Technologies Pvt Ltd.
3	Vandana Rajan	Avionics	Digital Signal Processing	Mathworks, Team Indus
4	Gayathri G	Avionics	Digital Signal Processing	Analog Devices Pvt. Ltd.
5	Shreeja Sugathan	Avionics	Digital Signal Processing	Analog Devices Pvt. Ltd.
6	Vaishak	Mathematics	Machine Learning and Computing	Intel Technologies Pvt Ltd.
7	Nimai	Mathematics	Machine Learning and Computing	Oxyent Technologies
8	Tinkesh	Avionics	RF & Microwave Engg.	Team Indus
9	Shubham Diwakar	Avionics	B.Tech.	Kottackal Solutions

3.8 Student Projects

Vyom MK II- Sounding Rocket Project

Vyom Mk II, successor of Vyom I, a student designed rocket, is nearing the end of its conceptual design. A multi-disciplinary optimization approach has been followed for designing Vyom Mk II. In the last one year, the team has taken small steps towards automating the grid generation over the rocket which would enable them to incorporate high fidelity CFD in the optimization process to obtain aerodynamics forces and stability coefficients, which are otherwise estimated using engineering methods from aerodynamic codes provided by VSSC.

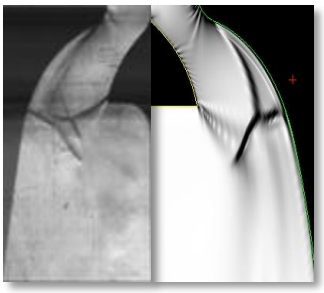
The team has also analysed feasibility of drag separation with the current design as payload separation would provide them an

altitude gain of 20 km, as predicted by the optimization study.

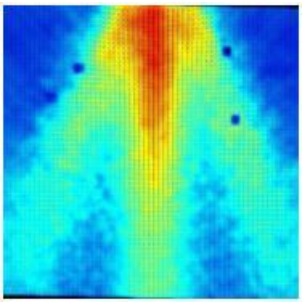
Work is being done on database generation (aerodynamic forces for a parametrized geometry) using CFD, which will be used to enhance the existing engineering methods based codes.

Team has explored the possibility of using a FPGA (field-programmable gate array) integrated circuit and a patch antenna in the design and has deemed them to be feasible and is currently working on their implementation. A scientific payload, Ozonesonde, is being developed by the students to accumulate the data on ozone concentration with altitude.

Team plans to complete the design in the current academic year and move into the manufacturing phase.



Schlieren image of flow through altitude compensating E-D Nozzle



Velocity field of 10 N Swirl Injector in Vernier engine-PS4 stage

Nano satellite Project

IIST nano-satellite mission is an interdisciplinary project taken up by a team of IIST students with mentor-ship provided by ISRO scientists and IIST Faculty members. The mission's objective is to set up a small-satellite standard for the Indian education institutes and for the students to have a hands-on experience on the design, fabrication and realization of small satellites at reasonable cost. The IIST nano-satellite mission began in the year 2008 and is in an advanced stage of development now. During this period it has helped our students in complementing their domain knowledge acquired from the curriculum in various disciplines like computer science, power systems, control theory, communication, PCB design etc.

Encouraged by the progress made under this program a few foreign universities including Caltech University, USA, University of Surrey, UK, University of Colorado, USA and foreign organizations like JPL and a few Indian Space industries have shown keen interest in collaborating with IIST for design and development of small satellites for a range of mission objective that includes technology demonstration and space science experiments. During the year 2015-2016 as part of the Nano-Satellite (Small-Satellite) Project, the group has designed and developed Onboard Computer version 3, RF front end for receiver and various test setups for ADCS subsystem.

4 RESEARCH AND DEVELOPMENT

Scientific and technological research is integral to IIST's vision. Research programmes in IIST focus on various areas of Science, Engineering and Humanities. The institute currently has 116 full time and 31 part time research scholars.

The institute actively supports its faculty to further their research careers. The state-of-the-art laboratories and dedicated centres of excellence provide students with opportunities to gather a wide variety of project experiences. The post-graduate programs of the institute are all research intensive. Students work in close partnership with faculty on research projects of short and long term duration. The institute also maintains interdisciplinary and collaborative work with international academic and research centres as well as various centres of ISRO. The doctoral students of the institute are encouraged and financially supported to attend workshops and conferences at institutes within India and abroad, where they also get to showcase their research work.

4.1 Department of Aerospace Engineering

Academic	Faculty	22
Technical	Staff	06
Students	Ph.D	34
	M.Tech	39

Research Activities

The major research initiatives from Department of Aerospace Engineering during the report period were in the broad areas of **(a) Thermal and Propulsion (b) Aerodynamics and Flight Mechanics (c) Structures and Design (d) Materials, Manufacturing and Management**. The research highlights under each of these areas are briefly described below.

THERMAL AND PROPULSION

Major research work of **A Salih** during the report period was focused on performance study of Gas Centered Swirl Coaxial (GCSC) Injectors. Gas-centered swirl coaxial (GCSC) injector elements have been preferred recently in liquid rocket engines because of an inherent capability to dampen the pressure oscillations in the thrust chamber. The gas-centered swirl coaxial injector chosen for the study is proposed to be used in semi-cryogenic rocket engines. Various configurations of gas-centered swirl coaxial injectors, sorted out by studying the spray angle and coefficient of discharge, and are investigated further for their atomization characteristics. The work was

performed in collaboration with focal points from Liquid Propulsion System Centre (LPSC), Valiamala.

Deepu M's research is in (a) numerical and experimental studies on thermal ignition of energetic materials, (b) studies of rocket nozzle flow separation and its control (c) simulation studies on passive enhancement of convective mass transfer, (d) heat transfer enhancement in microchannels and (e) numerical and experimental studies on micro-nozzles and thrustors. He has been working on the Simulation of Heat Transfer in GOX-GCH4 Pilot Igniter for the future Liquid Oxygen (LOx)/Liquid Methane (LCH4) rocket engine. This project is in collaboration with IPRC Mahendragiri and was initiated through the ASTDC/ IIST. In collaboration with Dr. Rajesh S. of IIST, and Dr. Praveen Nair of the Vikram Sarabhai Space Center, he has also been carrying out a joint IIST-ISRO project on the numerical simulation of secondary Injection to an Expanding Supersonic Cross Flow.

Major research carriedout by **Aravind Vaidyanathan** during the report period include (a)Investigation of the altitude compensating capabilities of Expansion-Deflection nozzle (b) Performance evaluation of swirl injector in 10 N vernier engine of PS4 stage using droplet size and velocity measurements (c) Study on supercritical jet behavior of fluoroketone to mimic Liquid hydrogen injection into thrust chamber and (d) Extensive studies on supersonic cavities to enhance noise suppression capabilities in flight/launch vehicles. Some of these research studies are progressing under ISRO-IIST projects.

Current research interests of **Shine S R**, include film cooling applications, cryogenic flows, natural convection flows, biological heat transfer, solar based vapour adsorption systems and CFD studies in tandem airfoil configurations. Development of analytical models for liquid and gaseous film cooling applicable to rocket combustion chambers is the major contribution to the rocket chamber film cooling research. His team has proposed new correlations for (i) local heat transfer coefficients for the case of natural convection flow around cylinder without confinement, and (ii) two phase average heat transfer coefficients for cryogenic chill down flows. Currently, involved in the development of a sorption solar refrigerator with inputs from National Academy of Sciences of Belarus.

C. Prathap worked on the experimental investigation of laminar burning velocity of premixed methane oxygen-N2/CO2 mixtures using spherically flame method. The purpose of this work was to measure the unstretched laminar burning velocity of premixed methane-oxygen mixtures at ambient conditions and different equivalence ratios with different levels of inert gases like nitrogen and carbon dioxide. Propagating spherical flames setup with high speed shadowgraph imaging system at IIT Delhi was used for this study. His group also undertook an experimental and numerical study of stationary flat flames. This joint IIST-ISRO project, done in collaboration with LPSC Valiamala, was to design and fabricate a burner to anchor a planar flame. The planar flame was anchored at near adiabatic condition. The anchored planar flame will be used as a reference flame for the calibration of laser diagnostic rigs at ISRO facilities. This burner will provide information on unstretched laminar burning velocity.

Rajesh Sadanandan was primarily working in the areas of optical and laser diagnostic techniques in propulsion research. (a) Role of Optical and laser diagnostic techniques in cryogenic propulsion research and (b) Experimental investigation of swirl effects on pollutant emission using OH chemiluminescence measurements are typical studies carried out by him during the reported period. Further, he has been working on the development of Ultra Lean Non-Premixed Gaseous Fuel Burner as well as Characterization of a non-premixed, swirl stabilised, methane burner using non-intrusive methods.

Pradeep Kumar along with a post-graduate student carried out a preliminary study on the centrifugal seal for Turbo pumps, a topic which is of interest to ISRO. The experimental work was done at the ISRO-LPSC Valiamala, during the report period. They were able to model and demonstrate the workability for water as the fluid. This work was adjudged as the best research paper in industry in the 42nd National Conference on Fluid Mechanics and Fluid Power. Dr. Pradeep and his doctoral students are also working on a project jointly undertaken with Dr. Aravind Vaidyanathan of IIST to develop a numerical model for cavitating venturi. The objective is to develop a variable area venturi useful for thrust modulation of future throttleable rocket engines. Dr. Pradeep's group, in collaboration with Dr. Seena of IIST, is also working towards the development of reliable electronic/ sensor cooling systems using micro fluidics specifically for space applications.

AERODYNAMICS AND FLIGHT MECHANICS

Under this stream, **R.V. Ramanan** made advancements in the following areas. (a) A new methodology and a design analysis tool was developed for generating and analysing the optimal transfer trajectories for the missions to Sun-Earth and Earth-Moon Lagrangian points. Using this tool ISRO launch vehicle capabilities were found out and presented to the ISRO study team Solar System Exploration in June 2015. (b) an adaptive guidance scheme that can be used in the process of rendezvous and docking was developed. The guidance scheme is based on optimal control theory and differential transformation techniques. The scheme works even for rendezvous between two objects which are in elliptical orbits. (c) a new analytical methodology based on pseudostate technique to generate the minimum energy transfer trajectories from Earth to other planets has been developed. This method identifies the multiple design options that exist for a launch opportunity of an orbiter mission. It provides improved analytical design for transfers under extended force model. This design tool can be used to analyse a number mission scenarios; and (d) the modulation of aerodynamic angles to obtain an optimal entry trajectory and maximize the parachute deployment altitude to be able to land at a particular site. The method uses the optimal control theory for the formulation of the problem and the differential evolution technique for the solution of the problem.

Manoj T Nair's research interests are in the areas of 1) numerical methods 2) low and high speed flows 3) optimization and 4) scientific computing. During the past one year the work was primarily focused on 1) improvement of Runge-Kutta methods for handling stiff differential equations - this would allow the use of large time steps in integration of differential equations at the same time improving the accuracy of the solution; 2) improvement of accuracy of higher order WENO schemes - this lead to

improvement is solution accuracy without considerable increasing the stencil and computing time; 3) separation control on low-speed airfoils using cavity; 4) separation control on low-speed airfoils using self-activating flaps - these two research considerably improves the efficiency of the airfoils used for MAVs; 5) control of supersonic flow past bluff bodies.

Major research works by **B R Vinoth** were (a) effect of nozzle inlet conditions on global oscillations of low density jets and its control, (b) development of spatio-temporal instability code to understand and predict the global oscillations in fluid flows,
(c) sensitivity studies on straight circular cylinder and tapered circular cylinder to map the regions responsible for flow oscillations, (d) control of global oscillations using geometrical modifications.

K Satheesh was involved in studies related to the aerodynamics of a flapping airfoil in low Reynolds number flows. As a part of this, experiments on the flapping airfoil were conducted in the low speed wind tunnel at IIST. The flow over flapping airfoil was also modeled analytically using potential flow techniques. Further, a 2-component force balance capable of measuring unsteady aerodynamic forces on the airfoil was developed as a part of this work.

Devendra Ghate works on adjoint gradient calculations for computational fluid dynamics. He has extensive experience in the application of automatic differentiation and parallel computing techniques. He is presently investigating various uncertainty propagation methods for aerospace systems design.

STRUCTURES AND DESIGN

Kurien Issac works in the area of optimal design and control of mechanisms and robotic systems. He, along with Sam Noble and Alok Ranjan, has proposed a new design for rocker-bogie like suspension to enhance step climbing performance of rovers. Along with Saurabh Chatterjee, he is exploring algorithms for estimating terrain properties as a rover moves on uneven sandy terrain, and thereby classify terrains for path planning on such terrains. Along with Mohankumar, Dr N Selvaganesan and Dr M Jayakumar, he is exploring methods for fault detection and diagnosis of linear actuators used in space applications. Along with Manoj T K, he has proposed an approach for reducing the time to de-orbit defunct satellites from near-polar low earth orbits using electrodynamic tether. Along with Divesh Soni and Sohan Yadav, he has proposed a new mechanism for the frame of an Astromesh type deployable space antenna, which has some features superior to existing designs.

P Raveendranath has been working on efficient and accurate finite element modelling of piezoelectric beam structures. The shortcomings of conventional Euler-Bernoulli beam beam element and Timoshenko beam finite element formulations when applied to piezoelectric materials have been identified and remedial measures proposed. Following a coupled polynomial interpolation approach, the dependencies of finite element accuracy and efficiency on the material properties of piezoelectric beam formulations have been eliminated. This paved way for versatile piezoelectric beam finite element formulations based on first order and higher order shear deformation theories. The experience gained in this area

is to be incorporated in the development of piezoelectric structural analysis module for FEAST software of VSSC. This activity is being proposed as a IIST-ISRO collaborative project. Dr.Raveendranath's team has also initiated a research work on Coupled numerical simulation of thermal, structural and chemical response of ablative composites.Currently working on modelling of pressure developed by decomposition products during the escape of decomposition gases through porous charred material.

Anup S has been pursuing investigations on the mechanics and physics of biological & bio-inspired composites. Under this, his research group made the following progress during the report period. (a) A work to understand the mechanical behaviour of nacre was carried out, where his group looked at the influence of nacre in the presence of defects, and found that the variation in mechanical properties could result from these defects. Such nacreous composites also suffer a large decrease in strength and toughness due to these defects. (b) Using molecular dynamics simulations, the mechanical response of bio-inspired brittle-brittle nano composites were investigated. The effect of aspect ratio, strain rate, interface strength and scale effects were studied. These results could pave the way for development of advanced composites; (c) the effect of structural arrangement on mechanical properties of CNT composites were also investigated. (d) An analysis to find the critical buckling load of dished shallow shells were carried out. With a view to help designers, the effects of various parameters were investigated under this. This problem is of relevance to space industry including ISRO where some of the components are made of dished shallow shells.

Arun C O along with his research students has been working on the development of numerical methods using wavelets. Wavelets are functions that satisfy certain mathematical requirements and are used in representing data or other functions. Wavelet based finite element is one such numerical method wherein, instead of using the traditional polynomial interpolation, scaling and wavelet functions of wavelets are used to form the shape functions. His current research intends to address the limitations of FEM and extend its capability to stochastic framework as well. Mechanical, Aerospace, Marine and Civil Engineering are some the areas of application of this work. Additionally, he is also developing a tool for solution of elastic buckling of columns with random material properties, using element free Galerkin method (EFGM). Arun's research has also been on the application of EFGM for 2D Nonlinear Static Problems, and on the development of a numerical tool based on EFGM to understand the effect of initial damage in buckling and bending. Concurrently, he is also investigating the wrinkling of thin plates subjected to tensile loading. A detailed examination of characteristics of wrinkling of thin plates was done numerically and experimentally. Different parametric studies have done and buckling coefficient curves have been proposed for plates having circular and diamond holes.

Praveen Krishna's research over the report period involved the aeroelastic analysis of Bending–Torsion wing, where a theoretical formulation for flutter analysis was utilized to develop a working method for determining flutter speed of a typical subsonic linear bending–torsion coupled aircraft wing. His group has also been working on the application of Element Free Galerkin Method (EFGM) in 2D nonlinear

static problems. Through this, they were also able to show that EFGM can be used as a numerical tool for solving two dimensional nonlinear static problems in solid mechanics. Praveen's group has also been studying oscillating airfoils in low speed flows. The main aspect of this work was to obtain the forces on pitching airfoil experimentally and validate these results analytically. NACA 0015 and NACA 0024 wings with different aspect ratios were fabricated for the experimental aspect of this study. Praveen's group has also been carrying out aeroelastic analysis of flapping wings. The purpose of this work was to obtain the lift on a plunging wing model, theoretically and experimentally. An experimental setup was designed to find the lift on a 2-D and 3-D wing executing pure plunging motion.

Bijudas C R is involved in research in the area of structural health monitoring with his post graduate students. Tomography of a cylindrical shell using guided waves is done using arrays of piezoelectric transducers. This work involves experimental study of guided wave propagation in cylinders, analytical investigations for dispersion relations in cylinders and numerical simulation of wave propagation. The results conclude that time reversed guided wave modes can be used for damage detection in cylinders. Another investigation regarding the non-linear interaction of de-bonded piezoelectric transducers is also done. Here the influence of modal characteristics of the transducers are studied to find the frequencies at which higher non-linear interaction occurs in terms of higher and sub harmonics of Lamb wave. Another current project is the design of the Ka band antenna for NRSC, Hyderabad. The design involves structural, thermal and aero-elastic studies of the antenna in the operating condition. The work is expected to propose new configurations and detailed design to meet the stringent requirements of high frequency signal reception.

Sam Noble was focused on the research related to suspension mechanisms for wheeled rovers. As a part of this, he has carried out (a) simulation studies on different configurations of wheeled rovers, (b) kinematic analysis and fabrication of variable diameter rover wheel, and (c) design and development of a six axis load cell.

MATERIALS, MANUFACTURING AND MANGEMENT

P Chakravarthy has been pursuing experimental studies on flux bounded tungsten arc welding, a variation of Activated TIG welding wherein a narrow strip of base metal is coated with activating flux and is exposed to the arc during welding. Bead on plate welds by FBTIG process on commercially pure aluminium plates were performed using silica as flux, under this project. The experiments were aimed to investigate the effect of flux gap and flux powder particle size on the weld penetration and depth to width ratio. Microstructural analysis was also carried out to understand the changes in grain structure in the weld pool and adjacent zones. It was observed that the weld penetration and depth to width ratio increased with the decreasing flux gap. Also, results showed better penetration for activating flux with finer flux powder size. The mechanisms that supported these observations have been demonstrated.

V S Sooraj has been working primarily on the (a) design and development of a low pressure abrasive flow finishing system, and the (b) design, development and

investigations on rapid prototyping (3D printing) systems. Under the former, a low pressure abrasive flow finishing system was developed at IIST and allied research is currently carried out using it. Using the FDM based rapid prototyping system in manufacturing processes lab of IIST, he was able to realize 3D rapid prototyped models for the wind tunnel testing of LVM III (GSLV-III), based on the design from Aero Entity of VSSC. Under a joint IIST-ISRO project, Dr. Sooraj and Dr. Praveen Krishna, in conjunction with Shri. Pradeep of IISU (ISRO) have initiated the development of a flexible open source 3D printing system to support the rapid prototyping of wind tunnel models and to meet the relevant reverse engineering requirements. Sooraj has also been involved in carrying out various investigations on advanced machining and finishing operations. Studies on the curl and spring behavior of CNC machined Beryllium Copper Chips using computational image/video analysis, Investigations on elasto abrasive finishing etc. are typical areas under this category. Another ISRO-IIST collaborative work of his, with Dr. Chakravarthy of IIST and Shri Mohankumar of CMSE is the machianbility on Silica Phenoic and Carbon Phenolic Ablative Composites.

Girish B S has been investigating a number of problems related to air traffic control, and aircraft scheduling. This includes the aircraft landing problem (ALP), which is a well-known NP-hard optimization problem in air traffic control, dealing with runway allocation, sequencing and scheduling of arrival aircrafts at busy airports. This problem has been researched for over two decades and the methodologies proposed in the literature include metaheuristic approaches such as Genetic algorithms, ant colony optimization, etc. Most of the existing approaches in the literature use MILP solvers (like CPLEX) to determine objective value for a fixed landing sequence and runway allocations. In his research work, a schedule generation algorithm was developed to determine the objective value, which was found to be almost 100-200 times faster than that obtained with CPLEX. A hybrid particle swarm optimization (HPSO) algorithm was proposed that effectively and efficiently generates solutions satisfying the constraints in the problem. The HPSO algorithm, which was implemented in a rolling horizon framework and with multi-threaded processing, outperformed all the existing approaches by a big margin in terms of both solution quality and computational time. His group has also been modeling the aircraft sequencing and scheduling problem based on the air traffic control operations at CSI Mumbai international airport. The developed optimization problem considers several real-life parameters and operational constraints of aircrafts sequencing and scheduling, which were obtained from Terminal radar approach control (TRACON) and Air traffic control tower (ATCT) of Mumbai airport. An MILP formulation was developed which was modelled and solved using CPLEX solver. Two metaheuristic algorithms, a GRASP and an ant colony optimization were developed to solve this problem. Girish's group has also generated a simulation model for reducing the the inter-arrival spacings between aircrafts so as to increase the runway throughput defined in terms of number of arrivals and departures per hour. The factors affecting the runway throughput were identified and their influences were quantified in this research.

4.2 Department of Avionics

Academic	Faculty	20
Technical	Staff	03
Students	Ph.D	26
	M.Tech	47

Research Activities

The research in the department fall under the broad categories of **virtual reality and 3D image processing, control system design, smart sensors, networking microwave circuits, antenna design, power electronics and drives, digital signal processing, virtual instrumentation, VLSI signal processing, smart systems, micro-nano electronics, micro-electro mechanical systems, and robotics.**

N.Selvaganesan has been working on fractional control design, the objective of which is to investigate the limit cycle performance of Fractional Order Controllers (FOC). He has also been investigating artificial intelligence based techniques for the prompt detection and diagnosis of faults in industrial systems, which is essential to minimize the production losses, increase the safety of the operator and the equipment. In this effort, he has generated an artificial intelligence based fault detection and control for a 6/4 Switched Reluctance Motor, Permanent Magnet Synchronous Generator, Deaerator in thermal plant and Heat exchanger systems. Selvaganesan is also leading an IIST-ISRO project on the design and development of brushless DC motor. This project focuses on the design and simulation of L110 EGC quadruplux torque motor which is used for PSLV/GSLV rockets. Additionally, he is also the principal investigator on another IIST-ISRO project on the modeling and controller design for micro actuators. Under this, the mathematical modeling of piezo proportional diaphragm valve was studied and verified through simulation.

Sam K Zachariah's research has been on the design of autonomously walking humanoid robots. The CAD model of humanoid having similar mass distribution and geometric dimensions of human counterpart has been generated. A novel walking control algorithm for planar biped over slopped terrain has also been formulated and validated on physics based simulation test bed. The algorithm, named *hybrid-state driven autonomous control* (HyDAC), has been extended for ascending and descending stairs with random dimensions and surface slopes. The stability and robustness aspects of HyDAC has been proved mathematically and demonstrated based on simulation model. The proposed algorithm is far superior to current biped control schemes reported in the literature. The future work concentrates on extension of HyDAC to 3D humanoid capable to walk over uneven terrain as in a planetary surface.

B S Manoj's interests include Computer Networks, Wireless Networks, Next Generation Internet, Complex Networks and Cyber Security. Two research labs viz., Systems and Networking Lab and the Cyber Security Lab were developed to cover these research areas. His research group has

been pursuing five major projects using these laboratory facilities, namely (a) an IIST-ISRO project on the development of an integrated enterprise network security, whose primary goal is to create solutions for detecting and providing enterprise network security from HSCMs, botnets and future threats by using a combination of techniques that span machine learning, signal processing, information theory, deep packet inspection, data and traffic finger printing and network data traffic analysis; (b) an Indo-US collaborative research on Pervasive Computing for Disaster Response whose objective is to support improved information flow in evolving disaster situations through distributed sensing, processing and dissemination capabilities; (c) an ITRA funded collaborative project named MICRONet (Mobile Infrastructure for Coastal Region Offshore Communications & Networks) that aims at studying the characteristics of wireless propagation over sea for long-range communications in order to develop a wireless mesh network to cover a distance of 50-100 Km from sea shore. The purpose of such a network is to provide a communication system that can greatly benefit the fishermen community in India, specifically in Kerala. Another project, jointly undertaken with fellow colleague Vineeth B. S., deals with studying the interplanetary communications environment and arriving at algorithmic and protocol solutions for efficient communication. This project aims at the development of algorithms which route and schedule packets between multiple source-destination pairs to optimize quality of service (QoS) metrics for delay tolerant interplanetary networks.

The Virtual Reality and Image Processing Lab (VRIP lab), headed by **Deepak Mishra**, has been working in the areas of image and signal processing, machine learning tools & techniques, and virtual reality. The members of the lab are presently working on signal tracking approaches for phase estimation, deep learning and machine learning applications, computer vision tracking for surveillance applications, and compressive holography. Recent work in the report period includes development of deep leaning architectures for watermarking applications, image fusion, and tracking of objects in a sequence of videos, content based retrieval and copy detection. The lab has also recently proposed a robust integrated tracker which got short listed in the VOT 2016 challenge as one of the best trackers. The lab also works on bio-inspired computing and on various problems related to computational neuroscience & neuroinformatics. The VRIP lab is currently involved in a IIST-ISRO joint project for developing a virtual reality model for disaster simulation, primarily flood water inundation based on satellite images and Bhuvan maps. Work is also actively underway in another IIST-ISRO joint project that uses object-based change detection techniques for identifying landslide scars, and hotspots by monitoring land use.

H Priyadarshnam's research interests are in the design, modeling and development of control systems. His research group is currently developing a tactile sensor for an underactuated robotic arm designed by the Vikram Sarabhai Space Center. The project involves modification of the existing design, fabrication of new components, and the development of a fail-safe control algorithm for an under-actuated robotic hand. He is also heading two IIST-ISRO projects, which involves the (1) development of reaction wheel hardware and interface system for small satellites, and (2) the design and development of standards for various subsystems of small-

satellites in the Indian context and carry out scientific experiments in space at regular intervals.

Basudeb Ghosh is currently working on the design of multiband reflector antennas for satellite data reception. This work done in collaboration with ISRO-NRSC Shadnagar is leading towards a modified design of reflector antennas working in the S, X and Ka bands, which will be efficient both structurally, considering extreme weather conditions in Hyderabad, and also performance-wise. In addition Basudeb is also working on the design and analysis of leaky wave antenna, with particular focus on the improvement of open stop band suppression method for such antennas.

Lakshminarayanan Raghavendran's interests are in the development of various signal processing algorithms. In the report period, he has developed new algorithms for tracking and estimation of time varying sparse signals, with particular focus on the development of recovery algorithms with reduced complexity for practical applications, an area that has not been addressed adequately by researchers. He has also been working in collaboration with ISRO for the (1) development of turbo encoder and decoders for ISRO space missions and (2) development of tracking algorithms for multi object tracking radar developed by SHAR.

Rajesh Joseph Abraham's research group looks into the mitigation of issues in smart Grids with renewables integration. Depletion of fossil fuels and growing concern about environment has resulted in integrating more and more renewable energy sources into the smart grid. Further, two way communication between the energy supplier and the customer and smart meters have brought in economic aspects in power generation and distribution which needs further investigation. The intermittent nature of renewables pose further threats as far as stability is concerned. The group is actively investigating different aspects of smart grids such as frequency stabilisation using energy storage devices, design of stabilisers for voltage stability, optimal placement of distributed generation etc, with one doctoral student about to graduate in this area and another pursuing doctoral studies.

Sheeba Rani's research is on developing high performance hardware algorithms and architectures for signal/image processing applications. Her group has developed novel pipelined parallel architecture in FPGA for non rigid body motion estimation. At present the focus is on developing cloud motion estimation and tracking algorithm and improving the performance by introducing hardware accelerators for highly computationally intensive task which will be reducing the time of climate prediction, weather forecast during natural calamities such as cyclone/flood. The group also works on developing ASIC based designs such as sigma delta modulator ADC, instrumentation amplifier and FLASH ADC in collaboration with SCL Chandigarh for fabrication.

Seena V's interests are in MEMS and Nanoelectronics. She is the principal investigator on a joint ISRO-IIST project for the development of MEMS accelerometer with ultra-sensitive transductions for space applications. Under this, a MEMS accelerometer with lowest cross axis sensitivity has already been designed, simulated and modeled. A novel nonplanar multi flexure silicon MEMS with piezo resistive transduction has also been designed for the first time. The work is in progress towards fabrication of these

devices. Concurrently, her group is also leading an effort for the development of an electromechanical transduction for nanomechanical sensors. Seena is also pursuing research funded through the Science and Engineering Research Board (SERB), DST, Govt. of India's excellence award on the development of a novel polymer nanomechanical sensor platform with integrated ITO strain gauge for electrical transduction. With simple and cost effective polymer MEMS process integration, low temperature deposited ITO has already been incorporated for electromechanical transduction of SU-8 nanomechanical devices.

Rajeevan Puthen Purayil works in the areas of power electronics such as power converters and PWM techniques, control of electric drives, and renewable energy. He is involved in the development of new topologies of multilevel power converters and pulse width modulation techniques with specific emphasis on applications in the areas of drives, power quality improvement and renewable energy. He is also working on new schemes for control of current source inverter fed induction motor drives with open-end stator windings. Another ongoing research is the development of control schemes for multiphase drives with number of phases more than three, for space applications. Multiphase AC drives are potential candidates for space applications due to their inherent advantages compared to the standard three-phase drives such as the enhanced fault tolerance, higher power density, higher efficiency, higher torque density, reduced torque pulsations etc. In the field of renewable energy, he is involved in the development of dual converter based systems for maximum power point tracking and control of power flow in stand-alone as well as grid connected solar photovoltaic energy sources.

Chinmoy Saha's research is in printed microwave circuits and antennas. With collaborators, he has proposed new techniques of designing frequency notched ultrawideband antenna. This technique doesn't impact the impedance and radiation characteristics of the antenna excepting the desired notch frequency and applicable on various microstrip/CPW fed printed antennas. The findings are being used for new generation ultra compact UWB antennas. His group has also improvised design for multiple notched UWB antennas and multifunctional antennas. A completely new concept of reconfigurable antenna design has been proposed. These antennas can provide various complementary antenna functionality (UWB/Frequency Notched UWB/Narrow band) evolved from a single radiator by combinatorial actuation of various resonators and switches. Such antennas have the potential for applications in software defined radio (SDR) and cognitive radio (CR) environment. Along with these, his group has also shown a new technique to enhance mutual isolation between multiple antennas in MIMO environment. This technique is versatile and can be applied on various antenna geometries. Chinomy is leading a IIST-ISRO collaborative project on the design and implementation of a compact widebad microstrip patch antenna.

Harsha Simha's research is in the areas nonlinear dynamical systems and control. Autonomous rendezvous and docking is a key technology for many complex space missions. It requires complicated and precise transnational and rotational maneuvers whose dynamics are coupled. Conventional control methodologies which neglects this coupling between

transnational and rotational dynamics are unsuitable for precise control. Harsha's research is to model the coupled attitude and transnational dynamics in the framework of geometric mechanics, where his group is coming up with control algorithms to achieve precise and fast maneuvers. He is leading an ongoing joint IIST-ISRO effort for the simulation and development of ADCs and sensor technologies for docking of quad-copters which can later be used for developing and testing of ADCs for docking of autonomous spacecrafts in space.

Palash Kumar Basu's research are in the development of nanotechnology based gas sensors, biosensors and flexible electronics. The availability of gas sensors suitable for space applications is very limited. In this context, Palash's group is trying to investigate low weight, high performance nanostructure gas sensor array on flexible substrate at room temperature where each element of the array will be functionalized by required nano materials (metal 0xide with catalyst) to enhance the performance of the sensor. The group is also working on THz detectors. A high sensitivity, low power (~1μW to 10 μW), room temperature, antenna coupled, THz (0.8 THz) detector has been developed by means of field effect transistor (FETs) fabricated on epitaxial-grown graphene on silicon carbide. Palash is also the principal investigator on a joint IIST-ISRO project for the design and fabrication of grapheme based RF transistor for eventual space applications. Concurrently he is also leading another effort for the development of high performance hydrogen sensors to reduce or avoid hazardous events which could hinder the implementation of hydrogen fuel.

Anindya Dasgupta is currently leading a joint IIST-ISRO effort to study switching topologies and control schemes for isolated DC-DC power converters. During the report period, the Phase I of this project has been completed, which involved the identification of prospective topologies with numerical simulation without considering effect of parametric uncertainties on switching delays.

Sooraj Ravindran's research is on developing optoelectronic and photonic devices for communication, computing, sensing, energy harvesting and lighting. Currently he is working on developing energy efficient optical switches, modulators and logic gates having micro-ring resonator/directional coupler configurations especially looking at their integration prospects on Photonic Integrated Circuits (PICs), and investigation of slow light propagation in microring resonator structures. The focus is also on developing microring resonator based gyroscopes for navigational applications. He is leading an effort to design active and passive optical waveguides for high-speed optical interconnects for use in launch vehicles so as to replace the conventional copper cables and thereby enable high-speed data transmission.

Sanjeev Kumar Mishra has been working on Microstrip Antennas and Circuits. The area of printed microwave circuits and antennas has attracted the attention of antenna researchers over last two decades. Recent surge in wireless communication demands new antennas which will satisfy the requirements for these services. Considering this latest trend and requirements designed and development of various new microstrip antennas has been conceived.

Vanidevi M is interested in the development of signal processing techniques. In cellular networks, the massive MIMO architecture proposed for 5G communication consists of a base station equipped with a very large number of antennas serving multiple single-antenna users simultaneously. The increase in the antenna at the base station exploits the additional spatial degrees of freedom to multiplex data streams for several users on the same time-frequency resource, to maximize the beamforming gain by focusing the radiated energy towards the intended receivers and to minimize the intra-/inter-cell interference by using detection and precoding algorithms. Therefore, her research focuses on the development of the signal processing, detection and estimation technique in the receiver. It includes uplink/downlink channel estimation problem (in both TDD and FDD mode), uplink detection and downlink precoding schemes.

Vineeth B S's research activities are on building optimized protocols and algorithms for communication and senor networks for improved communication, estimation and detection performance. Analytical tools and simulation software to aid in this purpose were developed during the report period. Low complexity threshold control policies for active sensors for fast and energy efficient detection of changes in sensor networks have also been realized in the recent past. He has also developed analytical algorithms to optimally add links to a communication network to minimize the average path length of networks. Another recent research contribution has been the development of joint compression and scheduling algorithms to optimally compress data and schedule data transmissions for power constrained communication networks, which achieve an average delay performance an order of magnitude better than previously known algorithms. His current research is also on the development of software simulators for analyzing communication network performance for small satellite networks. Vineeth is the principal investigator of an ongoing joint IIST-ISRO project, in collaboration with ASTDC, to develop a multiple target tracking and trajectory prediction algorithms to be used in multi-object tracking radar. Towards this, a software simulator for simulating the detection data obtained by the radar as well as a software prototype of the multi-target tracking system was developed in the report period.

Chris Prema's work is in wideband spectrum Sensing using polyphase filter banks for cognitive radios. Recently she implemented a low complexity multistage polyphase filter bank (MPFB) for the detection and estimation of center frequency of wireless microphone (WM) in television (TV) channels for cognitive radio (CR) applications. In this work, a mathematical expression for calculating the center frequency of WM from the subband energy (power) using centroid method was derived. In IEEE 802.22 WRAN standard, spectrum sensing has to be done to allow television (TV) services and wireless microphones (WM) to coexist. WM are low power licensed users and are allowed by federal communications commission (FCC) to operate on vacant TV channels without causing interference. The TV channels can be utilized fractionally when the exact position of the WM is detected. The multistage polyphase filter bank with the centroid method detects the exact position of the WM such that the TV channels can be utilized fractionally. Research is in progress to detect multiusers and estimating the spectral edges.

4.3 Department of Chemistry

Academic	Faculty	10
Students	Ph.D	22
	M.Tech	12

Research Activities

Research activities of the department include **nanomaterials, materials for energy applications, sensors, polymeric materials, biomaterials, functional materials, composites and high temperature materials.**

Kuruvilla Joseph's research group's activities include (a) the development of new *structural epoxy nanocomposites*with high toughness as well as mechanical strength suitable for space applications, (b) the development of *polyimide nanocomposites* for space applications where they could show improved transparency, flexibility and electrical conductivity with electrostatic charge mitigating properties, (c) the development of High Performance in-situ conducting Microfibrillar Composites which are found to have good conductivity and mechanical properties than the basic MFCs. In addition, the group has also developed recently gold nanoparticle based colorimetric sensor for naked eye detection of cholesterol in human blood, fructose in semen samples and E.Coli bacteria in UTI patients. Followed by the colorimetric sensor they have also developed a fluorescence sensor for Alzheimer's disease using bovine serum albumin (BSA) protected atomically precise clusters of gold. Recently, a blood creatinine sensor using protein protected gold quantum clusters was also developed by his research group.

Nirmala Rachel James's research is primarily in the development of polymeric materials for medical application. Recently, her group could successful use polyelectrolyte complex based on polysaccharides for enhancing the solubility of curcumin leading to the efficient drug delivery. Polymer-drug conjugate and nanogels have also been developed in her lab for drug delivery applications. The group also works on nanofiber composites. Polyurethane nanofibers generated using electrospinning was used for preparation of composites with resorcinol-formaldehyde resin. The composite showed improved thermal and mechanical properties. The feasibility of using crystalline polymers to functionalize carbon nanotube (CNT) via CNT-induced polymer crystallization was also investigated in the recent past. Modified CNT without sacrificing the beneficial properties of CNT was then used as precursors to form electrospun composite nanofibrous mat.

Honey John's research work includes synthesis, characterization and various property evaluations like electrical properties, microwave properties, nonlinear optical properties etc. Her group works in the area of synthesis of polymers, nano materials, processing of nanomaterials etc. She has guided three thesis works based on graphene/CNT/polyanilinenanohybrids for various applications and B.Tech /M.Tech projects/internship projects etc in the areas of Super capacitors, DSSC, EMI shielding, nanohybrids etc. Her research papers in reputed international journals are

primarily related to photoconductivity, photocatalysis, electrical and electronics properties etc

Gomathi N's research group works on the synthesis and functionalization of graphene based materials through plasma functionalization. The group is also working on *in-situ* chemical reduction to obtain hybrid materials of graphene with other nanomaterials and identify their applications on sensing of various biological analytes such as ascorbic acid, dopamine, uric acid, glucose, etc. The group also focuses on enhancement of dispersion of carbon nanotubes (CNTs) in the polymer matrix and improving the interfacial interaction between the nanomaterial and the matrix in a composite. Plasma functionalization of CNT is used to reduce the surface inertness and enhance the dispersibility and interfacial bonding of CNT through increased chemical affinity with surrounding polymer matrix i.e. cyanate ester which can be used for satellite structural applications.

Sandhya K Y's research is on developing materials for energy applications. Tapping of energy from renewable sources calls for energy storage in huge capacity and this has drawn the attention to developing new batteries and new electrode materials with higher specific capacity such as advanced lithium-ion batteries. Her group is working on (i) electrode (anode) materials with higher capacity for lithium-ion batteries,(ii) photoharvesting materials: TiO_2-based composites for visible light photocatalysis, (iii) electrodes for electrochemical sensing of analytes. Further areas of interest are functional nanomaterials for CO_2 adsorption, pollutant removal by adsorption, etc.

Prabhakaran K is interested in development of light weight high temperature materials of low thermal conductivity for thermal protection applications. His lab is engaged in developing novel processing methods for preparation of carbon and ceramic foams to achieve this goal. As far as possible we try to replace the fossil fuel based chemicals with natural renewable materials of plant origin as precursors/processing additives for the preparation of carbon and ceramic foams for environmental friendliness and sustainability. The lab is also working on the development of novel carbon based sorbents of high CO_2 adsorption capacity from bio-mass for CO_2. The materials will be a candidate for CO2 removal from manned crew cabins in space shuttles and submarines.

Mary Gladis's research interests are also in developing materials for energy applications. The lithium-sulphur (Li-S) batteries have been considered as the most promising next generation Li batteries for high energy density applications to satisfy the high-energy demandsof electric vehicles (EVs) and sustainable energy-storage systems. Sulphur has several drawbacks such as poor conductivity, large volumetric expansion upon lithiation and dissolution of the intermediate polysulfides during charge-discharge processes. Strategies adopted by her group to address the above challenges are(i) using low cost, high surface area mesoporous carbon matrix from biomass to trap sulphur and to reduce the shuttling of polysulphides during cycling (ii) combining sulphur with conducting substrates like mesoporous carbon, polymer material and CNTs to improve the electrical conductivity of cathode material and to ensure active utilization of the material and (iii) employing hetero atoms doped porous

carbon to trap the polysulphides to improve the rate capability.

Sreejalekshmi K G works in the development of functional organic materials. The exploration of chemical space around 1,3-thiazole core for the development of theranostic agents is one of the prime focus of research in Organic Chemistry. Synthesis of novel class of molecules in 4-hydrazinothiazole family has already been established by her group and currently the utility of N-rich heterocycles in a fragment based anticancer drug discovery is being pursued. The molecular docking in kinase proteins and prediction of drug likeness is being carried out in her lab to assist small molecule drug design. Yet another research area actively pursued by her group is in the development of multicore heterocycles, exemplified by the design and synthesis of 5-(thiophen-2-yl)-1,3-thiazole core. Using density functional theory the charge carrier mobility in the systems wererecently studied and a facile and versatile [4+1] ring synthesis route was established. The thienylthiazole core accommodated tunable handles at C2 and C4 and photophysical properties evaluation proved them to be the smallest solid state red emitting molecules with positive solvatochromism, large Stokes shift and aggregation-induced emission (AIE) behaviour.

Chemical sensors group, led by **Jobin Cyriac,** is interested in developing nanomaterials based chemical sensors for small molecule detection. The methods adopted towards this goal include fluorescence based methods, surface enhanced Raman spectroscopy (SERS) and mass spectrometry. The group recently demonstrated easy and effective detection of various molecules such as PETN, RDX, ammonia, metal ions, etc. using fluorescent quantum dots. SERS based sensors were developed in a flexible substrate platform for the effective in situ detection of explosive and pesticides.

Mahesh S works on functional materials. Recently his group reported a simple and cost effective method for the synthesis of graphene quantum dots (GQDs) from easily available bioresource-Honey. Interestingly these fluorescent GQDs can be used as a security ink for currency counterfeit. Development of functional materials from plant/crop based feed stocks is another area of interest for his group. Photoswithable molecule has been developed from Cardanol, a byproduct of cashew. The molecule can undergo self-assembly leading to the formation of nanospheres and these can transforms to microspheres upon light exposure. This is an example of light induced size variation at nanoscale.

4.4 Department of Earth & Space Sciences

Academic	Faculty	16
Students	Ph.D	18
	M.Tech./MS	31

Research Activities

The department has on-going research in such diverse disciplines as **astronomy and astrophysics, atmospheric science, geology and planetary sciences, and remote sensing.**

The faculty in the astronomy & astrophysics group of the department has been pursuing the following research activities.

A.Chandrasekar's research is on improving the model forecast by adding time dimension in the traditional variational data assimilation system, which is generally known as four dimensional variational data assimilation system. Recently, the group is involved in quantifying the impact of assimilation of radiance from ISRO/non-ISRO satellites in improving the weather forecasts over Indian subco ntinent.

Anandmayee Tej's research primarily focuses on high-mass star formation and their interplay with the surrounding interstellar medium. Her work is observational based where the national facilities like the Giant Meterwave Radio Telescope, Himalayan Chandra Telescope and Mount Abu Infrared Telescope are extensively used. Her research group is currently involved in detailed study of Infrared Bubbles which are the observational manifestation of the radiative and mechanical feedback of massive stars. The group is also trying to understand the nature of Extended Green Objects which are signposts of the early phases of massive star formation.

Anand Narayanan's interests are in modelling the physical conditions of diffuse gas in the extended halos surrounding galaxies and the intergalactic medium. In the report period, his group, using data from the Hubble Space Telescope, reported the detection of a large reservoir of dark baryons near to a concentration of galaxies in a far away location of the universe. This work is relevant in the context of global efforts to map the distribution of ordinary matter in the universe over its last 10 billion year history. Presently, he is pursuing work along similar lines through a larger spectroscopic survey of distant quasars.

Jagadheep's research interests are in observational studies of early phases of high mass star formation. In the report period, he worked on the hierarchical mass distribution and fragmentation from large scale clumps to small scale cores of young regions of high-mass star formation. When extended to a large sample of sources, this work is expected to help distinguish between competing theories of high-mass star formation. He is also part of an international collaboration carrying out a large survey of the plane of the Milky Way at radio wavelengths with the aim of obtaining a global picture of star formation in our galaxy.

Samir Mandal's major research interests are accretion physics around compact object objects, radiation hydrodynamics, particle acceleration across shocks, analysis of X ray data from different space mission. Recently, his group has been working towards forging a better understanding of the behaviours of the outbursting sources (compact sources show sudden enhanced X-ray activity) by analyzing the X-ray timing and spectral data.

Sarita Vig's research interests include investigation of early stages of massive star formation using tracers such as HII regions, that result from the direct interaction of these infant stars with the surrounding interstellar medium. The group's work during the report period relates to probing HII region complexes in extensive detail including detection of non-thermal emission from HII regions that are traditionally believed to be largely thermal in nature. The work plays a role in

improving our understanding of the emission mechanisms in HII regions as well as in augmenting the current insight regarding the formation of HII regions. The body of work relies on data obtained from the Giant Metrewave Radio Telescope (GMRT), India apart from various scientific missions and surveys.

In addition, the astronomy & astrophysics group has also been pursuing the following joint collaborative efforts.

The Square Kilometre Array (SKA) is the next generation radio telescope of extremely high sensitivity (50 times better than that of the current biggest radio telescope) and angular resolution. The astronomy group of the Department of Earth & Space Science of IIST joined the SKA-India consortium in October 2015 as a full member. This is expected to improve the visibility of IIST since it can act as a regional nodal centre for scientific users of this upcoming global facility. The SKA project is managed by an international consortium of 11 member countries. India is a full member of this international consortium. The SKA-India consortium has been created to oversee and coordinate activities related to the SKA project by the Indian scientific community.

The astronomy group of the department also has members in the Training & Outreach Team (TOT) of the ASTROSAT mission. The TOT is responsible for the educational and public outreach activities associated with this multi-wavelength astronomy mission, which is ASTROSAT. The team is responsible for conducting workshops across the country for promoting the scientific user base for high energy astronomy data. At an equally important level, the TOT is planning to have programs promoting scientific literacy among school children and the public through wide range of educational outreach activities. During the report period, the IIST members of the TOT were actively involved in the scripting and discussions of the documentary that was brought out by DECU-ISRO. IIST also played a key role in the design and production of educational posters, for public distribution, describing the scientific instruments on ASTROSAT and their broad science goals.

The atmospheric science group of the department is involved in both theoretical and observational aspects of weather and climate studies.

The Ponmudi observatory headed by **M.V. Ramana** is actively pursuing research in the fields of Aerosol-Radiation-Cloud-Climate interactions and atmospheric boundary layer.The uncertainty of the impact of anthropogenic aerosols on clouds and precipitation has proven to be one of the biggest obstacles to understanding global climate change. This is, in part, because there are so few in-situ observations. To address these challenges, continuous measurements are carried out over Ponmudi by setting up an observatory with suit of Aerosol-Cloud instruments. These measurements were able to contrast natural and anthropogenic aerosol populations, and quantified the natural and anthropogenic Cloud Condensation Nuclei (CCN).Its impact on cloud droplet concentrations is in progress.Also, an instrumented 10-meter Meteorological tower was successfully installed at Ponmudi in 2015 for continuous turbulence measurements to understand the role of turbulence in orographic clouds versus stratocumulus clouds versus cumulus convection.Continuous measurements carried out at this observatory during 2015-16 are turbulence, solar radiation, aerosol concentration, CCN and cloud droplet

concentration (i.e., drop size distribution). In addition, continuous Carbon Dioxide (CO_2) measurements are also carried out at Ponmudi observatory as a part of National Carbon Project.

Moreover, the analysis of the scientific data collected over southern Bay of Bengal as part of CTCZ cruise campaign; has shown that the aerosol plumes from maritime ships produced severe pollution along the international shipping route (i.e., 5-6^{0}N).The analysis showed that the estimated BC heating rates for 0.5-3.0km layer for relatively-clean and polluted-shipping locations to be 0.01 and 0.11K/day, thus a south-north gradient of 0.1K/day. Emissions from commercial ships over southern Bay of Bengal were directly heating the lower troposphere by factor of ten, increasing the CCN by one order of magnitude and lowering the CCN efficiency from 0.56±0.06 to 0.2±0.1. The effects seen here may have significant impact on the convection and implications for climate mitigation strategies. Soil moisture retention with rainfall is documented using the automatic weather station data collected at IIST.

The atmospheric science group, in collaboration with NRSC centre of ISRO, has initiated research on quantifying the effect of change in land use patterns (afforestation/ vegetation) on the precipitation with a special focus on regional climate of Indian subcontinent. Such a study has significance in the wake of concerns of increased human influence over the change in the land use patterns. The satellite based vegetation index from Advanced Wide Field Sensors (AWiFS) from ISRO satellites will be used to identify the changes in the vegetation and its implications in the evolution of atmosphere.

Rajesh V J's research includes deep crustal processes during the evolution of Archaean Nilgiri block, southern India
Funding Source: Ministry of Earth Sciences (MoES)
Role: Co-PI in collaboration with Centre for Earth Sciences, Indian Institute of Science, Bangalore.

Earth's crust which consist of continents and oceanic basins is a part of a complex system that has evolved over the last ~4600 million years (Ma). The evolution of planet Earth took place through a series of interactions involving the core, mantle, crust and atmosphere. However, only limited remnants of the early crust remain because of the extensive reworking. Consequently, in order to understand the crustal evolution of the early Earth in general and the formation, growth and evolution of continents in specific, it is crucial to investigate these early continental crust relicts from the standpoint of both their formation and subsequent modification during later continental crust accretion. This study includes understanding the evolution of Nilgiri Block (~2500 Ma), southern India using petrological, geochronology and rock magnetic tools. This study would provide a complete picture of evolution of the Nilgiri Block and thereby gain greater insight into tectonic events during the formation and evolution of an Archean crust.

Study of Moon and Mars analogues: Investigations on orthopyroxene-olivine-spinel (OOS) group of minerals and cumulate rocks in India based on remote sensing, mineralogical and geochemical methods
Funding Source: Indian Space Research Organization (ISRO)
Role: PI in collaboration with Space Application Centre, Ahmedabad.

The mineralogy and mineral composition of planetary samples contain a rich record of the thermal and chemical evolution of the planetary body. These processes produce distinct signatures in the mineral assemblages and compositions produced across a range of depths and across the body's surface. While the record can be complex, the composition and mineralogy of planetary samples represent one of the most powerful tools available for unravelling the geologic history of a planetary body. The uppermost mantle of the Earth, the Mars and the Moon consists of only four major minerals, namely, olivine, clinopyroxene, orthopyroxene and spinel (chromite/chromian spinel). During the early stages of evolution of a terrestrial planet, energetic impacts, radioactivity and core formation creates one or more whole or partial silicate mantle magma oceans. Understanding their mineralogy and chemistry is significant in providing clues to the planetary evolution. The spectral reflectance property of minerals comprising mantle cumulates in compositional space is therefore important to examine in conjunction with compositional and structural information in order to derive systematic and quantifiable spectral-compositional relationships. Such relationships could allow the presence, abundance, and composition of these minerals to be determined from optical remote sensing data. This would enable petrogenetic conditions to be assessed for inaccessible targets such as the Moon, Mars, and the asteroids and aid terrestrial geological exploration and mapping based on optical remote sensing of such targets.

Geological and spectral studies of terrestrial analogue rocks: Implications for Mars exploration

Funding Source: Indian Institute of Space Science and Technology (IIST)
Role: PI in collaboration with Dr. Gnanappazham, IIST

Planetary analog research is an important topic in planetary geoscience both in terms of planetary origin and evolution and in the preparation and result interpretation of robotic exploration to support future manned missions. Overall the past decade, much attention has been drawn to potential research on terrestrial analogue sites for Mars and Moon on Earth. The analogue sites on Earth provide us with resources and data that can be used as ground truth for satellites and other training purposes. For example, Mars may have been, in some ways, similar to ancient Earth, and that is what makes it an intriguing planet. To understand the processes on or the evolution of one solar system object, frequently the Earth's surface and objects (like rocks and minerals) are to be compared and studied. Several landforms/terrains which show similarities with Martian landforms will be studied in terms of mineralogy and morphology to get a better understanding of Martian geological processes.

The geology lab, headed by **Rajesh V J**, has been actively pursuing several research problems in Earth and planetary geology. Over the report period, his research group has been trying to understand the evolution of Nilgiri Block (~2500 Ma), of southern India, using petrological, geochronology and rock magnetic tools. This work, when completed, would provide a complete picture of evolution of the Nilgiri Block and thereby gain greater insight into tectonic events during the formation and evolution of an Archean crust. More broadly, such investigations are crucial to forge a better understanding of

the crustal evolution of the early Earth in general and the formation, growth and evolution of continents. Additionally, Rajesh's group is also leading the effort on a project in collaboration with ISRO-Space Applications Center, Ahmadabad, to study the orthopyroxene-olivine-spinel (OOS) group of minerals and cumulate rocks in India based on remote sensing, mineralogical and geochemical methods. This work is meant to enable the petrogenetic conditions to be assessed for inaccessible targets such as the Moon, Mars, and the asteroids along with aiding terrestrial geological exploration and mapping based on optical remote sensing of such targets. Concurrently, in collaboration with L Gnanappazham of the remote sensing group of IIST, Rajesh has been pursuing geological and spectral studies of landforms/terrains on Earth which show similarities with Martian landforms to get a better understanding of Martian geological processes.

The remote sensing group of the department has been pursuing the following research activities.

L. Gnanappazham's interests are in the application of remote sensing and GIS technologies in the management of natural resources, with special focus on coastal zones and mangroves. In the report period, her group carried out field based and satellite based Hyperspectral data analysis to study the different species composition of mangroves of Odisha. Statistical analysis and image processing algorithms were applied to spectrally discriminate about 34 mangrove species. The spectral transformation such as continuum removal and inverse spectra and combination of both were derived and analyzed using multiple statistical approaches followed by popular feature reduction methods such as Principal Component Analysis (PCA) and Stepwise Discriminant Analysis (SDA) to select optimal wavelengths for species discrimination. Such wavelengths are used to classify the Hyperion hyperspectral satellite data using multiple classification system to improve the classification accuracy from those of base classifiers to map more number of species which was not accomplished using multispectral data such as Landsat 8 OLI and IRS P6 L3.Urban modeling is yet another research on GIS based Cellular automata and Artificial Neural Network Modeling. This study is currently being taken up for modeling the urban sprawl of Chennai metropolitan city using temporal remote sensing data and spatial parameters which will be the key factors determining the urban growth such as transportation, industrial development, population growth, migration, income, and land value.

Rama Rao Nidamanuri's research is on hyperspectral remote sensing, which is an advanced broad spectrum space technology tool for detection, identification, and quantification of surface and sub-surface materials. The research carried out during report period have mostly been aimed at developing novel algorithms, methodological frameworks, and implementation modules for the processing and analysis of hyperspectral images for several applications of interest. In addition, a new direction in the research on hyperspectral imaging, fusion and integration of hyperspectral imaging with high performance laser scanning, has also been undertaken in order to widen the application base of present and future hyperspectral satellite missions. Several undergraduate and post-graduate theses works were carried out under this. Rama Rao's group and collaborators have also been active in national scientific

infrastructure development in the hyperspectral remote sensing by the Department of Science and Technology, Government of India, a Central Facility on Hyperspectral Remote Sensing is being set up in IIST. This facility will cater to the laboratory needs of interested faculty and students across universities/colleges in south India.

Gorti R K S S Manyam has developed signal tracking approaches based on adaptive filters for phase estimation from Digital Holographic Interferometry data, which enables 3D extraction at microscopic level from highly noisy and rapidly varying fringes. His research has also produced a novel framework for unstained Leukemia cell segmentation and classification from imaging flow cytometry data. This framework eventually results in a cost effective mass cancer screening. He is currently working on the development and application of active learning, transfer learning and deep learning techniques. He has also developed Convolutional Neural Networks (CNN) based generic satellite image segmentation and is currently developing rotational invariant CNNs. He has recently proposed a robust integrated tracker which is short listed in VOT 2016 challenge as one of the best trackers. In addition, he is leading several ISRO-IIST joint projects on (1) object based high resolution image analysis for land slide classification, an ongoing effort with NRSC, (2) vibration data analysis technique for finding patterns, features that help for automatic classification of normal and faulty satellite structures, in conjunction with the VSSC, (3) a virtual reality model for disaster simulation and a (4) gate based approach for online simultaneous tracking of satellites, in collaboration with SDSC SHAR.

V Poompavai was actively involved in the processing of RISAT-1 SAR (Synthetic Aperture Radar) data in different imaging modes to generate backscatter co-efficient values (sigma nought). Application of various speckle suppression filters (Lee, Lee sigma, Frost, Boxcar, Gamma MAP) for reduce noise and enhance SAR image.

Govindan Kutty M is working on improving the forecasts from weather models using advanced methods in data assimilation Such as Ensemble Kalman Filter (EnKF). Of late, the group has successfully tested the impact of flow-evolving error covariance in variational data assimilation system, which is found to be beneficial in improving the track forecast of tropical cyclones formed over Bay of Bengal. This work is in collaboration with National Atmospheric Research Laboratory (NARL), Gadanki.

Resmi Lekshmi's research interest is primarily in the field of High Energy Astrophysics, focusing mostly on the physics of Gamma Ray Bursts and Blazars. She investigates the structure and evolution of Gamma Ray Burst jets through theoretical predictions of GRB afterglows and interpretations of multi-wavelength afterglow data. Since the last couple of years she has started to focus more on the properties of short duration Gamma Ray Bursts, thought to be originating from merger of binary compact objects.

Ambili K M is working in the field of planetary atmosphere and ionosphere, specifically on the theoretical modelling of equatorial and low latitude region of Earth's ionosphere. Her work makes use of space borne and ground based radio and optical instruments, such as Incoherent Scatter radar, GPS Satellites, Ionosondes, Magnetometer and multi-wavelength day glow photometer. During the annual report period, her work with collaborators was

mainly focused on the following : (a) development of a photochemical model for the lunar ionosphere, (b) morphological features of the plasma irregularities estimated using geostationary satellites, (c) variabilities in the total electron content across Indian sub continent during geomagnetic storm events, (d) development of a quasi-two dimensional First Principle Ionospheric Model for low latitude region, and (e) photo chemical model development for Venus and Mars. Using Chandrayaan – 1 radio occultation measurements, she has made important breakthroughs in our understanding of the origin of Moon's ionosphere.

Ramiya A. M.'s research is in the area of LiDAR Remote Sensing of earth surface features with particular emphasis on 3D semantic labeling of LiDAR point cloud. The current thrusts of her work are in 3D point cloud segmentation, 3D feature extraction and labelling, and multisensor fusion (especially with hyperspectral and multispectral data). The research is motivated by practical utility of LiDAR technology for earth resource management particularly focusing on 3D smart city modeling, urban forests, and structural parameters estimation from vegetation point cloud.

Ongoing Research Collaborations (National): Rajesh V J

Sl.No.	Name and Address of Scientist	Topic of Collaboration
1	*Dr. Sajeev Krishnan*, Centre for Earth Sciences, Indian Institute of Science, Bangalore, India	(i) Mapping (Geological and Remote Sensing) of suture/shear zones in South India. (ii) Petrogenesis of mafic-ultramafic rocks in South India
2	*Dr. Prakash Chauhan* and *Dr. Satadru Bhattacharya* Space Application Centre, Ahmedabad, India	Planetary Geosciences and Planetary Analogue Research
3	*Dr. Dwijesh Ray*, Physical Research Laboratory, Ahmedabad, India	EPMA analyses of geological samples
4	*Dr. V. Nandakumar*, National Centre for Earth Science Studies, Thiruvananthapuram	Laser Raman Analyses of Geological Samples

4.5 Department of Humanities

Academic	Faculty	05
Students	Ph.D	11

Research Activities

Research activities of the department are in the areas of sociology, economics, management, digital humanities, visual communication, and gender and gender studies.

Research work in management by **V Ravi** is mainly focused on supply chain management, reverse logistics and new product development. In supply chain management, resilient supply chain, green and sustainable supply chains is the focus. In resilient supply chain, research on strategies for mitigating various risks in supply chain, its organization and management was studied. In sustainable supply chain, researches on economic, environmental and social aspects to sustainability have been carried out. In reverse logistics issues related to product recovery options as refurbishing, remanufacturing, recycling and quantitative modelling of various parameters have been done. Research has also been conducted for efficient management of electronic (e-waste). In new product development (NPD) studies have been conducted to gain a broad insight about the various issues related to NPD in R & D context.

Lekshmi V Nair's research in sociology is focused on gender studies, gerontology and science, technology & society. In gender studies, a study on the life of women in different professions, the entry and empowerment of coastal women in self-help groups in Kerala and the nature and type of violence towards women in Kerala were completed. Studies in gerontology were based on institutionalization and the life of elderly living in the different old age homes of Kerala, especially the people living in the different institutions for more than 10 years. Studies were also undertaken to know the causes and consequences of the longer lives of the elderly women. In the area of science, technology and society, collaborative work was done on the different aspects of space technology such as the impact of tele education and telemedicine mobile van and also to assess the penetration of space technology into the social and economic life of the households of India. She also has collaborations with Indian Social Institute, Bangalore, Department of Sociology, IIT Delhi and University of Kerala.

Shaijumon C. S.'s research in the field of economics is focussed on development economics and space economics. The specific research areas are technology, innovation, diffusion and economic development, various issues of Indian economy, economic vulnerability due to various economic impacts including climate, natural shocks, social changes etc. He has also undertaken work on agriculture issues, infrastructure, governance and regional economics. His doctoral student is currently working on understanding the impacts of technology diffusion in marine sector as well as the effects of climate change vulnerability in agriculture sector. In the area of space economics, research is on-going to analyze the cost-benefits analysis of the Indian space program, quantification of Indian space economy, understanding the space technology penetration among the households of India, study on Village Resource Centres, Telemedicine impact study, space technology and inclusive growth of India.

In addition, **Shaijumon C. S. and Lekshmi V. Nair** are currently pursuing a ISRO-IIST joint project that looks at space technology and it's mediation into the socio- economic space of households of India. The study, with data being gathered from five states of South India, will look into the diffusion of new space based technology and its impact on the socio-economic wellbeing of households. An understanding of the factors gleaned from this study is anticipated to be useful both for the social scientists studying the determinants of socio-economic sustainability

of the household, and for ISRO, who are the creators and producers of such technologies.

Babitha Justin with the help of a state-of-the-art audio visual lab of the department, has been thinking of ways to harness the power of new technologies for the enhancement and dissemination of knowledge. She has started a consortium for the production of Open Course Ware, based on the core competencies at IIST and ISRO, which will eventually bring out video lectures online for information sharing. The work on this is in progress. Her research also draws on the hierarchy of visuals and text, the rhetorical, contextual situations in which visuals and texts co-mingle, film studies, disability studies and travel writing.

Gigy J. Alex's interests are in gender studies. In the changing sensibilities of gender perceptions and gender ideologies, transgender studies have emerged as an interdisciplinary of this genre. Her ongoing research is an attempt to look at the identity contestations of transgenders and how they are perceived and analysed in Malayalam cinema. There is also another study, in progress, on gender and religion, which looks at issues related to censoring, banning, and prohibition from an Indian perspective.

4.6 Department of Mathematics

Academic	Faculty	11
Students	Ph.D	13
	M.Tech	09

Research Activities

The research activities in the department are spread over a range of disciplines. During the report period, research activities included

The major areas of research of **Dr Raju K George** are mathematical theory of Control, Orbital Dynamics and soft computing techniques. The problems of fundamental interest in control theory are the one like controllability problems, observability problems, stability problems and optimal control problems etc. We deal with control systems described by nonlinear differential equations both ordinary differential equations and partial differential equations. These problems can be investigated by using the tools of functional analysis, namely, the theory of linear and nonlinear operators. In the analysis we invoke the tools from Monotone operator theory and Lipschitz continuous operator theory. In controllability problem, we characterize conditions for controllability of nonlinear and linearized systems. The Steering controllers are obtained by algorithms established through Banach contraction principle and other iterative schemes. The theory can be applied for finding steering controllers for artificial satellites and launching vehicles. We also employ tools from Artificial Neural Networks and fuzzy logic to obtain steering controller for special systems having fuzzy components.

K S S Moosath's research focuses on Geometric structures of the deformed exponential family and also the dually flat geometry of the deformed exponential family and F-escort probability distributions. Another topic of research was the momentum maps on symplectic manifolds.He has also been working on the geometry of statistical manifold on finite sets. This ongoing work is in collaboration with Dr. Harsha who is a Post-Doctoral Fellow in the Department of Mathematics at IIT Mumbai.

N. Sabu's research is in the broad areas of distribution theory and Sobolev spaces and also on Justification of asymptotic analysis of linear slender rods.Lower dimensional models of plates and shells are preferred to three dimensional models when the thickness of the plates or shells is very small. One reason for preferring lower dimensional theories is their simpler mathematical structure which permits one to obtain richer variety of results. The other, is these theories are more amenable for numerical computations. Most of the lower dimensional theories rely on a priori assumptions of a mechanical or geometrical nature. Further it is not evident which is the model most to a particular case in hand. Thus before approximating the exact solution of a given lower dimensional model we should first know whether it is close enough to the exact solution of the three dimensional model it is intended to approximate. Thus one is lead to the question of justifying a lower dimensional model starting from the three dimensional model.

Anil Kumar C V's research includes nonlinear analysis and modeling of naturally occurring series from Ionospheric and Magnetospheric data. He has investigated the chaotic dynamics of the time series of Total Electron Content (TEC) in detail. He is also working on Dynamics and Rheology of Periodically forced suspensions. His other area of research interest is in nonlinear dynamics and suspensions. His theoretical and numerical work in these topics will provide insights to develop smart fluids for applications in future projects of ISRO. Additionally he is also involved in the the analysis and modeling of naturally occurring series from Ionospheric and Magnetospheric dataHis groupinvestigated the chaotic dynamics of the time series of Total Electron Content (TEC). The analysis based on the calculation of the invariant characteristics such as Lyapunov exponent, Correlation dimension, etc. and of the surrogate data test established the existence of a low dimensional deterministic chaotic system in all cases. Both the dynamics are efficiently modeled to an approximate functional relation in symbolic form using an evolutionary program, which can be used for prediction. This idea may be extended to any system such as earth quake etc. having time series, and hence some information can be obtained, if otherwise impossible.

Deepak T G's research focuses on Modelling and analysis of some queuing problems related to wireless network theory. He is involved in a joint Indo-Russian project titled "Elaboration of the Mathematical models, methods, algorithms and computer tools for quality of service evaluation of broadband wireless networks, multimedia information transmission along main transport systems".

Prosenjit Das works on Embedding of plane over DVR of characteristic zero and study of locally nilpotent derivations of affine fibrations. He in collaboration with Dr. Neena Gupta of the ISI Kolkata worked on "Embedding of plane over DVR of characteristic zero". He also worked, in collaboration with Dr.Swapnil A. Lokhande, IIIT Vadodara worked on the "Study of Locally Nilpotent Derivations on Affine Fibrations".

Sarvesh Kumar's research is on development of new discontinuous finite volume schemes (with emphasis on theoretical and computational aspects) for the approximation of certain fluid flow problems such as: coupled flow-transport problems, immiscible displacement problems, Stoke's equations, nonlinear hyperbolic conservation laws. His research also includes Development and analysis of discontinuous finite volume methods for

the approximation of distributed optimal control problems governed by certain partial differential equations subject to pointwise control constraints. He has been collaborating with Dr. Ricardo Ruiz-Bair, Mathematical Institute, University of Oxford, and Prof. Raimund Burger, University the Concepcion, Chile in the area of computational partial differential equations, in particular, on Stokes, Sedimentation-consolidation processes and Poroelasticity equations. In collaboration with Dr. Deepak Mishra of IIST, Sarvesh Kumar has been working on the development and analysis of image fusion techniques for satellite images. Concurrently, he is also involved in a short term NPDE-TCA project that looks into Discontinuous finite volume methods for optimal control problems governed by fluid flow equations.

E Natarajan's research is focussed on developing new stabilization methods for the convection dominated reaction diffusion problem over polygonal and polyhedral meshes. **E Natarajan and Sarvesh Kumar** are heading a joint project with the Vikram Sarabhai Space Center SMSD team for developing modules for FEAST Software (Finite Element Analysis of Structures).

Kaushik Mukherjee's research is on developing parameter-uniform alternating direction hybrid numerical scheme for 2D singularly perturbed parabolic convection-diffusion problems and uniformly convergent improved hybrid numerical scheme for singularly perturbed convection dominated boundary value problems.

Sumitra S Nair research focuses on development of theoretical models and algorithms using kernel methods. She has initiated collaborative work with the analysis team of VSSC, Thiruvananthapuram for (i) Flight Mining, which is a system for mining knowledge from launch vehicle repositories. (ii) automation of simulation results analysis, and (iii) flight performance estimation and subsystem parameter estimation from available flight measurements using optimization techniques.

K Sakthivel's research is on Feedback synthesis of optimal control problems for stochastic fluid dynamic models subject to Gaussian and Levy type stochastic forces using dynamic programming approach and also on reconstruction of wave parameters in the K-dV equation from the observed measurements of surface elevation of water waves in a suitable time or boundary of the domain. He is involved in a joint project with S.S. Sritharan, Air Force Institute of Technology, Ohio, USA on "Dynamic Programming for Stochastic Fluid Dynamic Models". He is also working on a joint project with A. Hasanov, Izmir University, Turkey on "Inverse Problem of KdV Equation".

4.7 Department of Physics

Academic	Faculty	12
Scientific	Staff	01
Students	Ph.D	23
	M.Tech	20

Research Activities

The research activities in the department are spread over a range of disciplines of theoretical and experimental physics. The portions below highlight some of the work that overlaps with the report period.

Through the applied and adaptive optics lab of the institute, **C. S. Narayanmurthy** has been developing techniques of high resolution optical systems for earth observations. The presence of stray light in imaging optical systems reduces the image contrast and hence the image quality. To avoid stray light interfering with the image resolution in telescopes, the adaptive optics lab is developing a new baffle design method. Another area that the lab is working on is in developing an electro optical module (EOM) using Shack Hartmann Wave. The lab has already completed the testing of optical system in an integrated electro optical module (EOM). Measurements were conducted using MLA (Micro Lens let Array) using both spherical and plane wave fronts for obtaining optimum results. The applied and adaptive optics lab is also exploring techniques for vibration analysis is time average digital holographic interferometry, where the test object is holographically recorded with a single exposure and using a exposure time longer than compared with the period of vibration one can obtain vibrational fringes for evaluation. The lab has developed methods to detect aerospace structures using time average digital holography with low and high frequencies.

S. Murugesh's research mostly involves non-linear dynamics and their applications to condensed matter systems. With students, he has constructed explicit spin configurations for the breather solution of a one-dimensional Heisenberg ferromagnetic spin system. This corresponds to the breather soliton solution of the gauge equivalent nonlinear Schroedinger equation.

Rakesh Kumar Singh's research interests are in optical metrology, non-diagnostic and in-situ/in-vivo imaging through homogeneous and inhomogenous media, Computational Optics, Coherence-Polarization Optics, Singular Optics, and Diffraction Optics. Through the applied and adaptive optics lab, his group has been developing new and effective techniques to control various physical properties of light such as polarization, coherence, complex amplitude for applications in optical metrology, imaging and diffraction control. At IIST, the group has successfully demonstrated several new results in the area of physical optics, optical imaging, metrology and coherence theory. In the physical optics, their very recent works are in the creation of singularity in partially coherent light, synthesis of coherence comb structures, controlled synthesis of coherence and polarization of the light, ghost diffraction for singularity in low coherent light, development of an experimental technique to determine statistical properties of light. In the applied domain, their recent contributions are new method to recover complex coherence function from single shot intensity measurement, quantitative phase contrast imaging through the random scattering medium, imaging of 3D complex valued objects from laser speckles, 3D deformation measurement by self referencing holography, polarization imaging in free space and in random scattering medium, complex field imaging by combining speckle interferometry with computational optics, development of new Jones matrix imaging system for the birefringence measurement etc.

Sudheesh Chethil's interests are also in the area of quantum optics and quantum information. His work has brought out several important applications of optical tomograms in quantum dynamics and entanglement. The manifestations of

revivals and fractional revivals of quantum states have been shown directly in the optical tomogram of the time evolved quantum states, which in turn can help experimentalists avoid the errors that can accumulate during the reconstruction process of quantum states. The investigations on the effect of decoherence on the optical tomograms of states at the instants of fractional revivals can be used to find out how much the decoherence models really capture the effects of environmental interactions in an actual experimental setting.

The atomic and molecular physics lab, headed by **Umesh R. Khadane**, has developed several experimental set-ups for its ongoing research works. The group has been studying indirect ionization and related structural effect on large molecules like PAHs. An electron-ion coincidence setup was designed and fabricated at IIST for this purpose. The lab has also been providing support, for several years now, to the ongoing LPSC-ISRO program in electric propulsion systems. Within the period of this report, one new facility was added to this collaboration and five new sets of diagnostic probes were developed and delivered to LPSC. Out of these, three probes, namely RPA, Faraday Probe and Langmuir probe have already been tested and are in regular use at IVTF, LPSC, Bangalore for the test of 75 mN Hall effect thrusters. These probes allow one to precisely measure several vital plasma properties; they can perform beam intensity measurements accurately close to the thruster without disturbing the plasma, and they can measure the velocity and obtain the full energy spectrum of the ions.

Apoorva Nagar works in the area of non-equilibrium Statistical Physics and Biological Physics. A major portion of his research focuses on studying steady states in one dimensional dynamical models where non trivial phase structure emerges from relatively simple dynamical rules. Such models are not merely a theoretical tool for exploring nonequilibrium systems but also find applications in various disciplines including Biology. Protein production by mRNA-Ribosome complexes and the collective motion of ants are two examples from life systems where such models are being applied.

Nuclear Magnetic Resonance (NMR) is one of the most powerful ways where the quantum properties of a system are measured. **Jayanthi S**. is pursuing research in solid state NMR, which has extended applicability in surface chemistry. Several challenges associated in retrieving dynamic parameters of the system utilizing standard dynamic Floquet theory for computational affability has been achieved. Experimental and theoretical investigations are also being presently corroborated with molecular modelling obtained through molecular dynamic simulations.

The Electronic Materials and Device group is headed by **K. B. Jinesh**. The lab has established a marked progress in research on advanced memory options for post-Flash data storage, high-mobility thin film transistors (TFT's) for display and logic applications and thin film solar cells for space applications. The current focus of this group is in understanding charge transport in graphene-based devices. Recently, the technology of gate-controllable resistive memory (ReRAM) devices using graphene as the channel layer was developed at IIST. In collaboration with NIIST (Trivandrum), the first memory devices using perovskite

nanoparticles with tunable programming voltages and organic-inorganic hybrid ReRAM devices were also realized. In addition, the influence of vitrification of polymer active media on the organic ReRAM cells were investigated and the results were published during this annual report period. The group is at present involved in various projects with different ISRO centers for the development of space-qualified ReRAM cells, protective coatings to prevent tribological or plasma erosions, and solar cells for future space missions.

Kuntala Bhattacharjee is pursuing studies of two dimensional (2D) layered materials like various transition metal dichalcogenides (TMDC), stanene - a 2D allotrope of tin (Sn) etc. on clean semiconductor, metal substrates. Investigations of different growth processes of various self-assembled low dimensional structures and studying surface properties like local electronic density of states (LDOS), band mapping, various defects and dislocations on the surfaces, understanding towards the local electronic properties are underway.

Naveen Surendran works in the area of quantum many-body physics. His research is mainly focused on the study of systems with topological order. Due to topological protection, excitations in such systems are robust against decoherence and are considered the most promising candidates to physically realize quantum gates. With students and other collaborators, he has been studying solvable models with topological order in three dimensions (3D), a much less explored area in comparison to two dimensions. In particular, they have classified the excitations and studied their properties in a 3D generalization of the well-known Kitaev model.

Pramod Gopinath's research activities include the development of optical materials for nonlinear optical (NLO) applications and study of optical emissions from laser produced plasma. ZnO nanostructures are synthesized and their nonlinear absorption are investigated using Z-scan technique. The functionalization of ZnO with reduced graphene (rGO) and multiwalled carbon nanotubes (MWNT) was found to alter the defects in ZnO and hence their absorptive nonlinearity. The ZnO decorated reduced graphene oxide sheets exhibited good optical limiting properties than their individual counterparts, suggesting effective two-photon absorption with photoinduced electron transfer between ZnO and graphene sheets. Polymer nanocomposite films of ZnO/MWNT were fabricated, and studies revealed that cascaded absorption leading to effective three-photon absorption is taking place in them. Switching of absorptive nonlinearity from reverse saturation to saturation is also observed in polymer-ZnO composite films. Hybrids of polyaniline with reduced graphene oxide and MWNT are also synthesized which shows strong optical limiting properties. Optical Emissions from laser produced plasma is another area of research which is being pursued. Plasma is generated by the irradiation of a high power laser on to solid targets like barium and tungsten and the emissions from it is monitored using a Spectrograph-CCD assembly to identify the different emitting species present in the plasma. The time-of-flight studies of these emitting species reveal the formation mechanisms involved. A multi-component shifted Maxwell Boltzmann distribution was adopted to resolve the individual

components in the temporal profiles. The temporal profiles of ionic lines were observed to be compressed significantly in the presence of magnetic field due to the resistive force by the magnetic pressure in addition to the ambient pressure. A model was proposed to explain the narrowing of ionic profiles. Imaging studies of the plasma shows field aligned striations due to instabilities in the plasma.

In recent theoretical work carried out at IIST, in the area of quantum information theory and quantum optics by **Solomon Ivan**, the notion of nonclasicality breaking was introduced for the first time. A mathematical classification of all the single-mode bosonic Gaussian noisy channels was established. The connection to degardation to entanglement of correlated photons on passage through such a channel was brought out by this work. This research is highly relevant in quantum communication through a noisy channel such as atmospheric turbulence for instance. Solomon's group also carried out an experiment in collaboration with the Raman Research Institute, Bangalore, involving the development of a novel method to control `classical light' to achieve a desired photon statistic. New incoherent states of `classical light' were theoretically proposed and then experimentally demonstrated in this work. The work has implications towards generating exotic states of `nonclassical light'. In another experimental work, the profile of a light beam as it propagates through atmospheric turbulence like conditions was investigated, with several quantities of physical interest measured and presented. New and highly significant findings in free space communication in a turbulent atmosphere were also published during the report period. This latter work is much relevant for ISRO's current interests in free space optical communication, and adaptive optics. The group also published very recently the fundamental role of spatial coherence of a light field in the context of phase estimation from transverse intensity measurements. The work has implications for commercially available wavefront sensing devices which encorporate such algorithms, such as those routinely used in SAC Ahmedabad for ISRO applications. In a more recent work, an algorithm to extract phase in its unwrapped form from an interferogram having perturbed straight line fringes was proposed and studied. The work is applicable for surface metrology and surface profiling of reflectors, which is relevant to the routine work carried out at ISRO's LEOS center in Bangalore.

4.8 Advanced Space Technology Development Cell (ASTDC)

The Advanced Space Technology Development Cell (ASTDC) was incorporated in IIST in October 2015 with the objective of facilitating collaborative research between IIST and various ISRO centres and SCL. Since then, ASTDC has been active in determining the ISRO requirement for collaborative research projects and aligning some of these with the research interests of IIST faculty to define new projects. Projects which were initiated prior to the formation of ASTDC were also evaluated for importance to the ISRO space programme. At present there are thirty eight projects in collaboration with ISRO which are in progress in IIST. These projects are in collaboration with Semi Conductor Laboratory, Space Applications Centre,

NRSC, ISAC, VSSC, IISU, SDSC, LPSC and IPRC. Of the projects of importance to the space programme, these six have made good progress. They are:

1. **NRSC project: Design and development of a Ka band antenna system** to be used for Cartosat 3 data reception. This is a joint collaborative project with NRSC. Several meetings have taken place between IIST faculty and NRSC personnel and four MTech students have visited Shadnagar campus for familiarisation with the existing antenna system and preliminary design work.
2. **SHAR project: Multi Object Tracking Radar (MOTR) signal processing** to discriminate different objects was initiated in March 2016 by visit of IIST faculty to SHAR. Two MTech students are working on this project and the first review of the progress was held.
3. **IPRC project: Design and Development of High Performance Hydrogen Sensor** Design completed. Hardware manufactured and characterised. Further testing using H2 being carried out in IPRC.
4. **IPRC project: Computational fluid dynamics of methane/ liquid oxygen pre-igniter** followed by CFD studies of the Methane/LOX engine. This project was taken up in March 2016 and work is being carried out.
5. **SCL project: Design and development of two ASICS**. SCL had provided a list of six ASICS which are important for ISRO and two of these (the programmable gain difference amplifier and 14 Bit, 1MSPS SAR ADC) have been taken up with three MTech students. More ASIC designs will be taken up shortly. The objective is to develop IIST as a lead ASIC design institute.
6. **VSSC project: Intrinsically conducting polyimide composites with CNT or graphene** with good optical properties. This project was reviewed recently and good progress has been reported. Repeatability is to be established by preparing more samples and afterwards, VSSC has been requested to take up the qualification for space use.
7. **Student satellite projects:** The IIST Nanosatellite project is being designed and developed by the student under the guidance of faculty. ASTDC has provided the necessary support for progress of this project.
8. In addition, ASTDC is responsible for coordination and guidance of two IIST student satellite projects with international collaboration. These are **AAReST student satellite project** in collaboration with JPL/Caltech and University of Surrey and **INSPIRE student satellite project** in collaboration with University of Colorado and National Central University of Taiwan.

4.9 Centres of Excellence

Advanced Propulsion and Laser Diagnostics (APLD)

(Department of Aerospace Engineering)

The setting up the Advanced Propulsion and Laser Diagnostics (APLD) is aimed at the establishment of a centre of excellence that will serve as (i) centre for conducting academic research in IIST which would assist ISRO activities, (ii) national facility for performing advanced research and (iii) national technological development centre for aerospace

organizations. The current objective is to perform propulsion research studies through laser diagnostic techniques. The short term scope and objective of setting up the laboratory is to primarily focus on applying 10 Hz and 1 MHz laser diagnostic techniques to basic propulsion facilities while the long term goal is to apply it to real scale engines that are most relevant to ISRO's technological development.

As part of the ongoing research activities in academic year 2015-16, the following major studies were carried out:

(i) Investigation of the altitude compensating capabilities of 'Expansion-Deflection' (E-D)nozzle
(ii) Performance evaluation of swirl injector in 10 N vernier engine of PS4 stage using droplet size and velocity measurements
(iii) Study on supercritical jet behavior of fluoroketone to mimic Liquid hydrogen injection into thrust chamber
(iv) Extensive studies on supersonic cavities to enhance noise suppression capabilities in flight/launch vehicles

As part of expanding the research facilities through ISRO-IIST R&D project, the procurement of Phase Doppler Particle Analyzer is under process.

The research activities carried out in the APLD lab contributed to three peer reviewed journal, three international conference and eight national conference publications.

Virtual Reality Lab

(Department of Avionics)

Virtual Reality and Image Processing Lab (VRIP lab) carries out research in the area of image and signal processing, computer vision using machine learning tools & techniques, and Virtual reality applications. The members of the lab presently working on the area of signal tracking approaches for Phase estimation, deep learning and machine learning applications, computer vision tracking for surveillance applications, compressive holography. Recent work includes proposing deep leaning architectures for watermarking applications, image fusion, and biological applications for tracking objects in a sequence of videos, content based retrieval and copy detection. Recently proposed a robust integrated tracker which is short listed in VOT 2016 challenge as one of the best trackers and results will be published in ECCV conference 2016. The lab also works on bio-inspired computing and on various problems related to computational neuroscience & neuroinformatics.

Center of Advance Research in Nanoscience and Technology

(Department of Chemistry)

For facilitating research in Nanoscience and Technology and to address challenges in Space Science and Technology and related areas the department has established a centre of Advanced Research in Nanoscience and Technology. The Department is in the process of bringing all the facilities required to conduct advanced research in Nanoscience and allied

fields. Currently, facilities such as Atomic Force Microscope, Particle size Analyzer, Glove Box, Electrospinning Machine, Contact angle Goniometer, HPLC, Planetary Ball Mill and Surface Area Analyser, ESI mass spectrometer etc. are available in centre. The Department plans to add X-ray Diffractometer and Scanning electron microscope to the facilities shortly.

4.10 Advanced Research Facility in Atmosphere Science

Climate Observatory

(Department of Earth and Space Sciences)

The **Climate observatory** at Ponmudi continues to provide important micro-meteorological measurements such as air temperature, pressure, turbulence, relative humidity, soil moisture, soil temperature and radiation. An Automatic Weather Station (AWS) facility was recently installed in the climate observatory at Ponmudi hills (1081 meter asl; 8^0 45' 26"N, 77^0 06' 50"E). The AWS instruments include Fast response sensors and slow response sensors to make measurements on continuous basis. Fast response sensors include sonic anemometer, CO_2 and H_2O vapor analyser for the intensive measurements of eddy covariance flux which will help to understand the carbon exchange between hilly ecosystem and the atmosphere in climate change perspective.

4.11 PROJECTS

Sl No	Name of the Programmes/Activities/Schemes/Projects	Principal Investigator/Co-Investigator	Project Estimate (in Lakhs)
1	Developing a VR model for disaster simulation.	Dr. Deepak Mishra Shri. Shasidhar Reddy Avionics	17.5
2	Object based high resolution (optical) image analysis for land slide and land use land cover classification.	Dr. S. Gorti Earth & Space Sciences Dr. Deepak Mishra Avionics Dr. Tapas Martha	16.5
3	Assessment of machining characteristics of ablative materials.	Dr. Chakravarthy Aerospace Engineering	9
4	Studies on secondary injection to an expanding supersonic cross flow.	Dr. Rajesh Sadanandan Aerospace Engineering	45
5	Geological and Spectral Studies of Terrestrial Analogue Rocks: Implications for Mars Exploration.	Dr. V. J. Rajesh Dr. L. Gnanappazham Earth & Space Sciences	18.19
6	Radio continuum mapping of ionized emission associated with infrared bubbles.	Dr. Anandmayee Tej Earth & Space Sciences	5.5
7	Mixing Enhancement in Supersonic Combustors Using Pylon-Cavity Flame Holder.	Dr. Rajesh Sadanandan Aerospace Engineering	10
8	Space Technology and its Mediation into the Socio Economic Space of Households of India – 1 Phase – South India.	Dr. C. S. Shaijumon Dr. Lekshmi V. Nair Humanities	23
9	Modeling and Controller Development for Micro actuators.	Dr. N. Selvaganesan Avionics	2.64
10	Superionic conductor as electrolytes for all solid-state-lithium sulfur batteries.	Dr. J. Mary Gladis Chemistry	13.44
11	Low power Design of flash ADC	Dr. Sheeba Rani Mr. Mohammed Asim Syed Avionics	19.96
12	Object based high resolution (optical) image analysis for land slide and land use land cover classification"	Dr.S Gorthi Dr. Deepak Mishra Dr Tapas Martha	16.5

4.12 Intellectual Property Rights

Institute's policy is to protect its intellectual property, and contribute to the country's industrial growth by facilitating commercial exploitation of such property through transferring technology and licensing its patents. Such activities started formally within IIST by 2014, and is being coordinated by Dean IPR & Continuing Education.

In the year 2015-16 IIST filed 3 patent applications, of which 2 are complete specifications, while one is provisional. Since its inception in 2007, the institute has filed 10 applications for patents. Some industries have expressed interest in some of our technologies.

PATENTS APPLIED

- **K. Prabhakaran.**, Praveen Wilson, SujithVijayan, "A process for the preparation of microcellular carbon foams", Indian Patent File No. 201641010319

- **R. Sadanandan.**, "Ultra lean Non-premixed gaseous fuel burner", Indian patent-application No. 6632/CHE/2015.

4.13 Awards and Recognitions

IIST faculty members made significant contributions in the areas of teaching and research. They won several awards and honours.

Mohankumar.L, Anandapadmanabhan.E.N, **Chakravarthy P**	**Aerospace Engineering**	➢ **Best paper award** "Advanced Manufacturing Processes for Aerospace Ablative Composites", National aerospace manufacturing seminar
Mohan,K., Vishak Sasidharan, **Vaidyanathan A**	**Aerospace Engineering**	➢ **Best Paper award** "Flow and Shock Structure Development in Planar Expansion Deflection Nozzle" 4th National Symposium on Shock Waves held at Karunya University in co-ordination with IISc, Bangalore and National Shock Wave Society.
Mohan, K., Prabal M., **Vaidyanathan A**	**Aerospace Engineering**	➢ **Best Paper award** "Effect of Pintle Shape on Internal Shock Structure of Expansion Deflection Nozzle", 4th National Symposium on Shock Waves held at Karunya University in co-ordination with IISc, Bangalore and National Shock Wave Society.

R Aswathi	**Chemistry**	➢ **Best Poster award** "A simple method of synthesis of graphene oxide-silicon nanoparticle composite as potential anode material for lithium ion batteries" at the International Conference on Advanced Materials and Manufacturing Processes for Strategic Sectors (ICAMPS 2015) Organized and Hosted by Indian Institute of Metals (Trivandrum Chapter), May 13-15, 2015, Thiruvanathapuram, Kerala.
J.Lavanya **N.Gomathi**	**Chemistry**	➢ **Best Poster award** "Synthesis and characterization of nickel oxide/graphene sheet/graphene ribbon composite", 2nd International Conference on Emerging Technologies: Micro to Nano 2015 (ETMN 2015), Manipal University, Jaipur, October 2015
Ambili K. M.	**Earth and Space Sciences**	➢ **Young Scientist Award** International Union of Radio Science – Regional Conference on Radio Science (URSI-RCRS), November 2015
Jarpala, R. **Sadanandan R**	**Aerospace Engineering**	➢ **Best Student Poster award** Characterization of a Non-premixed, Swirl Stabilised, Methane Burner Using Non-intrusive Methods, ASME Gas Turbine India Conference, December 2-3 ,2015, Hyderabad, India.
Mohan, K., Prabal M., **Vaidyanathan A**	**Aerospace Engineering**	➢ **3rd Prize for student paper award** "Comparison of Performance and Altitude Compensation Capability of ED Nozzles with Bell Nozzles", SAROD 2015-CP184, *7th Symposium on Applied Aerodynamics And Design of Aerospace Vehicles (SAROD-2015)*, VSSC Thiruvananthapuram, December 3-5, 2015
Sanand T V, Unnikrishnan P, Paul P George **Pradeep Kumar P**	**Aerospace Engineering**	➢ **Best paper award** "Numerical and Experimental Evaluation of performance of centrifugal seals". **Award for "Best Research paper"** in "Industry- Academia": in 42nd National conference of fluid mechanics and Fluid power held during December 14-16, 2015, NIT Surathkal.

K Dalavi, A Bhattacharya, **B Ghosh,** **C Saha**	**Avionics**	➢ **Best Research and Oral Presentation award** For a paper in IEEE CODEC, December 2015
N. Selvaganeshan	**Avionics**	➢ **IEEE Senior Membership award-** February 2016
Sanjeev Mishra	**Avionics**	➢ **IEEE Senior Membership award-** February 2016
B Ghosh, **C Saha,** Ms. Jyoti	**Avionics**	➢ **Best Poster award "**Think Nano in IISC Bangalore, 2016
S. Mahesh, Lekshmi. C. L., Devi Renuka K	**Chemistry**	➢ **Best Poster award** "Simple and Cost-Effective Synthesis of Graphene Quantum Dots from Honey and its Application as Stable Security Ink' at ISCAN 2016) IISER - Trivandrum, March 9-12, 2016
Bibin Wilson, **A.M.Ramiya,** **Rama Rao Nidamanuri**	**Earth and Space Sciences**	➢ **Best student paper award** "Hyperspectral and LiDAR data fusion for species classification (3D)" Geosmart India 2016 at Greater Noida, conducted by Geospatial Media and Communications.
Kaushik Mukherjee	**Mathematics**	➢ **National Board of Higher Mathematics award-** for International Congress on Industrial and Applied Mathematics"(ICIAM-2015)
Subrahamanian Moosath K S	**Mathematics**	➢ **Best Paper award in Mathematics** "Geometry of the q-Exponential Family", in the 28th Kerala Science Congress, University of Calicut, Kerala, India, January 28-30,2016.
Sarita Vig, **A. Tej,** Nimisha Kantharia, S.K. Ghosh	**Earth and Space Sciences**	➢ **Best Poster in International Conference/School** "High Resolution Mapping of 172α Radio Recombination Lines Towards G351.7-1.2 and G351.6-1.3 Sixth European Radio Interferometry School (ERIS 2015), Munich, Germany, Sept. 2015

4.14 Research Publications

4.14.1 JOURNAL PAPERS

DEPARTMENT OF AEROSPACE ENGINEERING

- Y Rathee, **B. R. Vinoth**, P K Panigrahi, K Muralidhar., (2015). "Imaging flow during impingement of differentially heated jets over a flat surface", *Nuclear Engineering and Design, Vol. 294, pp. 1-15.*

- Sebastian G, **Shine S R.**, (2015). "Natural convection from horizontal heated cylinder with and without horizontal confinement", *International Journal of Heat and Mass Transfer, 82,* 325-334.

- Johnson J, **Shine S R.,** (2015). "Transient cryogenic chill down process in horizontal and inclined pipes". *Cryogenics* 71, 7–17.

- Sudhanshu Chand, Koushik Jalali, George Oommen C, **Chakravarthy P,** Murugesan N, Arun Prakash NV., (2015). "Effect of process parameters on anodization of AA7075", *Materials Science Forum, Vol. 830-831 pp 643-646*

- Mohan Kumar.L, Usha.K.M, Anandapadmanabhan. E.N, and **ChakravarthyP.,**(2015). "Development of a novel ablative composite tape layup technology for solid rocket motor nozzle and liquid engine liners", *Materials Science Forum, 830-831 pp 417-420*

- Joby V. Thomas, K. Thomas Tharian, Anoop C. R. **Chakravarthy P.,**(2015). **"**Influence of filler wire material on dissimilar welding of 15-5PH to KC20WN", *Materials Science Forum, 830-831 pp 298-301*

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- K.S. Arpan, M. Niladri, T. Venkateswaran**, Chakravarthy P**, G. Singh, D. Sivakumar., (2015). "Prediction of Temperature Profile in the HAZ of Maraging Steel GTAW Weldments", *Materials Science Forum, Vols. 830-831 pp290-293*

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- Agarwal, D. K., **Vaidyanathan A**, Kumar S.S., (2015). "Investigation on Convective Heat Transfer Behaviour of Kerosene- Al2O3 Nanofluid", *Applied Thermal Engineering,* 84, pp. 64-73

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- **V S Sooraj**, V Radhakrishnan., (2015). "Sizing and Finishing of non-circular internal bores using elasto-abrasives", *International Journal of Precision Technology, 5 (3/4), 261-276*

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- **Shine S R**, Nidhi S., (2016). "Review on Film Cooling of Liquid Rocket Engines", *Propulsion and Power Research, Paper accepted.*

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- E. K. Kang, Y. W. Lee, **Sooraj Ravindran**, J. K. Lee, H. J. Choi, G. W. Ju, J. W. Min, Y. M. Song, I. B. Sohn, and Y. T. Lee., (2016). "4 channel × 10 Gb/s bidirectional optical subassembly using silicon optical bench with precise passive optical alignment", *Opt. Express 24(10), 10777-10785.*

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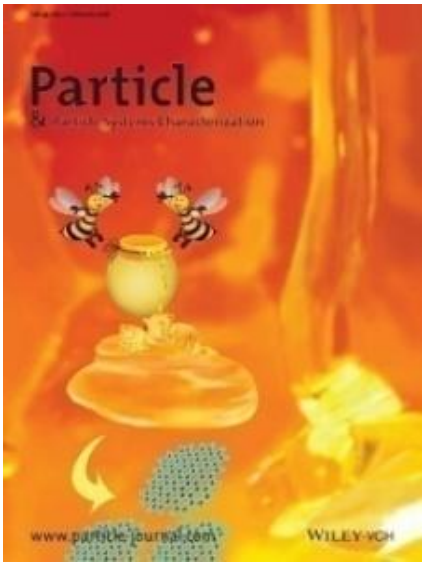

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DEPARTMENT OF CHEMISTRY

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DEPARTMENT OF EARTH AND SPACE SCIENCES

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DEPARTMENT OF HUMANITIES

- **V.Ravi**., "A multicritieria decision making methodology for selection of suppliers in sustainable supply chain", *10th Annual Conference of Knowledge Forum: Technology, Growth and Sustainability, National Institute of Advance Studies, Bangalore, pp.468-483, November 27-28, 2015*

- **V.Ravi**., R.Rajesh,. "An Integrative Decision Making Model for Sustainable Supply hains in Indian Industries", *XIX Annual International Conference of the Society of Operations Management, IIM Calcutta, pp.150, December 11-13, 2015.*

- **Lekshmi V Nair.**, "Workshop on Use of NVivo", *Loyola College of Social Sciences, February 3-5, 2016*

- **Shaijumon C S.**, "Dimensions of Foreign Direct Investment, in the National Seminar on FDI: Prospects, Challenges and Alternatives". *PG Department of Economics, St. Thomas College, Kozhanjerry, March 18, 2016.*

- **Shaijumon C S.**, "Make in India Program: An analysis through an un-balanced growth perspective". National Conference on Understanding Contemporary India", *Mahathma Gandhi University, January 14-15, 2016.*

- **Shaijumon C S.**, "*Space Technology and Knowledge Management in Agriculture*", 10th Annual Conference of Knowledge Forum on "Technology, Growth and Sustainability". *National Institute of Advance Studies (NIAS), Bangalore, November 27-28, 2015.*

- **Shaijumon C S.**, "E-Governance and Kerala Society", *UGC National Seminar* " E-governance and Kerala Society: Prospects and Challenges" *N.S.S Hindu College Changanasserry, September 10, 2015.*

- **Shaijumon C S.**," Macro Economic Crisis of India and the World", *General Lecture Series. Central University of Kerala, Kasargode, October 30, 2015*

- **Lekshmi V Nair** & **Shaijumon C S.**, "Indian Science Congress 2016". *Mysore, January 3-7, 2016*

- **Shaijumon C S.**, "Rapporteur Global Education Meet". *Government of Kerala, Hotel Leela International, Kovalam, January 29-30, 2016.*

DEPARTMENT OF MATHEMATICS

- Suja Eapen, **Anil Kumar CV., "** Evidence of chaotic dynamics inherint in TEC data measured in mid latitude stations and scaling behaviour on Lyapunov exponents", *proceedings of the National Conference on Time series, Analytical & Recent Advances in Statistical Modelling, Department of Statistics, Central University of Rajasthan, Rajasthan, India, August 24-25, 2015.*

- **Kaushik Mukherjee.,** "International Congress on Industrial and Applied Mathematics" *(ICIAM -2015), Beijing, China, August 10-14,2015*

- **Prosenjit Das.**, "Coordinates of the form bZn −a in the affine 3-space", *at NSADM-2015, St. Gregorius College, Kottarakara, October 9, 2015.*

- **K. Sakthivel.**, "Advanced Level Workshop on Controllability of Heat and Wave Equation", *November 16-20, 2015, IIT, Mandi.*

- Ruchi Sandilya, **Sarvesh Kumar.**,"Discontinuous finite volume methods for parabolic optimal control problems", *Proceedings of International Conference on Mathematics, Mathematical Sciences International Research Journal, 4(2), pp. University of Kerala November 26-28, 2015*

- Harsha K V, **Subrahamanian Moosath K S.**, "Geometry of F-likelihood Estimators and F-Max-Ent Theorem", *AIP Conf. Proc., 1641: pp.263-270, 2015.*

- **Kaushik Mukherjee.,** "National Conference on Emerging Trends in Mathematics and Mathematical Sciences" (NCETMMS- 2015), *Calcutta Mathematical Society, KOLKATA, December 17-19, 2015.*

- **Prosenjit Das.**, "Are A^2-fibrations over domains containing rationals trivial?", *CoCoA-2016, IIT Gandhinagar, February 22-26, 2016.*

- **K. Sakthivel.**, "National Conference on Control and Inverse Problems," *Central University of Tamilnadu, Thiruvarur, February 25-26, 2016*

- **K. Sakthivel.,** 'NBHM sponsored International Conference on Nonlinear Dynamical Systems", *Bharathiar University, Coimbatore, March 24-26, 2016*

- **S. Sumitra**, A. Aravindh., "Kernel online multi-task learning In Computational Intelligence, Cyber Security and Computational Models", *volume 412 of Advances in Intelligent Systems and Computing, pages 55-64. Springer Singapore, 2016.*

DEPARTMENT OF PHYSICS

- Vinu R. V, **Rakesh Kumar Singh.,** "Correlation holography for imaging through random media" *World Congress on Microscopy: Instrumentation, Techniques and Applications in Life Sciences and Materials Sciences (WCM 2015), October 2015, Kerala, India.*

- **K.B. Jinesh.**, "Material and Scaling Challenges of Resistive Random Access Memory Technology" *Int. National* Conference on Materials for Power Engineering, M.G. University, Kerala, December 2015

- Preetam Hazra, **K.B. Jinesh.**, "Gate-controlled random access memory using reduced graphene oxide", *Int. National Conference on Materials for Power Engineering, M.G. University, Kerala December 2015*

- **S. Jayanthi.**, "Understanding Alzheimer's: Amyloid beta fragment peptide structural analysis by solution and solid state NMR". *32nd Annual Symposium on Space Science and Technology, IISc- Bangalore, January 7-8, 2016.*

Library

- **Nikhil. Eyeroor,** "BYOD Revolution in Libraries: Are You Ready?" Asian Journal Of Multidisciplinary Studies .4.4 (2016): 151-15

4.14.3 BOOKS / BOOK CHAPTERS

- **V.Seena**, Prasenjit Ray, V.Ramgopal Rao.,(2015). "Nanocantilever fabrication techniques in polymers and transduction techniques for nano-electro-mechanical-sensing", *in the book "Nanocantilever Beams: Modeling, Fabrication and Applications", Edited by Ioana Voiculescu, Mona Zaghloul, Pan Stanford Publishing, CRC Press/Taylor & Francis Group.*

- **Rajesh Joseph Abraham**, Aju Thomas., (2016). "A Genetic Proportional Integral Derivative controlled Hydrothermal Automatic Generation Control with Superconducting Magnetic Energy Storage", *Electricity Distribution, Springer Verlag Berlin Heidelberg.*

- **Nair, Lekshmi, V** & Sonny Jose., (2015). "Women in Tourism"- *A Study in Kerala. Serial Publications, New Delhi*

- **V.Ravi.**,(2015). "Industrial Engineering and Management", *(PHI Learning Private Limited): New Delhi.*

- **BabithaJustin.,** (2015). "Of Fireflies, Guns and Hills. A Collection of poems by the author published by the Writers Workshop", *Kolkota 2015.*

- **Babitha Justin.,** (2015). "Humour: Texts, Contexts (edited)", *Creative Books, New Delhi.*

- **Shaijumon C S.,** (2016). "Making India a Global Manufacturer", *Mathrubhumi Printers and Publishers, pp 36 – 51.*

- **B. S. Manoj**, Sukirna Roy.,(2016). "IoT Enablers and their Security and Privacy Issues", *Chapter in the book titled Internet of Things (IoT) in 5G Mobile Technologies, edited by Constandinos X. Mavromoustakis, George Mastorakis, and Jordi Mongay Batalla, Springer International .*

5 INTERACTIONS AND OUTREACH

5.1 Institute Conferences / Workshops / Seminars / Invited Lectures

DEPARTMENT OF CHEMISTRY

Conferences

- National Conference on Materials Science and Technology-2014 (NCMST-15), July 28-30, 2015, Thiruvananthapuram, Kerala, India.

  Following dignitaries have given invited talks during the conference.
  - Pulickel M. AJayan, Rice University, USA
  - T. Pradeep, IIT Madras
  - Ashish Lele, NCL Pune
  - S. Sampath, IISc Bangalore
  - Vijayamohanan K Pillai, CECRI Karaikudi
  - Suresh Das, NIIST Thiruvananthapuram
  - Santikumar V Nair, Amrita University, Kochi

Seminars

- 'Mass Spectrometry for Space Related Research: Moon soil organics analyses by ultrahigh resolution MS. Quantitative proteomics of cosmonaut's blood. Prof.EvgenyNikolaev Moscow Institute of Physics and Technology &Founding Faculty Fellow,
- Chemistry of Quantum Dots'Prof. P.K. Khanna (Dept. of Applied Chemistry DIAT, Pune), November 29, 2015.
- Skolkovo Institute of Science and Technology, Moscow, Russia. December 15, 2015

DEPARTMENT OF EARTH AND SPACE SCIENCES

- GeoConnect 2015: Summer School on Geospatial Technologies, IIST, Trivandrum,June 15-19, 2015
- "National Remote Sensing Day" celebration, IIST, Trivandrum,August 18, 2015
- IIST Astronomy and Astrophysics School, IIST, Trivandrum, December 10 – 19, 2015

DEPARTMENT OF HUMANITIES

- Workshop on Research Methodology in Cultural Studies. June 15-18, 2015
- Ambassador TP Sreenivasan, "Swami Vivekananda: The Awakening for India", January 13, 2016.
- National Workshop on " Use of ICT in Social Science Research" , February 27-28, 2016
- Prof. Joseph Antony, "The Tolerance-Intolerance Debate in India", Colloquium in the Department of Humanities, IIST, March 16, 2016.

DEPARTMENT OF MATHEMATICS

- Young Talent Nurture-2015, May 25 - June 7, 2015.
- Member of the Organizing Committee for the third level of two weeks National Level Young Talent Nurture program conducted on Algebra, metric spaces, Differential

equations and complex analysis, sponsored by IIST; May 25 to June 7, 2015

- Women in Computing Symposium, IEEE International Conference on Recent Advances in Intelligent Computational Systems 2015, December 10, 2015.
- Dr. Shrihari Sridharan, Dept. of Mathematics, IISER Trivandrum, December 22, 2015, "Period three implies chaos".
- Dr. S. Sundar, Dept. of Mathematics, IIT Madras, December 23, 2015, "Shape Optimization to Imaging".
- Dr. K. Muralidharan, Head, Department of Statistics, Director, Population Research Center, Maharajah Sayajirao University of Baroda, Vadodara, "Six Sigma for Organizational Excellence" , March 22, 2016
- Dr. Chithraprasad D., Professor & Head, Department of Computer Science & Engineering, TKM College of Engineering, Kollam, Kerala, "Introduction to Computational Geometry". March 30, 2016

DEPARTMENT OF PHYSICS

- Rajesh Kushawaha, Kansas State University, USA, "From double-slit interference to structural information in simple hydrocarbons", May 12, 2015.
- S. Dutta Gupta, School of Physics, University of Hyderabad, "Nonlinear optical PT-symmetric systems: Cavity control and regularization of spectral singularity", May 18, 2015
- Jayakumar Balakrishnan, IIT Patna, "Spin orbit coupling in graphene decorated with adatoms", July 06, 2015.
- S S Rajeev, University of Rochester "Continuity and Roughness", July 30, 2015.
- S. Dutta Gupta, School of Physics, University of Hyderabad, "Three decades of Plasmonics and Nano Optics at University of Hyderabad", November 06, 2015.
- Zeev Zelevsky from Faculty of Engineering, Bar-Ilan University, Israel, "Photonic ear for remote detection of diseases and eye for super resolved imaging", November 11, 2015.
- Anjali Sood, Picosun Ltd., "Atomic Layer Deposition systems", December 17, 2015.
- Sandeep K Goyal, University of Calgary, Canada, "An almost convincing scheme for discriminating the preparation basis of quantum ensemble and why it will not work", December 18, 2015.
- Nandan Singh Bisht, Dept. of Physics, Kumaun University, "Generation and Characterization of Broadband Polarization Entangled Photons", January 27, 2016.
- Dinesh N. Naik, School of Physics, University of Hyderabad, "Optical vortex beams from superposition of two Gaussian beams", March 9, 2016.

5.2 Conference / Workshop attended by Faculty Members

- **L. Gnanappazham.,** Aarthy Aishwarya., "Free & Open Source Geospatial Technologies (FOSS4G) for Urban Environment Applications (mapping, inventorying & monitoring)" at IISc Bangalore, April 1-5, 2015
- **Samir Mandal.**, "Recent Trends in the study of Compact Objects (RETCO-II) – Theory and Observation," Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital, India, May 6-8, 2015
- **J. Mary Gladis.,** "Advanced Materials and Manufacturing Processes for Strategic Sectors" (*ICAMPS 2015*), CSIR-NIIST, *Thiruvananthapuram,* May 13-15, 2015.
- **C. Saha.**, "Indian Week 2015 organized by IEEE Antenna Propagation-Microwave Theory Techniques" Kolkata Chapter, Ajmeer, Rajasthan, India, May 30 -June 03, 2015
- **Anand N.,** TMT-India Science and Instrumentation Workshop, IIST, Trivandrum, Kerala, June 11-13, 2015
- **Sarita Vig.,** TMT-India Science and Instrumentation Workshop, IIST, Trivandrum, June 11-13, 2015.
- **B.S.Manoj.**, 4th International Conference "Advances in Computing, Communications, and Informatics" (ICACCI 2015), Kochi, India, August 10-13, 2015
- **Sarvesh Kumar.**, "International Congress on Industrial and Applied Mathematics (ICIAM)", August 10-14, 2015, Beijing, China.
- **B.S.Manoj.**, 4th International Conference "Advances in Computing, Communications, and Informatics" (ICACCI 2015), Kochi, India, August 10-13, 2015
- **Muvva Venkataramana.**, "7th Annual workshop on Science of Climate Change and Sustainable development, NCESS", August 19-20, 2015.
- **Shaijumon C S.,** "E-Governance and Kerala Society", UGC National Seminar on " E-governance and Kerala Society: Prospects and Challenges, N.S.S Hindu College Changanasserry, September 10, 2015
- **Pramod Gopinath.**, "Two Day Workshop on Syllabus Restructuring" Maharaja's College (Autonomous), Ernakulum, September 17-18, 2015
- **B. S. Manoj.**, 7th International Congress on Ultra Modern Telecommunications and Control Systems (ICUMT 7), Brno, Czech Republic, October 7-10, 2015.
- **Prosenjit Das.**, National Seminar on "Algebra and Discrete Mathematics", St. Gregorius College, Kottarakara, October 8-9, 2015
- **B.S. Manoj.**, IEEE International Conference on "Connected Vehicles and Expo" (IEEE ICCVE 2015), Shenzhen, China, October 9-13, 2015
- **B. S. Manoj.**, 3rd IEEE WiMoB Workshop on "Internet of Things Communications and Technologies 2015" (IOT-CT2015), Abu Dhabi, UAE, October 19-21, 2015.
- **Shaijumon C S.,** "Macro Economic Crisis of India and the World", General Lecture Series., Central University of Kerala, Kasargode, October 30, 2015
- **Ambili K M.**, "Indian Geophysical Union 52nd Annual Convention on 'Near Surface Earth System Science", National Center for Antarctic and Ocean Research (NCAOR), GOA, November 3-5, 2015.

- **Ambili K. M.**, "2nd URSI Regional Conference on Radio Science", Jawaharlal Nehru University, New delhi, November 16-19, 2015

- **V.Ravi.**, "A multicritieria decision making methodology for selection of suppliers in sustainable supply chain", 10th Annual Conference of Knowledge Forum: Technology, Growth and Sustainability, National Institute of Advance Studies, Bangalore, November 27-28, 2015

- **Shaijumon C S.**, "Space Technology and Knowledge Management in Agriculture", 10th Annual Conference of Knowledge Forum on "Technology, Growth and Sustainability"., National Institute of Advance Studies (NIAS), Bangalore, November 27-28, 2015

- **B.S. Manoj.**, IEEE Globecom Symposium on Communication QoS, Reliability, and Modeling, San Diego, USA, December 6-10, 2015.

- **B.S.Manoj.**, "IEEE Globecom Symposium on Selected Areas in Communications – Software Defined Networking and Network Functions, San Diego, USA, December 6-10, 2015

- **V.Ravi**, R.Rajesh., "An Integrative Decision Making Model for Sustainable Supply hains in Indian Industries", XIX Annual International Conference of the Society of Operations Management, pp.150, , IIM Calcutta, December 11-13, 2015

- **Ambili K. M.**, National Seminar on "Experimental astronomy and Space Science" (NSETAS-2015), NSS Hindu college, Changanasseri, 14-16 December 2015.

- **B.S.Manoj.**, "IEEE International Conference on Advanced Telecommunications and Networking Systems (IEEE ANTS 2015), Kolkata, India, December 15-18, 2015.

- **Sai Subrahmanyam Gorthi.,** "Integrated algorithm for different tracking Challenges", in Computer Vision, Pattern Recognition, Image Processing and Graphics (NCVPRIPG), 2013 Fourth National Conference, IIT Patna, December 15-19, 2015

- **C. Saha.**, IEEE International Conference on "Computers and Devices for Communication" (CODEC 2015), Swiss Hotel, Kolkata, India, December 16-18, 2015

- **B. S. Manoj.**, 12th IEEE INDICON 2015, New Delhi, India, December 17-20, 2015.

- **C. Saha.**, IEEE Applied Elcetromagnetics Conference (AEMC 2015), IIT Guwahati, Assam, India, December 18-21, 2015

- **B. S. Manoj.**, IEEE "Recent Advances in Computational Intelligence 2015" (IEEE RAICS 2015), December 2015.

- **K.B. Jinesh.** International National Conference on "Materials for Power Engineering", M.G. University, Kerala, December 2015

- **A Salih.**, 23rd National and 1st International; "ISHMT-ASTFE Heat and Mass Transfer" Conference Trivandrum, India, December 2015

- **Lekshmi V Nair, Shaijumon C S,** "Indian Science Congress 2016", Mysore, January 3-7, 2016

- **Shaijumon C S.,** "Make in India Program: An analysis through an un-balanced growth perspective". National

Conference on Understanding Contemporary India, Mahathma Gandhi University, January 14-15, 2016

- **Samir Mandal.**, "Jet Triggering Mechanisms in Black Hole Sources", Tata Institute of Fundamental Research, Mumbai, India, January 20 - 23, 2016.
- **Shaijumon C S.,** "Rapporteur Global Education Meet"., Government of Kerala, Hotel Leela International, Kovalam, January 29-30, 2016
- **B. S. Manoj.**, Served as ComSoc member representatives of record for "COMSNETS 2016", January 2016.
- **Lekshmi V Nair.**, Workshop on "Use of NVivo", Loyola College of Social Sciences, February 3-5, 2016
- **Anand N., "**National Space Science Symposium", VSSC, Trivandrum, Kerala, February 9 –16, 2016
- **Sarita Vig.**, "National Space Science Symposium", VSSC, Trivandrum, February 9 – 16, 2016
- **Ambili K. M.**, 19th National Space Science Symposium (NSSS), Space Physics Laboratory, VSSC, February 9-12, 2016.
- **Ambili K. M.**, Workshop on "Fundamentals of GNSS/IRNSS and Applications to Atmospheric Science", NARL, Gadanki, February 26 2016.
- **Prosenjit Das.**, "CoCoA-2016", IIT Gandhinagar, February 22-26, 2016
- **Sheeba Rani J.,** National Conference for ISRO Women Employees organized by VSSC, Thiruvananthapuram, March 16, 2016
- **Shaijumon C S.**, "Dimensions of Foreign Direct Investment, in the National Seminar on FDI: Prospects, Challenges and Alternatives", PG Department of Economics, St. Thomas College, Kozhanjerry, March 18, 2016
- **Sheeba Rani J.**, Chaired Signal Processing Session in the International conference Research Vogues in information and Communication technologies organized by DMI college of Engg, Arlavoimozhi on March 19, 2016.
- **Apoorva Nagar.**, Indian Statistical Physics Community Meeting, Bangalore (2016).
- **Samir Mandal.,** Editor of the conference proceeding volume on RETCO-II, published in ASI conference series.

5.3 Invited Lectures delivered by Faculty Members

- **Anand N.**, "HST: An Ongoing Saga" at the Amrita University, Kollam, Kerala, April 18, 2015
- **B. S. Manoj.**, "IEEE GCCT 2015", Organized by Noorul Islam University, TN, India, April 23, 2015.
- **N.Selvaganesan.,** "Control System Design -Conventional to fuzzy and AI based Fault Identification for Electrical Machines" ISTE Approved Short Term Training Programme on Soft Computing Techniques & Applications in Electrical Engineering MBCE, Trivandrum, April 24, 2015
- **K.B. Jinesh.**, "Introduction to nanoelectronics", Faculty Development Program, Amal Jyothi College of Engineering, April 2015

- **K S S Moosath.**, Mini Mathematics Training and Talent Search (MTTS) program, Kerala School of Mathematics, Kozhikode, May 4-9, 2015.
- **Kuruvilla Joseph.**, (Plenary Talk). "Nano Technology & Space Application", (AICTE Sponsored) Amaljyothi College of Engeneering, Kanjirapalli, May 15, 2015
- **N.Selvaganesan.,** " Controller design using Bode", AICTE Sponsored Two Weeks FDP on "Topics of Research in Electrical Engineering" (TREE'15), MSEC, Sivakasi, May 16, 2015
- **Anand N.**, Sarva Sikhsha Abhayan State Resource Center, Thiruvananthapuram, Kerala, May 16, 2015
- **Ramiya A.M., "**Potential of LiDAR for forest applications", NRSC Hyderabad, May 22, 2015.
- **K. Sakthivel.**, Four Lectures on complex Analysis, "Young Talent Nurture Program" (YTN-2015), Indian Institute of Space Science and Technology (IIST), Trivandrum, May 25 - June 07, 2015.
- **K S S Moosath.**, "Young Talent Nurture" (YTN) workshop conducted at IIST, May 25 -June 7, 2015
- **Prosenjit Das.**, "Ideals and Homomorphisms", YTN-2015, IIST, Trivandrum, May 25 – June 7, 2015.
- **B.S.Manoj.**, "Graph Theoretical Applications in Big Data" at LBS Institute of Technology for Women, Pujappura, Trivandrum, India, May 30, 2015.
- **C. Saha.**, "An insight into THz Antenna Technology", in IEEE Indian Antenna Week organized by IEEE AP-MTT Chapter, IEEE AP-Society at Ajmer, Rajasthan, India during May 30- June 03, 2015.
- **B.S.Manoj.**, "Recent Advances and Future Trends in Networking," LBS Institute of Technology for Women, Pujappura, Trivandrum, India, June 8, 2015.
- **Anup S.**, "Fracture Mechanics of Biological Composites", Mar Baselios College of Engineering, Thiruvananthapuram; Invited lecture in Short term training programme on Recent Advances in Mechanics, June 8, 2015.
- **Ravi V**, "Quality Management in manufacturing and service sectors", G.Karunakaran Memorial Co-operative College of Management and Technology, June 12, 2015.
- **Sumitra S Nair.**, Theory of Kernel Methods: Talk delivered in the AICTE sponsered 14 Days Summer School Faculty Development Training Programme on "Soft Computing Techniques for the Engineering Research and its Applications" (SCTERA'15), Organized by Department of Electronics and Communication Engineering, Sri Ramakrishna Engineering College, Coimbatore, June 12, 2015.
- **N.Selvaganesan.,** "Fuzzy Observer For Chaotic Based Secure Communication", IETE zonal Seminar on Space communication technology, June 13, 2015
- **K S S Moosath.**, delivered two lectures on Differential Geometry at the Department of Mathematics, ST. Aloysius College, Thrissur, June 19, 2015.

- **B.S.Manoj.**, "Multihop Wireless Network," LBS Institute of Technology for Women, Pujappura, Trivandrum, India, June 25, 2015.
- **Jobin Cyriac.,** "Innovations in Engineering Sciences' Viswajyothi College of Engineering & Technology, Muvattupuzha, July 2, 2015
- **Shaijumon C S.**, "Technology Diffusion and Economic Development", in the National Seminar on "Innovation in Engineering Sciences, Viswajyothi College of Engineering, Ernakulam, July 2, 2015
- **C. Sudheesh**, "Resource Person - Quantum Mechanics", National Seminar on Innovations in Engineering Science, Viswajyothi College of Engineering & Technology, Vazhakulam, July 2, 2015.
- **B.S. Manoj.**, "Countering Cyber Physical Attacks" at Liquid Propulsions Systems Centre (LPSC), Valiamala, Trivandrum, India, July 6, 2015.
- **N. Selvaganesan.,** "Research Methodology in Engineering Education" Department of Electronics, Amritha University , July 25, 2015
- **C. Saha.**, "An insight into THz Antenna Technology", in IEEE Kingston Section at Royal Military College of Canada, , Kingston, Canada , July 27, 2015
- **Shaijumon C.**, "Latest Economic Development in India and the World" Lecture at Department of Economics, Fatima Mata National College, Kollam, July 29, 2015
- **Priyadarshan H.**, "Research and Education", Mohandas Engineering College, August 3, 2015
- **Sarvesh Kumar.**, 2 Days training programme on "CFD in Propulsion", VSSC, August 6-7, 2015.
- **Chakravarthy P.**, "The materials for aircrafts and launch vehicles" for the course 'Aerospace Materials', National Institute of Technology, September 2015.
- **Nirmala Rachel James.**, "Electrospinning: The technology and applications", Sree Devi Kumari College, Kuzhithurai, September 3, 2015.
- **K. Prabhakaran.,** "Advanced Carbon Materials", in state level seminar organized by Sree Devi Kumari Women's College, Kuzhithurai, Kanaykumari District, Tamil Nadu , September 4, 2015.
- **Lekshmi V Nair**, "PRA methods", Loyola College of Social Sciences, September 6-8, 2015
- **Muvva Venkataramana**, "Patching the Ozone Hole – 30 Years On"; Department of Environmental Sciences, All Saints' College, Thiruvananthapuram; September 14, 2015
- **Muvva Venkataramana**, "The Ozone Hole Discovery – Are we safe from harmful UV rays"; Department of Physics, SVRNSS College, Vazhhoor, Kottayam, Kerala, September 16, 2015
- **Kuruvilla Joseph.,** (Plenary Talk). UGC Sponsored Diamond Jubilee Seminar on "Advanced Functional Material" Mar Athanasius College, Kothamangalam, September 16, 2015
- **Gnanappazham. L.** "Geoinformatics applications in Agriculture" Central Tuber Crops Research Institute, Trivandrum (Kerala State Council for

Science, Technology & Engineering sponsored Science Enrichment Programme under Students Programme for Excellence in Experimental Design (SPEED), September 19-23, 2015

- **B. S. Manoj.**, Internet of Things: "The Future of Internet," Heera Engineering College, Trivandrum, India, September 22, 2015.

- ***Shaijumon C S.,***"Global Financial Crisis", Economics Lecture Series, Department of Economics, Basaleus College, Kottayam, September 23, 2015.

- **C.V Anilkumar.**, "Application of Fixed Points theorem on Sierpinski's Carpet", Department of Mathematics, St. Gregorius College, Kottarakkara, Kerala, September 23, 2015

- **B.S.Manoj.**, 4th National Conference on "Emerging Technologies (NCET) 2015", Government Engineering College, Barton Hill, Trivandrum, India, September 25-26, 2015.

- **C V Anilkumar.**, " Scaling behaviour on the measure of complexirties of local and global dynamics of TEC" at the national level symposium on "Complex Systems and Applications" CSIR 4th Paradigm Institute, Wind Tunnel Road, Bangalore. September 29, 2015.

- **Ramiya A.M., "**Advanced geospatial application with focus on LiDAR for vegetation applications", DST-NRDMS sponsored training programme on *"Geospatial Technologies"* TNAU, Coimbatore from October 7, 2015.

- **Kuruvilla Joseph.**, (Plenary Talk). "Nano Technology for Packing Applications at World Packaging Congress", organized by IIP, Hotel Renaissance, Mumbai, October 9, 2015

- **Prosenjit Das.**, "Coordinates of the form bZn –a in the affine 3-space, NSADM-2015", St. Gregorius College, Kottarakara, October 9, 2015.

- **C. S. Narayanamurthy.,** World Congress on Microscopy : Instrumentation, Techniques and Applications in Life Sciences and Material Science, , M G University, Kottayam, Topic of Invited Talk : Digital holographic Microscopy, October 9-11, 2015

- **Nirmala Rachel James** " Electrospungelatin based nanofibers for biomedical applications", National Conference on Biopolymers and Green Composites organized by Centre for Biopolymer Science and Technology (CBPST), October 10, 2015.

- **K S S Moosath.**, Department of Mathematics, Amrita Vishwa Vidyapeetham, Kollam, October 16, 2015.

- **Sarvesh Kumar.**, "Discontinuous finite volume element methods and its applications" at TIFR Bangalore, India, October 20, 2015.

- **Anand N.**, Sri Mahaveera College, Moodbidri, Karnataka as part of an DST sponsored INSPIRE internship program, October 29, 2015

- **V Poompavai.**, "GNSS Applications and Microwave Remote Sensing" at Geoconnect:Summer School on Geospatial Technologies" at IIST, June 15-19, 2015.

- **Sarvesh Kumar.**, Faculty training programme, College of Engineering Karunagapally, Kerala, October 28, 2015.

- **Deepak.T.G.**, "Linear Algebra and Applications", Faculty Development Programme, College of Engineering,

Karunagappally, Kollam, October 30, 2015.

- **C. S. Narayanamurthy.,** SPECTRUM – 2015 , "Light Matter interaction in science on Contemporary Holography," Department of Physics, Central University of Tamil Nadu, Thiruvarur, Topic : Contemporary Holography, October 30- 31, 2015

- **Shine S.R.**, "Heat Transfer in Combustion Systems" in the AICTE sponsored short term course on "Combustion theory and computational techniques", TKM College of Engineering, Quilon, November 16-21,2015

- **K.Sakthivel.**, "Carleman estimates and Controllability of Heat Equation," Advanced Level Workshop on Controllability of Heat and Wave Equation, IIT, Mandi, November 16-20, 2015.

- **Kaushik Mukherjee.**, "National Conference on Emerging Trends in Mathematics and Mathematical Sciences" (NCETMMS-2015), Calcutta Mathematical Society, Kolkata, December 17-19, 2015

- **D. Jagadheep.**, "Fundamentals of Radio Astronomy", Mahatma Gandhi University, Kottayam, November 20, 2015

- **Deepu M.**, "Numerical modelling of combustion with applications", in AICTE sponsored short term course on "Combustion theory and computational techniques" TKM College of Engineering, Kollam, November 20, 2015.

- **Deepak.T.G.**, "Engineering Research: Practices and Tools", Faculty Development Programme, College of Engineering, Trikaripur, Kasaragod, November 26, 2015.

- **Sarvesh Kumar.**, "Numerical Computation using MATLAB" held at Veer Bahadur Singh Purvanchal University, Jaunpur U.P., November 26-30, 2015.

- **C. S. Narayanamurthy.**, "Adaptive Optics at SERC School on Modern Optics and Applications", conducted by Department of Physics, IIT, Patna, November 30- December 18 , 2015

- **K.B. Jinesh.,** "ReRAM: the future of electronic memory technology", St. Stephens College, Pathanapuram, Kollam, November 2015

- **S. Jayanthi.**, "NMR - a powerful tool for probing structure and dynamics in materials", VSSC - Trivandrum; PCM Academic and Selection Committee, November, 2015.

- **Kuruvilla Joseph.**, (Plenary Talk). "Green Technology for Green Environment", Sreenarayanan Mangalam College, Eranakulam, December 4, 2015.

- **JobinCyriac.**,"Advances in Spectroscopic Identifications", Nirmala College Muvattupuzha, December 5, 2015

- **Prathap C.**, "Introduction to Combustion, flame and its applications", B.E. (6^{th}sem) Mechanical Engineering students at MEPCO Schlenck Engg. College, Sivakasi. December 7-8, 2015.

- **C. S. Narayanamurthy.**, "Confocal Microscopy at National Seminar on Photonics and Applications, Department of Opto-Electronics,

University of Kerala, December 9-11, 2015

- **Deepak.T.G.**, "Mathematical Techniques in Engineering Research", Faculty Development Programme, Rajeev Gandhi Institute of Technology, Kottayam, December 10, 2015.

- **Sarvesh Kumar.**, Delivered three lectures in faculty development programme on "Mathematical Techniques in Engineering Research" at RIT Kottayam, Kerala, December 11, 2015.

- **Rakesh Kumar Singh.**, "Interference of coherence waves and its applications."The University of Electro-Communications, Tokyo, Japan, December 14, 2015

- **Deepak.T.G.,**"Applications of Probability and Statistics", Workshop, College of Engineering, Karunagappally, Kollam, December 16, 2015.

- **Deepak.T.G.**,"Mathematical Applications in Engineering Field", Faculty Development Programme, College of Engineering, Cherthala, Alappuzha, December 17, 2015.

- **Sarvesh Kumar.**, Motivating lecture in "Science Talent Enrichment Programme (Step 2015)", IISER, December 17, 2015.

- **Shine S.R.**, "Heat transfer Enhancement" at the IHMTC 2015 VSSC Trivandrum, December 17-20, 2015

- **Kuruvilla Joseph.**, "Nanotechnology in Material Engineering & Energy application under Tequip programme', College of Engineering, Adoor, December 18, 2015.

- **Priyadarshan H.,** "Inertial Navigation Systems", SAC Ahmedabad, Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP), December 21-23, 2015

- **Priyadarshan H,** "Determination of Control Inputs for State Transfer in Linear Dynamical System", IIST, Control Engineering Analysis and Design with Matlab/Simulink, December 16, 2015

- **Rakesh Kumar Singh.**, "Interference of coherence waves and its applications." Utsunomia University, Utsunomia, Japan, December 23, 2015

- **Sooraj Ravindran.,** "Microring Resonator Optical Switches for Photonic Integrated Circuits and Optical Interconnects." for IEEE SSCS Sponsored 3rd Conference on Solid State Circuits at Saintgits college of Engineering, Kottayam, August 14, 2015

- **Ambili K.M., "**Impact of geomagnetic storms on the energetics of the ionosphere", NSS Hindu College, Changanasseri, December 14-16 2015.

- **Sarvesh Kumar.**, "Convergence analysis of finite volume method" International Conference on Current Trend in PDEs: Theory and Computations, South Asian University, Delhi, December 28-30, 2015.

- **K.B. Jinesh.**, "Opto-electronics with Reduced Graphene Oxide; National Seminar on Optoelectronics, Kerala University, Trivandrum, December 2015.

- **K.B. Jinesh.**, "Materials for ReRAM Technology", National Seminar on Advanced Materials, St. Pauls College, Cochin , December 2015

- **K.B. Jinesh.**, "Resistive Random Access Memory Technology; National Conference on Advanced Materials, Deamatha College, Kottayam , December 2015
- **K.B. Jinesh.**, "Graphene: Faculty Development Program, Department of Physics", University of Kerala, Karyavattom campus; December 2015
- **K.B. Jinesh.**, "Material and Scaling Challenges of Resistive Random Access Memory Technology; Int. National Conference on "Materials for Power Engineering", M.G. University, Kerala, December 2015
- **A Chandrasekar.**, "Opportunities in IIST", Seminar organized by National Center for Science Communications, Pune, January 2, 2016
- **K S S Moosath.,** "Advances in Applied Mathematics, Materials Science and Nanotechnology for Engineering and Industrial Applications" at Federal Institute of Science And Technology (FISAT), Ernakulam, January 7, 2016.
- **J. Mary Gladis.**, "Energy Storage Materials -Opportunities and Perspectives", Women's Christian College, Nagercoil, January 8, 2016
- **Anand N.**, Assumption Colllege, Changanaserry, Kerala in connection with the International Year of Light Celebrations, January 14, 2016
- **Shaijumon C S.**, "Opportunities in Economics", Jyothis Central School, Trivandrum, January 18, 2016.
- **Lekshmi V Nair.**, "Qualitative Research Methodology- New Dimensions", Indian Social Institute. Bangalore, January 19-20, 2016
- **S. Murugesh.**, "General theory of relativity: Principle of Equivalence", National seminar on "Theoretical foundations of Quantum Mechanics and General Relativity" at Maharaja's College, Ernakulam, January - 21, 2016.
- **Ramanan R V.**, 'Mission to Mars', Manakula Vinayagar college of Technology, Puducherry, January 25, 2016.
- **Raju K. George.**, invited as a Subject Expert for the scholarship program "Kishore Vaigyanik Protsahan Yojana (KVPY)", January 25-27, 2016.
- **Sumitra S Nair.**, "Advancements And Algorithms In Image Processing", Organized by Department of Computer Science & Engineering, College of Engineering, Karunagappally, January 28, 2016.
- **Pradeep Kumar P.**, "On the predictive capabilities of one dimensional models in two-phase flows and heat transfer", @Government Engineering College-Trichur, January 29, 2016.
- **A Chandrasekar.**, "Climate Change and Monsoons", National Seminar on Climate Change-Trends, Impacts and Implication, Palakkad , January 29, 2016
- **Tej A**, "Story of Stars – from Birth to Death", Astronomy Fest at NIT, Trichy, January 31, 2016
- **K.B. Jinesh.**, "Optical properties of Reduced Garphene Oxide devices", National Seminar on Solar Photochemistry: Fundamentals & Applications, Fatima Mata National College, Kollam, January 2016.
- **K.B. Jinesh.,** Scaling down the transistors: Phyics and Technology, National Seminar or Nanomaterials for Energy Applications, S.N. College, Punalur, January 2016.

- **K S S Moosath.**, "Complex Analysis" at Govt. College for Women, Trivandrum, February 1, 2016.

- **Sai Subrahmanyam Gorthi.**, "Advanced Image Processing Workshop", on "Image Restoration" February 02, 2016.

- **Shaijumon C S.**, "Role of Students in Social Building" SNV School, Paravur Kollam, February 3, 2016.

- **Rajesh V J.**, National Conference on "Recent trends in the tectonics of Peninsular India", University of Kerala, February 5-6, 2016
  Theme: Petrogenesis of ultramafic rocks in Achankovil Tectonic Zone, South India.

- **Pramod Gopinath.**, "Optical diagnostics of laser produced plasma at the National Seminar on Advances in Scientific and Industrial Instrumentation at the Department of Instrumentation, Cochin University of Science and Technology, February 11-12, 2016.

- **K. Prabhakaran.**, "Carbon materials for advanced Technologies", National level conference on Expanding Frontiers in Chemical Sciences, organized by Vivekananda College of Arts and Sciences for Women, Tiruchengode, Tamil Nadu, February 12-13, 2016.

- **Rajesh V J.**, UGC-SAP-DRS III seminar "Shear Zones and Crustal Blocks of Southern India", Department of Geology, University of Kerala, Trivandrum February 15-16, 2016
  Theme: Potential Martian Analogues on Earth

- **Deepak Mishra.**, "Dimensionality reduction and feature selection techniques such as PCA, 2dPCA and SVD application to image processing and computer vision", workshop on 'Advanced Image Processing' CDAC Trivandrum, February 16 , 2016

- **J. Mary Gladis.**, "Microscopy – Looking beyond What we can see" National conference on Novelties of Material Science Women's Christian College, Nagercoil, February 17, 2016

- **Sai Subrahmanyam Gorthi.**, "Advanced Image Processing Workshop" on "Pattern classification approaches and deep learning", February 17, 2016.

- **Sai Subrahmanyam Gorthi.**, "Advanced Image Processing Workshop" on "Visual Tracking" February 17, 2016.

- **Shine S.R.**, "Thermodynamic power cycles for advanced rocket engines", Bishop Jerom Institute, Kollam, February 19, 2016

- **K S S Moosath.**, "National Seminar On Algebra, Analysis And Geometry" University College, Trivandrum, February 19, 2016.

- **Deepak Mishra.**, "Introductory talk on Virtual Reality and its applications". IET CET, College of Engineering Trivandrum, February 20, 2016

- **N.Selvaganesan.**, "Non linearity", Faculty development program, Coimbatore Institute of Technology February 20, 2016

- **Sarvesh Kumar.**, "Differential equations and its applications" at College of Engineering Karunagapally, Kerala, February 25, 2016.

- **Lekshmi V Nair.**, "Success Stories of Tribal Development in the Panel Discussion". Two day National Seminar On "Empowerment of Tribal Women: Challenges & Issues", University of Kerala, February 25-26, 2016

- **K.Sakthivel.**, "Control and Inverse Problems", National Conference on Control and Inverse Problems, Central

University of Tamilnadu, Thiruvarur, February 25-26, 2016.

- **N.Selvaganesan.,** "Limit cycle computation" DST sponsed workshop, NSN college of Engineering, Karur, February 26, 2016.

- **Raju K. George.**, "Control Inverse Problems", Central University of Tamil Nadu, Thiruvarur. February 27, 2016.

- **Sheeba Rani J.,** "Advance Digital Design circuits" in the Expert lecture series organized by College of Engg, Perummon, on February 29 , 2016

- **Raju K. George.**, "Indo- French Steering Board Meeting", February 29, 2016.

- **Prosenjit Das.**, "A1-forms", ISI Kolkata, February 29- March 11, 2016

- **Shaijumon C S.**, "Make in India", in the Department of Atomic Energy, Trivandrum, March 1, 2016.

- **Shaijumon C S.**, "Make in India Campaign", Department of Atomic Energy, Trivandrum, March 1, 2016

- **Shaijumon C S.**, "National Budget 2016-17: A Renewed focus on Public Expenditure", PG Department of Economics, Fatima Matha National College, Kollam, March 2, 2016.

- **K.Sakthivel.,** "Determination of a Coefficient in KdV Equation by Optimization Method", 19th Ramanujan Symposium on Recent Trends in Nonlinear Partial and Fractional Differential Equations, University of Madras, Chennai, March 3, 2016.

- **N.Selvaganesan.,** "Shaping Limit Cycle Performance of Fractional-Order Controllers for PlantsContaining Relay Nonlinearity' Faculty development program, College of Engineering, Pune March 4, 2016.

- **Gomathi N.**, "New horizons in plasma treatment and its surprising applications", in the workshop "Modern Trends in Chemical Research" in Vivekandha College of Arts and Science for Women, Tiruchengode, March 5, 2016.

- **J. Mary Gladis.**, "Electrochemical Energy Storage Systems Current developments and future prospects", Workshop on Modern trends in Chemical Research, Vivekananda College of Arts & Science for Women, Thiruchencode, March 5, 2016.

- **JobinCyriac.**, "Imaging Mass Spectrometry" National Seminar on Advanced Analytical Techniques, Mar Ivanios College, Thiruvnanathapuram, March 9, 2016

- **Shaijumon C S.**, "Career Opportunities in Economics Subject", University College, University of Kerala, March 15, 2016.

- **Raju K. George.**, "DST sponsored NPDE program", as resource person, ITMU Baroda, March 15-18, 2016.

- **Deepak Mishra.**, "Camera Calibration and Stereo basics, in Computer Science", in Faculty Development Programme on Computer Vision, Karunagapally, March 17, 2016.

- **Sumitra S Nair.**, Linear Algebra Applications in Computer Vision: Talk delivered in the Workshop on "Computer Vision: Techniques & Applications", Organized by Department of Computer Science & Engineering,College of Engineering, Karunagappally, March 17, 2016.

- **Deepak.T.G.**, "On Pobability Theory", a special talk arranged by Dept of Mathematics, Govt College, Chittoor, Palakkad , March 17, 2016.

- **C V Anilkumar.,** A key note speech is given as part of the inauguration of the Research Scholars Day celebrations of Mar Ivanios College, Thiruvananthapuram, Kerala, March 18, 2016.

- **Shine S.R.**, "Liquid rocket engine cycles", College of Engineering, Adoor, March 23, 2016.

- **Raju K. George**, "Nonlinear Dynamical Systems(ICNDS 2016)", Bharathiar University, Coimbatore, March 24, 2016.

- **Rakesh Kumar Singh.**, "Non-invasive single shot imaging through scattering layer using speckle interferometry." Department of Electrical Engineering , Physical Electronics, Tel Aviv University, Israel, March 28, 2016

- **Rajesh V J.**, Erudite Lecture Series of Kerala State Higher Education Council, organized by MES Ponnani College, Ponnani, Kerala, March 30, 2016
  Theme: Origin and Evolution of our Earth's Moon

- **Rajesh V J.**, Department of PG Studies and Research in Geology, MES Ponnani College, Ponnani, Kerala, March 30,2016
  Theme: Significance of Chromian spinels in understanding the petrogenesis of mantle-derived ultramafic rocks.

- **Deepak Mishra.**, "Virtual Reality and its applications" at 'National Conference on Informatics and Computing Technologies' sponsored by Teqip phase II. Department of Computer Science and Engineering and Information Technology, College of Engineering Perumon, Kollam, March 30-31, 2016

- **Sai Subrahmanyam Gorthi.**, "Data Analytics and Machine Learning in IEEE RAICS conference, Trivandrum

5. 4 Popular Publications

- **V Poompavai,** "Cloud Poetry" poem published in Surabhi magazine, IIST journal on Arts and Literature, Vol.4, No.1, June 2015

- **Shaijumon C S**, "National Budget" 2016-17, Mathrubhumi GK & Current Affairs, Mathrubhumi Publishers, March 2016.

- **Shaijumon C S**, "Gold Monetization Scheme", Mathrubhumi GK & Current Affairs, Mathrubhumi Publishers, February 04-07,201

5.5 Content Production

- **Babitha Justin,** (2015) Documentary "Homing Pigeon: A Student's Life in IIST (2015)

- **Babitha Justin**, (2015) Documentary: Interview Skills

6 EXTERNAL INTERACTIONS

6.1 Continuing Education

IIST reaches out beyond its own students, and disseminate knowledge and skills to working professionals, to other students, and to the public at large. Such out-reach programmes, in addition to directly helping professionals and students of other institutions by exposing them to modern trends and to good facilities, contribute (a) by bringing working professionals and their real life problems and needs to IIST, thereby enabling faculty to become familiar with industry sectors related to their areas, and (b) by helping individuals to be better informed and capable of taking better decisions in individual matters and in matters affecting society at large. Outreach programmes are in the form of (a) short term courses which introduce basics or address state of the art developments in certain areas, (b) workshops which aim to develop important skills in using analytical and experimental tools, (c) symposia and conferences which expose students to experts from within and outside IIST, etc. Continuing education activities in IIST are coordinated by Dean IPR & Continuing Education. In the year 2015-16 IIST conducted 7 short term programmes for industrial professionals and college teachers and students. In the past, from 2007-08 to 2014-15, IIST conducted around 30 such short term programmes.

Short Term Courses/Workshops organized in the financial year 2015-2016

1	Automatic Control Systems and Design with MATLAB/SIMULINK	19-22 May 2015	Avionics	Dr. Rajesh Joseph Abraham
2	Geo Connect : Summer School on Geospatial Technologies	15-19 June 2015	Earth and Space Sciences	Dr. Rama Rao Nidamanuri & Dr. L. Gnanappazham
3	Culture Vultures: Workshop on Research methodology in Culture Studies	15-18 June 2015	Humanities	Dr. Gigi Alex & Dr. Babitha Justin
4	Young Talent Nurture	25 May 2015 to 7 June 2015	Maths	Dr. Prosenjit Das
5	IIST Astronomy & Astrophysics School	07-16 Dec 2015	Earth & Space Science	Dr. Samir Mandal
6	Power Electronics for Space Systems	7-11 Dec 2015	Avionics	Dr. Rajeevan P. P.
7	Control Engineering Analysis and Design with MATLAB/STIMULINK	15-18 Dec 2015	Avionics	Dr. Rajesh Joseph Abraham

6.2 IIST-SPIE Student Chapter

Society of Photo-Optical Instrumentation Engineers (SPIE) is an Americal not-for profit professional society for optics and photonics technology. It organizes technical conferences, continuing education programs for researchers and developers in the light-based fields and also publishes several journals such as Biomedical Optics, Optical Engineering etc. We have a SPIE student chapter in the IIST campus with 34 active members. Purpose of this chapter is create awareness about optics by arranging lectures, inviting speakers, outreach programs, lab tours etc. Following activities were carried out in the IIST campus or arranged in the neighboring campuses with support of SPIE-IIST student chapter.

Date	Event	Activity
16th August 2015	Outreach activity	Outreach activity conducted in Govt. school Trivandrum, by through talks and experiments.
6th November 2015	Guest lecture at IIST by Prof. S. Dutta Gupta	Prof. S. Dutta Gupta delivered a talk at IIST on "Three decades of Plasmonics and Nano Optics at University of Hyderabad"
10th and 11th December 2015	Visiting Lecture by Prof. Zeev Zelevsky	Prof. Zeev Zelevsky from Faculty of Engineering, Bar-Ilan University, Israel, delivered a talk on, "Photonic ear for remote detection of diseases and eye for super resolved imaging," at Kerala Science and Technology Museum Auditorium on 10th Dec, and at IIST on 11th Dec.
1st December 2015	Talk by Prof. Ady Arie	Prof. Ady Arie from Dept. of Electrical Engineering, Tel Aviv University delivered a talk on, "New waves in holography," at the Dept. of Opto-Electronics, University of Kerala.
26th December 2015	Outreach programs	Outreach program conducted by members of SPIE for school students by giving lectures.
9th March 2016	Seminar by Dr. Dinesh N. Naik	A seminar on "Optical vortex beams from superposition of two Gaussian beams," by Dr. Dinesh N. Naik, School of Physics, University of Hyderabad.
20th and 21st March 2016	"Illumination" an Optics exhibition by SPIE IIST chapter	As a part of CONSCIENTIA (the technical fest of IIST), an optics exhibition was organized for the first time by SPIE-IIST chapter members (graduate and under-graduate students).

Our two students Mr. Sai Krishana (B.Tech Physical Science) and Mr. Shankar Ram (Eng. Physics) visited Munich, Germany during June 21 -25, 2015 to represent SPIE-IIST student chapter in the leadership program with SPIE support.

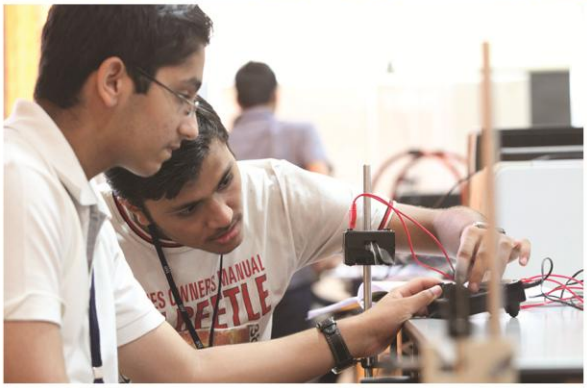
7 CAMPUS INFRASTRUCTURE

7.1 Laboratory Facilities

IIST maintains the following laboratory facilities for teaching and research purposes.





DEPARTMENT OF AEROSPACE ENGINEERING

The major milestones achieved by Department of Aerospace engineering, related to facility development, during the year 2015 are;

- Setting up of a Flame Diagnostics Lab: Which is proposed as an experimental test facility for combustion diagnostics in subscale and standard burner flames. The lab also aims to facilitate the employment of state- of- the -art optical and laser diagnostic measurement techniques to combustion studies.
- Setting up of Thermal and Fluid Calibration facilities to cater the precision research requirements in thermal and fluid mechanics area.
- Augmentation of cryogenic lab facility with a liquid nitrogen plant of 120 Liters/day capacity, to facilitate cryogenics related research activities. The lab is currently supporting other Departments like Chemistry and Physics as well.

The department also highlights the augmentation activities and experimental studies completed at Advanced Propulsion and Laser Diagnostics facility (APLD) during the year 2015.

The manufacturing processes lab and Engineering workshop under Department of Aerospace could effectively support many of the project and research related activities in IIST, offered support to almost all the departments in IIST. Further, the manufacturing processes lab in aerospace department could appreciably support ISRO, specifically the AERO entity in VSSC, to realize 3D rapid prototyped models for the wind tunnel testing of LVM III (GSLV-III).

Faculty members in aerospace department have credited 22 International Journal papers and 44 International/National conference publications during the academic year 2015. Out of these, six of the conference papers got awarded in best paper/poster categories. Out of the two patents filed by the Department of Aerospace Engineering based on the research at IIST, one is accredited to the year 2015. Department also encouraged the faculty to share their academic expertise by delivering invited lectures at various technical institutions. More than 10 such technical talks were recognized in the year 2015. Currently there are 14 IIST-ISRO collaborative projects initiated by Department of Aerospace Engineering.

The major lab facilities established under Department of Aerospace Engineering include

- ❖ Engineering workshop
- ❖ Strength of Materials Lab
- ❖ Engineering Drawing Lab
- ❖ Thermal and Propulsion Lab
- ❖ Fluid Mechanics Lab
- ❖ Heat Transfer Lab
- ❖ Computer Aided Design and Analysis Lab
- ❖ Metrology and Computer Aided Inspection Lab
- ❖ Manufacturing Processes Lab
- ❖ Materials Characterization lab
- ❖ Aerospace Structures Lab
- ❖ Aerodynamics Lab
- ❖ Advanced Propulsion and Laser Diagnostics Lab (Centre of Excellence)
- ❖ Flame Diagnostics Lab

DEPARTMENT OF AVIONICS

The department has excellent lab facilities and state-of -the-art software tools in various disciplines of electrical and electronics engineering. The following are the consolidated list of

Various teaching and research laboratories in the department:

- Analog Electronics Lab
- Basic Electrical Lab
- Basic Electronics Lab
- Computer Networks Lab
- Control System Lab
- Digital Communication Lab
- Digital Electronics Lab
- Digital Signal Processing Lab
- ECAD Lab
- Instrumentation and Measurement Lab
- Micro Processor Lab
- Navigation Systems and Sensor Lab
- Power Electronics Lab
- RF and Microwave Lab
- VLSI and Microsystem Lab & Micro/Nanosystem Characterization Lab

Some of the Labs were further appended with new equipments in the budget year:

A gas sensor calibration facility was established, the facility is equipped with the following equipment:

- **State of gas calibration system:** After fabrication of the sensor, the calibration system is mandatory to find out the performance of the devices. This setup is capable to generate the desired concentration of the gas in the chamber and the chamber can be heated depending on the sensor requirements. The set up includes the monitoring of electrical signals (based on the sensor) of the sensor at different concentration of gas.
- **Microwave assisted nanomaterials synthesis system:** The performance of the sensor can be enhanced by introducing nanomaterials. This system is generating different form of nanomaterials by large microwave power on precursor solutions.

PG/Research Labs in MEMS and Micro/Nanoelectronics is being established:

These laboratories are indented to focus on research and PG programme in the areas of micro/nano-scale electronics, devices, technologies, materials, micro and nano electromechanical systems (MEMS/NEMS) and various types of micro/nano systems. These laboratories would also support the research and development activities in these areas for various programs in ISRO.

Up-gradation/Additions in 2015-2016

- Nano-DMA was installed in the existing Nanoindenter system in Micro/Nano characterization lab.
- MEMS and Micro/Nanofabrication facility: The state of the art equipments are procured for this facility for fabrication of microelectronics, MEMS and various other micro/nano scale devices. This includes double side mask aligner and spin coater for photolithography, deposition systems such as ICPCVD, DC/RF sputter unit, parylene CVD, and etching system such as ICPRIE. The facility is for 4" silicon wafer substrates

with upgradability for 6" wafers. The construction of clean-room for installation of some of these equipment is in progress.

- Microspray system for deposition of solution processable functional materials in MEMS/Nanoelectronics was procured through grant from Science and Engineering Research Board, DST, Govt of India.

DEPARTMENT OF CHEMISTRY

Department has developed the following laboratories for catering to the needs of laboratory courses of B.Tech/ M.Tech programmes and research and development activities.

- General Chemistry
- Polymer Processing
- Organic Chemistry
- Polymer Technology
- Chemical Engineering
- Inorganic Chemistry
- Materials Characterisation

State of the art facilities for analysis, processing and testing are available in these laboratories. The major instruments include:

Analysis and testing: TGA, DSC, DMA, GPC, HPLC, ESI Q-TOF Mass Spectrometer, Universal testing machine, Surface area analyser, Permeability Tester, Particle size analyser, Rheometer, Goniometer

Spectroscopy: infrared, UV-visible, Fluorescence

Microscopy: Atomic Force Microscope, Inverted microscope andHot stage polarised microscope

Processing: Electrospinning machines, Micro compounder, Lyophiliser, Planetary ball mill and*Twin screw extruder*

DEPARTMENT OF EARTH AND SPACE SCIENCES

Astronmical Observatory
Atmospheric Science Lab
Geology Lab
Remote Sensing Lab

DEPARTMENT OF HUMANITIES

Communication Skills Lab

Department of Humanities offers a course in Communication Skills which uses both theory and practical classes for learning and teaching language in one semester. The objectives of the Communication Skills Lab are:

- To equip students of engineering and technology with effective speaking and listening skills in English.
- To help them develop their soft skills which will make the transition from the institute to workplace smoother and help them to excel in their jobs.
- To enhance students' performance at seminar presentation, in technical writing, in framing project presentation, Group Discussions and other skill-oriented exercises.

The lab practice is divided into two categories as "English Language Lab" where listening comprehension, reading comprehension and vocabulary and speaking tests are conducted, and "Career Lab" where writing tests on Resume/Report preparation and Letter writing are conducted. The students are also given training in presentation, Group Discussion and interview skills

Audio Visual Lab

The Audio Visual Lab is intended to be utilized for creating audio and video modules, study materials, to create content generation for lectures (both online and offline), documentaries, etc, by the faculty members, the students and the administrative fraternity of the Institute.

The studio can be utilized for the following purposes:

- As a tool for Enhancing Communiaction Skills
- Creating Content for various ISRO Centres
- Content Devepolment and Materials Development for lectures
- Recording of Interviews, talks of Dignitaries, etc

DEPARTMENT OF PHYSICS

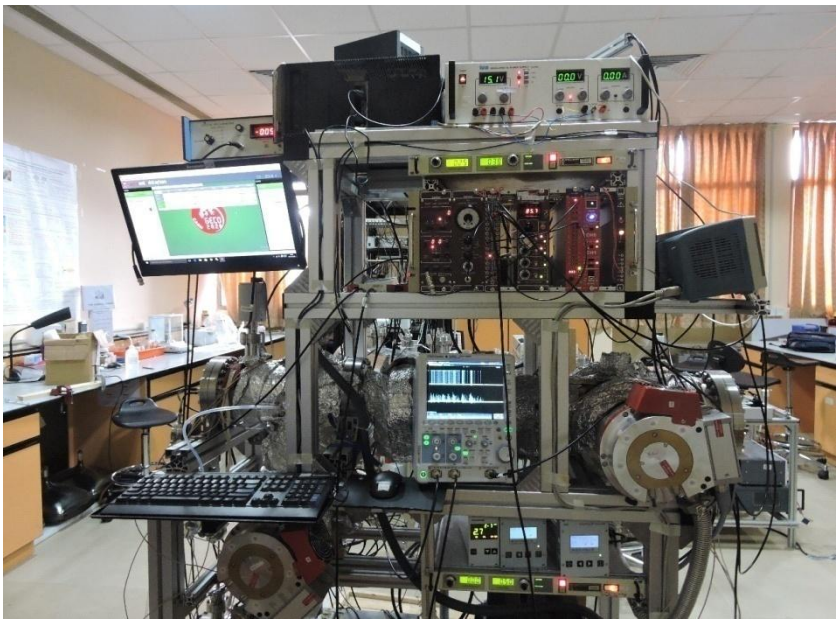
The following labs are part of the physics department:

- **Applied and Adaptive Optics**
- **Atomic and Molecular Physics**
- **Computational Physics**
- **Electronic Materials and Devices**
- **General Physics**
- **Lasers and Photonics**
- **Modern Physics**
- **Optics**
- **Solid State Technology**

The Labs acquired the following facilities during the last year.

Atomic and Molecular Physics Lab

An electron-ion coincidence setup is designed, fabricated at IIST. It was tested and established in October 2015.



Comprehensive stationary plasma thruster diagnostic instrumentation: IIST-LPSC collaboration has been active in the field of electric propulsion since October 2011.The expertise and infrastructure available in Atomic and Molecular Physics Laboratory, IIST provide support to the ongoing ISRO program in electric propulsion systems. In the one year duration from 1st April 2015 one new facility is added to support this collaboration and five new sets of diagnostic probes were developed. Out of which three probes, namely RPA, Faraday Probe and Langmuir probe have been tested and are in regular use at IVTF, LPSC, Bangalore for the test of 75 mN Hall effect thrusters.

- GENERAL PURPOSE VACUUM CHAMBER
    1. A vacuum chamber of 44 cm height and 50 cm diameter
    2. A top flange that can rotate 180^{0} using a hydraulic lift mechanism.
    3. A 700 L turbo pump is attached to create a vacuum up to 10^{-8} mbar.
    4. An ion source which can effectively cause plasma is another specialty.

➢ LIST OF PROBES THAT HAVE BEEN TESTED AND/OR DELIVERED

- **Langmuir Probe** : Effective in measuring plasma properties like plasma potential, electron temperature, electron and ion density at a given position, plume divergence
- **Faraday cup Probe**: Perform beam intensity measurements accurately and as close as possible to the thruster without disturbing the plasma itself
- **E X B Probe (Wien filter):** Can measure the velocity of the ions irrespective of their masses.
- **Retarding Potential Analyzer**: Measures the ion beam/plume characteristic as a function of the spatial coordinates as well as with duration of operation. Can be employed for the energy analysis of the charged particle species.
- **Parallel Plate Analyzer**: The instrument will be able to obtain the full energy spectrum of the ions. A pulsed injection of ions will help in identifying the mass to charge ratio of the species present in the plume down to parts per million levels.

Retarding Potential Analyzer

E X B Probe

7.2 Central Facilities

7.2.1 Library & Information Services

IIST library supports academic and research activities of IIST by providing information resources and also by enabling access to various electronic databases. It provides an enjoyable ambience for study and research.

Resource position of the library is given below:

Sl. No.	Resource	Quantity
1	Books	19000
2	Textbook Bank	9580
3	Journals (Print)	87
4	Online Databases	15
5	Online journals	5007
6	CDs	982
7	Bound Journals	142

Following online databases were subscribed by the library during the year:

ACM Digital Library, AIAA, AIP, AMS, APS, ASME, Cambridge Online, IEL Online (IEEE), JSTOR, MathSciNet, Optic Infobase, Oxford Journals, Royal Society of Chemistry, ScienceDirect. IIST library has joined in the ISRO/DoS Library Consortium – Antariksh Gyan. Access to SPIE digital library and Journal TOCs Premium Service were enabled through Antariksh Gyan.

Library activities are automated by using an open source LMS – Koha. In addition to normal library services the following services were also provided during the report period.

Text Book Bank: Many books were added to the text book bank based on recommendations of the faculty members. During the period 7880 text books were issued to the students through this service.

Inter Library Loan: Through this facility 7 books and 34 articles were arranged from other libraries and 52 articles were sent to other libraries in response to their requests.

Web OPAC: The online catalogue was deployed in the campus intranet on 24x7 basis. This helped users to search the catalogue any where from the campus and also to personalise the services offered through LMS.

Journal TOCs: This current awareness service was offered for users to follow their favorite journals and keep informed about publishing of current articles.

Library Portal: Library portal show cased the online resources subscribed by the library with provision to search various resources in a single stretch. This also provided extensive information about the library with respect to various services offered by the library.

Graphic Design Facility: This is a vital facility widely used for designing of various documents of IIST, such as annual report, institute brochure, calendar, conference proceedings, magazine, course materials, news letter, students' publications etc.

Reprographic Facility: This facility was set up to meet the printing requirements of academic and administrative community of IIST. In the reporting year 7.29 lakh copies were printed by using this facility. An amount of 2.56 lakh was generated for providing this facility for personal purposes.

Binding Facility: All binding requirements of the institute were accomplished with this facility. In the report year, 5764 volumes were bound. The Graphic Design Facility, Reprographic Facility and Binding facility continues to cater to the publishing needs of the institute.

An exhibition of books on and by Dr APJ Abdul Kalam was conducted in the Library.

To familiarize and promote usage of electronic resources five Resource Awareness Programmes (REAP) were conducted for academic and administrative community of IIST.

7.2.2 Computer System Group (CSG)

Computer Systems Group has set-up and is maintaining common infrastructure in IIST for web and mail services, high-performance computing, wireless internet services, IT security systems, audio-video conferencing services, audio-visual and multi-media services, and physical-security and surveillance systems in IIST. IT services in IIST formally commenced with the formation of Computer Systems Group in 2010.

In-house capabilities have been developed to undertake uninterrupted operation and routine maintenance of these to ensure 24x7availability of information systems and network services in the campus.

CSG today caters to the needs of about 900 undergraduate, postgraduate and research scholars and about 600 staff-members together having about 1800 deskop, laptop and tablet PCs and smart-phones that operate round-the-clock 20 buildings across this campus

Computing Infrastructure

About 900 desktop personal computers are installed and maintained in all academic departments, laboratories and offices of the institute, and provisioned with access to the internet.

About 200 laptop personal computers are in use by members of the faculty and staff, and provisioned with wireless access to the internet.

About 900 'Bring-Your-Own-Devices' (BYOD), like laptop and tablet PCs and smart-phones, owned mostly by students, are provided with roaming wireless internet services in all hostels and academic blocks round-the-clock. About 50 workstations installed with scientific and engineering software are maintained in the laboratories and academic blocks.

CSG also maintains a 24-seat internet room as a common-facility for use by students in the academic blocks, a 4-seat internet facility for the 1st year undergraduate boys' hostel and a 2-seat facility in the undergraduate girls' hostel.

Comprehensive contract for maintenance and support of about 900 desktop PCs in IIST has been finalized and is under implementation.

A new open-source inventory and help-desk software titled 'IT Services Management System' that comprehensively covers all aspects of management of computer systems in IIST has been made operational by CSG. The software has facilitated discovery, management and audit of all hardware and software equipment existing within IIST, and access to this information over the network by all users.

High Performance Computing (HPC) Cluster maintained by CSG as a common facility in the institute, consists of a 3-TFLOPS Intel cluster, and are made available through remote-access to students and faculty-members through the campus network round-the-clock.

High Performance Computing (HPC) Workstations maintained by CSG as a common-facility, consists of a 10-seat HPC Laboratory, and is being made available for round-the-clock use by students.

Resident scholars have been facilitated round-the-clock physical-access to the work-stations in the HPC facility controlled through biometric access systems.

Utilization of HPC systems in IIST has exceeded hardware limits, and will be due for augmentation in 2014-15 on account of

processor and memory deficiency and end-of-technical-support.

Financial proposal for setting up of a new 32-TFLOPS Intel Cluster in the year 2017-18 to augment the 7-year old infrastructure is awaiting budgetary approval.

Financial proposal for installing additional 10 nos of Intel Graphic Workstations in the year 2017-18 to augment the existing 7-year old infrastructure is also awaiting budgetary approval.

IIST proposes to consolidate further HPC requirements of various departments and operate this as a common infrastructure in the coming years in order to improve utilization and hasten return-on-investment.

Networking Infrastructure of the campus rests on a 1Gbps OFC-based gigabit backbone interlinking core-switches and distribution switches of various administrative buildings and academic blocks.

The campus is fully networked with wired and wireless connectivity through 79 network switches and over 136 wireless access-points monitored and maintained round-the-clock.

Roaming wireless internet services permit use of any BYOD in all academic and hostel buildings inside the campus to access services over this network.

Several of the network equipment is due for augmentation on account of end-of-technical-support and advancement of technologies. Financial proposal for augmenting backbone bandwidth to 10Gbps in the year 2017-18 is awaiting budgetary approval.Financial proposal for provisioning wired networks in the rooms of faculty-members and labs in the year 2017-18 to augment the existing 7-year old wireless infrastructure is also awaiting budgetary approval.Augmenting and replacing faulty networking equipment appear to be more prudent than undertaking short-term maintenances of older technology through costly AMCs.

Internet Services using 1000Mbps link from National Knowledge Network (NKN) of the MHRD, Government of India, have been made available round-the-clock at all offices and academic and residential locations in the campus since 2011.

Additional 10 Mbps Internet link from BSNL facilitates web-hosting and also backs-up the 1000Mbps link in case of network-outages since 2011.

In the year 2015-16, peak daily internet usage remains under 136Mbps while average monthly internet usage has increased to 72Mbps.

Network & Internet Security Infrastructure consists of firewalls and unified threat management devices deployed in multiple layers of the network.

Security of networks and internet/email services has been enhanced with the introduction of gateway security devices in the year 2015-16. Security logs are now also being retained in separate servers for prospective use by audit or investigation agencies.

Server Infrastructure of consists of about 60 multi-processor hardware servers (including the cluster hardware). These servers have been optimally divided into numerous multi-platform virtual servers to cater to the need to host new academic and scientific software and web-applications of the institute on ad-hoc basis.

These host several web services and information systems for management of routine administrative functions and also academic functions like admissions, courses and exams.

No new hardware was procured or any additional expenditure incurred since 2011 as a result of implementation of server virtualization.

Existing server hardware are under maintenance contracts. However, many of the server hardware equipment are due for augmentation on account of cent-per-cent utilization, end-of-technical-support, lack of processor and memory resources, and advent of newer and faster technologies.

Financial proposal for replacing servers in the year 2017-18 to augment the existing - year old wireless infrastructure is also awaiting budgetary approval.

Information Systems and services currently facilitated through the server infrastructure are briefly indicated below.

Web and Content Management services hosted include:

www.iist.ac.in : Internet Web Server for Official Web Site
moodle.iist.ac.in : eLearning Server
nanosat.iist.ac.in : Nano-Satellite Project Blog
ns.iist.ac.in : External Name Server

Office and Student Mail services hosted include:

mail.iist.ac.in
studentmail.iist.ac.in
ug.iist.ac.in
pg.iist.ac.in
res.iist.ac.in

Internet Web Application services hosted include:

academics.iist.ac.in as Student Web Portal
icampus.iist.ac.in for Academic Management
admission.iist.ac.in for Counselling & Admissions
Online-registration portals for seminars and conferences.

Intra-IIST Web Application Services hosted include:

Students Directory, of all students admitted since 2007.
Office Orders, Circulars and Forms Directory.
Gate Pass Management System Software.
Canteen Material Management System Software.
Koha Library Management Software.

Management Information Systems hosted include:

COWAA client-server based MIS.
cowaamis.iist.ac.in web-based MIS.
pis.iist.ac.in web-based Personnel Information System.
COWAA Sybase Database Servers are operational on Linux platforms.
Network Management & Security Systems maintained include:

MRTG Network Bandwidth Monitoring Server
Wireless Network Management Server
Network Management Server
Network Anti-Virus and End-Point Security Server.

Software License Management Servers host licenses of the following scientific and academic software:

Sl No	Software	No of License	Sl No	Software	No of License
1	89601B_Education	15	21	CST Classroom License	10
2	Abacus	15	22	CST Full License	3 + 7(free)
3	Adams (MSC)	3	23	EMPRO	25
4	ADS	30	24	FEKO	1 + 9
5	Altair (hw9)	1	25	Maple 14,15,16	25
6	Altera 7.0	10	26	Mathematica	30
7	Ansoft	1	27	MATLAB R2009a	30
8	Ansoft (HsFs)	5	28	MATLAB R2013b	Floating UL(672)
9	Ansys	25	29	Modfrontier 4.4,4.5	5
10	AutoCad 2009	60	30	OPERA	10
11	AutoCad Inventor 2011 -3D	30	31	Phoneix	
12	AWR	40	32	Pointwise 17.3	1
13	Cadence	10	33	Saber (Synopsis)	1
14	Cadence (OrCAD)	20	34	Solidworks	60
15	Cadstar	6	35	Synopsis	10
16	Calibre	1	36	TCAD	5
17	CATIA	30 & 30	37	Tecplot	1
18	CFD++	4 & 60	38	XILINX	25
19	COMSOL 4.4	UL			
20	Coventor	6			

Multimedia, Audiovisual and Satellite Communication Facilities are maintained to support conduct of academic lectures and conferences in classrooms, seminar halls and meeting rooms.

Spacenet-based Video Conferencing was installed and commissioned in the year 2014-15 with the support of ISTRAC, Bangalore, after retrieving the satellite equipment that were installed earlier in VSSC-ATF campus of IIST.

In addition, IP-based Internet Video Conferencing has also been facilitated in the facility set-up in the Administrative block, making use of existing NKN connectivity.

This has enabled virtual conferences with various ISRO centres and other universities and research institutions in India and abroad.

Public Address Audio Systems and Multimedia Projectors have been installed in all Class Rooms and are maintained on daily basis to facilitate smooth conduct of classes.

Financial proposal for installing similar facilities in the buildings nearing completion of construction in the year 2017-18 is awaiting budgetary approval.

Multi-centre online-counseling for BTech 2016 Admissions was facilitated by CSG, by setting up ad-hoc local-area-networks and computers systems in ISRO centres in Ahmedabad, Bengaluru, Kolkata, Delhi and connecting each of these through ad-hoc 2Mbps wide-area-networks to IIST's server-facility in Thiruvananthapuram.

Identity, Access Control and Surveillance Network Systems have been established to facilitate round-the-clock access to various laboratories and facilities, and enhance security in the campus.

Smart-Card based Biometric Access Control Systems have been implemented in line with guidelines given by ISRO HQ to facilitate self-authentication based entry into the institute through its main entry gate.

Work orders are being placed to augment this system in 2016-17 by procuring additional turn-styles to lessen congestion at the main-entry-gate during morning arrivals and evening departures. The system would be extended to cover all students and staff in IIST, and information transferred to the central DoS/ISRO system.

BACS has also been installed at exit-points in various other buildings to record the time of return after work.

Smart Card Personalization and Photo ID Card Printing facilities have been set-up and are being operated and maintained in-house by CSG personnel.

Network Surveillance Camera systems are not fully functional due to non-availability of in all have been extended to all hostel buildings in IIST for improving security. Procurement of 70 additional cameras for

CSG has issued new format of BACS-based Smart ID cards to all IIST employees as per ISRO guidelines. About 500 personnel engaged on contract and temporary employment basis, and about 900 students enrolled in various academic programmes are also issued Photo ID-cards.

installing surveillance systems in the newly constructed Library block is in progress.

Public Address Audio Systems have been installed in the new classrooms in D2 Academic building.

7.2.3 Software Support Group (SSG)

Software Support Group (SSG), lead by a team of IT professionals provides various software services and technical assistance in Indian Institute of Space Science and Technology. SSG implement software services to the various departments such as Academics, Administration, Canteen, Purchase, Stores, and Accounts in the Institute. SSG has designed, implemented, customized, tailored and updated many applications within limited time constraint with accuracy. SSG plays an important role in providing software solutions based on Institute demand. The latest ongoing project under this group is entitled as "*i*-Campus" which automates almost all the academic functions in IIST campus. Completion of this software will wash out some of the existing applications that now remain as separate entities.

SSG Activities – A quick walk through

a. Software tools developed for various activities in the Institute:
   Analysis, Design, Coding, Implementation, Maintenance and Enhancement
   1. IIST Admission Software (Ph.D., M.Tech. and Undergraduate Programmes)
   2. IIST Muti-center Counselling Software
   3. Grading System
   4. Result Publishing System
   5. Student Profile Management

6. ISRO Absorption Counselling Software
7. Gate pass management system
8. Card Generation System(ID and Canteen Cards)
9. Convocation Portal
10. Payment Information System
11. Student/Staff Directory
12. Student Payment Information System

b. Customized Applications:
   Implementation, Maintenance and Enhancement
   1. COWAA IIST MIS
   2. Canteen Management System
   3. TOMD for Transport
   4. Diarising System
   5. Personal Information System
   6. Cheque Printing
   7. Online Registration for conferences and workshops.

c. Software Support:
   Technical and User support
   1. IIST Website
   2. COWAA Implementation in Administrative areas
   3. COWAA Database support, backup and trouble shooting

d. Other Activities:
   1. Website design for seminars/workshops on request
   2. Record keeping and document preparation
   3. Analyze and provide various reports and charts based on requirement
   4. Admission help desk management.
   5. Query response for admissions through email.
   6. Uploading and version control of applications in server.

e. Current Software Development:
   Analysis, Design, Coding, Integration and Testing
   1. Continuing Education Programme – Website
   2. *i*-Campus
   3. Campus Portal

7.2.4 Placement Cell

The Placement Cell at IIST continually liaise with industry, R&D organizations, and management Institutions, with the vision of Training, Career-Guidance, Internship/Project, and Campus Placements for our post graduate and undergraduate students. The Placement Officers in charge of the Placement Cell are Dr. Pradep Kumar, Assistant Professor, Department of Aerospace Engineering and Dr. Deepak Mishra, Assistant Professor, Department of Avionics.

The Placement Cell works in line with the policies of the Institute and tries to coherently match the interests of students with an appropriate job profile. The Placement Cell channelizes feedback from Industry, R&D Organizations and Management Institutions on

academic programmes, to the Institute. The Placement Cell continually functions to safeguard the interest of the students and endeavors to be a part of their safe and secure future.

A company/R&D/Management, registers with the Placement Cell, through an online job portal for the purpose of placement and internship. Upon registration, the Company will receive a Log-In ID and Password to input more details. The Placement Cell will appropriately co-ordinate to take the process further. The internship period for both B.Tech. and M.Tech. Programmes usually lasts for two months, tentatively from May to July, every year. However, internships which require more than two months, for selected M.Tech Programmes, can be worked out in line with the Institute policies and guidelines. The Companies /Organizations are welcome to contact the Placement Cell for further details and discussions.

Invited Talks / Workshops conducted by Placement Cell

Sl. No.	Company	Visited Personnel	Event
1	TCS	• Dr. Kesava Swamy, Head, Academic Interface Programme • Shri. Selvan Suryaprakasham, Quality Assurance Team, Head	Technical Presentation
2	Sebastian Associates	• Mr. George Sebastian, Corporate Trainer	Workshop on Soft skill Training
3	KPIT Technologies	• Mr. Krishnan Kutty, Associate Technical Manager • Mr. Chaitanya Rajguru, Leader for Center for Research in Engineering Sciences and Technology	Technical Presentation
4	Analog Devices	• Mr. Anand Venkitasubramaniom, Technical Head	Technical Presentation
5	NFTDC	• Dr. Balasubramaniom, Director	Technical Presentation
6	Measat Satellite Systems	• Mr. Lakshmi Narasimham, Principal Engineer	Expert Lecture and Workshop on Ground Station Design & Development
7	Dhruva Space	• Mr. Sanjay Nekkanti, Co-Founder	Expert Lecture and Workshop on Nano Satellite and Ground Station Activity
8	Ernst and Young	• Mr. Binu Sankar, Assistant Director • Mr. Brijesh Madhavan, Associate Director	Technical Presentation

7.2.5 Official Language Department

IIST has a full fledged Hindi Section which not only caters to the Constitutional and Statutory requirements regarding the Official Language, Hindi, but also creates a conducive environment for the officials of the Institute to learn Hindi and work in Hindi. Implementation of Hindi in IIST continued with vigor during the year.

Major activities related to Policy Implementation

- Four Hindi Workshops were conducted on June, 24, 2015 (for the Executives of the Administrative areas), September 22, 2015 (for the Employees of Technical areas) and on December 18, 2015 (for the Employees of Administrative areas) and on March 17, 2016 (for the Executives of Administrative areas).
- Four Quarterly meetings of the OLIC were conducted and four Quarterly Progress Reports regarding progressive use of Hindi in the Institute were sent to the Department of Official Language. Annual Report 2014-2015 was printed in Hindi.
- **Hindi Fortnight** was organized in the first half of September, 2015 with competitions for both Students and Staff of IIST. Merit certificates and cash prizes were awarded to the winners of various Hindi Competitions on September 30, 2015. Software Training in Hindi was also imparted to the staff.
- **World Hindi Day** was organized on Janauary 13, 2016 with the conduct of essay writing competitions in Hindi for the Faculty, Staff and Students of IIST. Merit certificates and cash prizes were awarded to the winners on March 17, 2016.
- Hindi version of Tender Notification and Conditions of Contract, Telephone Directory were prepared and Mark lists, provisional Certificates, and all other certificates such as certificate of participation/ certificate of merit etc. were issued in bilingual format (both Hindi and English).
- Standard forms used in various Administrative and other Departments were bilingualised, visiting cards, name boards and rubberstamps were prepared in bilingual format.
- In order to ensure the compliance of Official Languages Act, 1963, Official Languages Rules, 1976 and relevant orders issued by the Dept. of Official Language time to time check Points were re- established.
- In order to encourage the progressive use of Hindi **the incentive scheme for doing official work in Hindi** was continued.
- Provided faculty assistance for the conduct of OL workshops in various ISRO Units as well as other central government offices.

Participation in various programmes:-

- Participated in various programmes under the Town Official Language Implementation Committee of Thiruvananthapuram. Sr. Admin Officer, Hindi Officer, Jr. Hindi Translator attended the Regional Official Language Conference conducted by OL Department, Regional Implementation Office (South-west) Cochin on February 19, 2016.
- One representative each from Accounts, Purchase and Stores and Computer Group along with Hindi Staff attended the one day training programme on COWAA – Hindi conducted by the Department at Antariksh Bhavan, Bangalore on August 12, 2015.
- Hindi Typist attended the ten days Induction Training Programme conducted at ISRO HQ, Bangalore.
- Hindi Officer participated in the Official Language Orientation Programme conducted by PRL Ahemdabad on January 28 & 29, 2016
- Two delegates and two paper presenters participated in the Inter Center Hindi Technical Seminar organized by Master Control Facility (MCF) Hassan on March 22& 23, 2016.

Shri R. Jayapal, Hindi Officer presented papers in Seminars as given below:-

Sl. No.	Seminar / Venue / Date	Title of paper presented
1	Inter Center Hindi Technical Seminar ADRIN, Secunderabad, Feb 26, 2016	भारत सरकार के कार्यालयों में राजभाषा हिंदी के प्रयोग की संभावनाएं / The possibilities of use of Hindi in the offices of Government of India.
2	Inter Center Hindi Technical Seminar MCF, Hassan, 22nd and 23rd March, 2016	इसरो/अं.वि. में तकनीकी गतिविधियों तथा राजभाषा नीति के कार्यान्वयन में समन्वय /Co ordination between Technical activities and OL Implementation in ISRO/DOS. • He was awarded the First Prize for the best paper presentation in the Official Language Session.

7.2.6 Laison Officer for SC/ST

Being an autonomous body under Department of Space, the institute follows Government of India directives / orders regarding reservations, concessions, relaxation etc. In favour of Scheduled castes and Scheduled tribes. Register of roster pertaining to direct recruitments and promotions are maintained for both teaching and non-teaching staff. Shri V. Sennaraj, Deputy Registrar (Academics) has been appointed as Laison Officer in the Institute for this purpose.

7.2.7 Women's Cell

The Women's Cell was established in the year 2008 with the objective of addressing matters relating to women n the Institute. The mandate of the cell was

- To discuss and suggest methods to promote gender amity amongst all IIST employees and students
- To address the gender discrimination and sexual harassment cases whenever reported and recommend appropriate necessary action
- To suggest awareness lectures/workshop for IIST members on different aspects of women welfare
- To consider any other matter on women issues referred to the committee.

The Cell was reconstituted by the Director, vide Office order 414 dated 21-09-2015 with Dr. Nirmala Rachel James, Professor and Head of the Department of Chemistry as the Chairperson.

The institute celebrated International Womens day on 9th March 2016. The Chief Guest for the day was Smt Ajeetha Beegum IPS, Principal, Police Training College, Thiruvananthapuram. Being the first lady officer to command Independence Day parade of Kerala state in 201, her talk was an inspiration to not only the women members but all who gathered for the occasion. An interactive session was also organised with the renowned literary persona Smt Jaishree Misra on the same day.

7.2.8 Internal Complaints Committee

The Honourable Supreme Court has laid down certain guidelines and norms to be observed in institutions to ensure the prevention of sexual harassment of women in workplace. As per the directives in the Sexual harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act 2013, an Internal Complaints Committee was set up vide Directors Office order 424 dated 17.12.2015 Dr. Nirmala Rachel James, Professor and Head of the Department of Chemistry as the Chairperson. The Committee would facilitate gender sensitive and congenial environment in the institute and avoid gender specific discrimination or sexual harassment.

7.2.9 Anti Ragging Committee

As per UGC guidelines, an Anti Ragging Committee was constituted vide Office order no 413 dated 21st September 2015 with Director as the Chairman, Deans, Heads of Departments, Parent and student representatives and non teaching staff as members as a preventive measure against the occurrence of incidents of ragging. It is the duty of the committee to ensure compliance with the provisions of the UGC Regulations on curbing the menace of Ragging in Higher Educational Institutions, 2009 as well as the provisions of law for the time being in force concerning ragging and also to monitor and oversee the performance of the Anti Ragging Squad constituted in 2012 for the prevention of ragging in the institution.

7.2.10 Public Information Office

The Institute adopted the Right to Information Act, 2005 and has disseminated required information in a time bound manner. Shri S. Ramanathan, Senior Administrative Officer (Recruitment and Review) is the Assistant Public Information Officer (APIO).

7.2.11 Counselling Centre -Sameeksha

SAMEEKSHA - Counseling services at IIST started functioning as a full time department from 01-08-2015. A webmail - sameeksha@iist.ac.in was created to relate with every individual in this institution. Starting from the initial days, SAMEEKSHA has now become one of the most efficient and happening department within the institution. SAMEEKSHA stands for the mental wellbeing of the students and staff of the institution. The department has two full time counselors who are professional psychologists. The counseling centre makes appropriate referrals when professional assistance can no longer be fruitful. The confidentiality of the data is maintained and releases personal data only according to prescribed laws or institute policies. The services of the cell try to ensure that IIST is not just an institute, but a home away from home.

SAMEEKSHA organized different activities which ensure the cooperation of all the faculties and staff of the institution along with the students.

- Anecdote Competition as part of the World Suicide Prevention Day-10- 09-2015
- World Mental Health Day observation- "High Five" for the Dignity in Mental Health- 10-10-2015
- A talk on " Mental Health Issues in College Students" by Dr. K Gireesh, President, Indian Association of Clinical Psychologist (IACP)- 21-10-2015
- Initiation of Motivation Club among the students- 26-01-2016
- Personality Assessment Camp- 24-01-2016 to 1-02-2016
- Numbers of events were organized as to accelerate the social life inside the institute.
- Trance Workshop on Personal Empowerment (27-02-2016) for a group of common issues to organizing camps of different sorts that might help any individual at their personal level.

8 CAMPUS FACILITIES

8.1 Infrastructure - Buildings

The Institute shifted to its main campus at Valiamala from its alternate campus at Veli in 2010. The buildings housing Department of Aerospace Engineering has been completed and it accommodates Department of Avionics also. The Physical Sciences block is also completed amd accommodates all the other academic departmerts. The Avionics block, Inter disciplinary block and Student Activity Centre are nearing completion.

In addition to this 11 hostels, administrative block and librart are fully operational.

8.2 Hostels

11 hostels named after the mythological constellations 'nakshatras' viz. Dhruva, Dhanista, Chitra, Revathi, Rohini, Ashwini, Ardra, Phalguni, Anuradha, Arundathi & Vishaka accommodate around 813 students.

All the hostels has provision for safe drinking water with hot and cold water dispensers, 24 Hr uninterrupted power supply with generator backup, housekeeping services, reading room with national and vernacular newspapers, indoor games facility, LCD television with satellite connection etc. and centralized gym facility with modern fitness equipments. All hostels are WiFi enabled with High-Speed Access to the Internet, Digital Library and other Digital Learning Resources. A laundry service provider meets the needs of resident students.

8.3 Canteen Services

More than 700 inmates are residents in the Institute hostels. Canteen Services therefore is fully functional round the clock through two well equipped kitchens catering to needs of not only the residential population but also the regular functionary population of more than 300 people which includes Faculty members, Officer, staff.

Student Dining Halls viz. 'Aditi' and 'Akshaya' have a capacity of 150 each caters to the auxiliary staff also. In addition to this, 'Tripthi' and 'Subhiksha' is for the faculty members and VIP services respectively.

Menu is finalized by the Canteen and Hostel Committee which includes student representatives. In addition to this, Canteen Management Committee, Canteen Procurement Committee and Canteen Accounting Committee are constituted to assist the smooth functioning of the Canteen Services.

8.4 Sports and Recreation

Even though infrastructure development is still on its way, IIST has given utmost importance to sports facilities for its students. A Sports Ground (100m x 50 m) in the area earmarked for the future residential area is available to the students for all kinds of sports activity. This is now being upgraded to (100m x 100m). All the hostel are provided with Table Tennis tables. Academic blocks viz. Aerospace Building (D4) and Physical Sciences (D2) building are also supplied with TT tables. An open Basket ball court and Volley ball Court are alos available in the campus. There are two badminton courts in the Physical Sciences building.

Gymnasium

IIST is having a fitness centre to maintain Health and Fitness of students, which is situated in Hostel Dhanishta and Hostel Arundhathi. It features a selection of Cardio Vascular Endurance training machines, Resistance training equipments and free weights.

In Dhanishta building the Cardio area is composed of Two Club Momentum treadmills and cross-trainers located in first floor. The Strength training area is located in ground floor, composed of Body Fit and Muscle Fit selectorized equipment and a multitude of free weight equipment.

In Arundhathi building the Cardio area is equipped with two Stationary upright Bikes and two Body vibrators exclusively for the lady students. The strength training area is composed of Muscle Fit selectorized multi gym. Also provide varieties of instructional and fitness oriented classes like Yoga, Pilates, Aerobics and dance classes.

Additionally the Outdoor gymnasium housing with space for functional strength training and core training. This facility is extended to students for various training programme such as a Kettlebell workout, the Medicine ball workout and Jump rope workout.

8.5 Health Centre

Medical Centre extends primary health care to students and staff of the institute. It is operational with doctors and para medical staff on round the clock duty. Necessary medicines are kept available in stock. A fully equipped ambulance is always ready to meet emergency situations in addition to the vehicle which is assigned medical duty.

For cases requiring specialised treatment or hospitalisation, patients are referred to Sri Uthradom Thirunal Institute of Medical Sciences, Vattapara, Thiruvananthapuram located 13 kms from the Institute.ll students of the institute are having medical coverage which includes accident insurance coverage through this hospital.

Permanent staffs including faculty members, officers and other technical and administrative staff are covered by the Contributory Health Service Scheme (CHSS) of ISRO which meets their medical needs as well as that of their dependents.

9 AMENITIES

The following amenities are available in the campus for the students and staff.

9.1 Communication

The Institute has a central exchange from M/s BSNL with 250 direct lines to different departments, offices and facilities.

Centralised electronic franking takes care of outward postage.

Fax facility is available in most of the departments in addition to the centralised one available in the administrative office.

9.2 Bank

Union Bank has a fully computerised branch with all facilities including ATM in the campus.

9.3 Book Shop

A private run book shop with stationery is available in the campus.

9.4 Cafeteria

Private run cafeterias are present in the Aerospace (D4), D2 buildings and near the gate complex. A juice outlet is also available. All necessary requirements of stationery and other toiletries are met by the stationery counter operational along with the cafeteria.

9.5 Security Services

Private security personnel are engaged for the security of the Institute. Access control system also functions in the campus.

9.6 Transport

The transport section maintains a fleet of service through institute owned and vehicles hired.

10 EXTRA CURRICULAR EVENTS/ ACTIVITIES

10.1 Sports Activities

Sports Council, IIST organized tournaments in different sports and games in the year 2015-16.

Annual Sports Day

Annual sports meet 2015-2016 was held on 20th February (Saturday) 2016 at LNCPE (Kariyavattom) It was the grandest and the most awaited event in the college calendar. Shri. Jacob punnoose IPS(Chairman KSEDC& Ex DGP of the Kerala state) was the chief guest of the event who hosted the IIST flag.

This was followed by lighting of torch by the chief guest and other dignitaries. The meet declared open with various track and field events. Medals were distributed then and there to the winners, first Runner up and Second runner up.

Inter House Tournaments

Inter-house tournaments for events such as football, basket ball, cricket, volley ball, chess, caroms, table tennis, and badminton were organized for the students and the certificates were distributed to the winners and runners. These events spanned for a year long.

Zest Tournament

Students have participated in national level sports competition organized by College of Engineering Pune, ZEST on 23rd -26th January 2016. Around 20 students represented the institute in football and basketball.

Revels Cup Championship

Students of IIST participated in a national level Revels cup championship on 9th -12th march 2016, which was organized by Manipal University, Udipi Around 42 students participated in Cricket, football, volleyball, squash and badminton, (boys and girls). Volleyball team entered the semifinals and lost in the game against the home team.

Staff Faculty Cricket Tournament

The sports committee organized cricket tournaments for staff and faculty at LNCPE grounds and the match was played using stitch ball on 5th march 2016. There were 7 teams from different sections. Transfighters (ToMD) have won the tournament.

Inter Center Sports Meet

For the first time IIST made its debut to the inter center sports meet in Nov 2015, hosted by SCL Chandigarh. The faculty and staff participated in the events such as cricket and football.

10.2 Dhanak 2015 – The Annual Cultural Festival

Dhanak 2015 was organized from October 16th - 19th 2015, with Shri Rajiv Nath, the renowned Malayalam film director flagging off the program. It had a footfall of around 1200 people spread over four days, which was inclusive of around 800 college students and 400 school students. There was Around 40 events inclusive of online events were organized as part of the fest. The Flagship event, Battle of the Bands was partnered with MTVI Xtreme, who offered to let the winner of the event play in their festival in Bangalore/Mumbai. LQ GrandMaster Contest, a test to assess the reasoning and mathematical ability of the students was conducted for school students of classes VIII-X. Fun Events were conducted on a larger scale than previous years to engage the crowd. Two exhibitions one based on the life and work of our former Chancellor Dr. A.P.J. Abdul Kalam and the other one by ISRO were visited by students from the different schools around IIST and from the city. The whole campus was made vivid and lively through the efforts of the Deco Team. The pro-show by famous festival organizers VH1 Supersonic was the star attraction of the fest. The artist that performed was Thermal Projekt, which consisted of two people.

10.3 Conscientia 2016 – The Annual Technical and Astronomy Festival

Conscientia 2016 was the eighth edition of the Annual Technology and Astronomy fest of the Indian Institute of Space Science and Technology. The curtains for the festival were raised by the Director, IIST on the evening of 18th March 2016. The occasion was graced by the Chief Guest Dr. Kuncheria Issac, Vice chancellor, Kerala Technical University and the Guest of Honour Shri S Somanath, Director LPSC. With their inspirational words and the experiences they shared, Conscientia 2016 had a glittering start.

Challenges in a variety of fields ranging from Physics and Astronomy to Robotics and Aerospace Engineering, Conscientia 2016 proved to be an exhilarating experience for the participants from all around the country. Having a total footfall of 1200, in this Conscientia, the hospitality team were all geared up to host nearly 500 students coming from all across India. Students from far reaches of the country attended the event highlighting the name and fame Conscientia has gathered over the years.

Publicity for this extravaganza had started from the very beginning. Throughout the city hotspots, posters and decorations were put up. Pamphlets describing the vibrant event lists were sent to colleges and universities all across the country. The state-of-the-art website designed solely dedicated for catering to the needs of Conscientia 2016 (conscientia.co.in), enabled users to have full-fledged access to all information on events, event schedules and guidelines for the various programs in the college campus. Specially allocated transport was started to bring in participants from key locations of the city to the buzz of the campus. Vehicles were also arranged to facilitate commute back to the city zones late in the evenings after a power-packed day in the campus.

Guest lectures by renowned personalities and industrial magnates and a plethora of

events such as Robot Wars, Water Rocketry contests, Online Treasure Hunts, Contraptions, Astronomy sessions were held. Workshops on Drone technology, Robotics, Game development and Mind Control were some of the other highlights and saw the largest ever participation from outside colleges. Nearing the end of the workshops, the skies of the campus were filled with Sphere Drones made by the new Drone designers.

The new collaboration of the Kerala State Science and Technology Museum and Conscientia 2016, resulted in an Astronomy Night event which had nearly 200 students who took their Conscientia experience to cosmological scales. Experts from the field of Astronomy dove with students into an ocean of knowledge only bound by the ever expanding universe. Students stayed up throughout the night gazing at the Big Dipper, the Hunter and the Lion.

Three guest lectures, first on Gravitational waves by Dr. Sanjeev Dhurandhar, IUCAA, next on Digital to Analog Converter by Dr. Vajeed Nirman, Texas Instruments, and third on Aviation by Dr. Srinivas Dhruvvri, Director of Strategy & International cooperation, Airbus Group, were inspiring and all well appreciated by the crowds.

Seminars and demonstrations on hot topics like Gravitational Waves, Optics also saw a healthy participation. Time slots free from the fun filled schedule had the participants savouring the tastes offered by our food partners – Haveli Restaurants and Dominos. Mouthwatering desserts and delicious snack items were also offered by ZeroDegree and ChatWaala.

With an extravaganza of online events starting weeks before the fest, ranging from C language coding to Photography contests, a total prize money worth Rs. 3.5 lakhs were distributed to the winners. Sponsorship by companies and other organisations, like our highest contributor, the title sponsor, Union Bank of India, added a total of 3.5 Lakhs, which paved way for the smooth functioning of the programs.

With the Hospitality team having the opportunity to host the guests of the fest for 4 days, on 21st March, the events concluded with the Valedictory function. The speech by Mr. B Balakrishna, Regional Head, Union Bank of India was a real highlight were all the experiences he shared were a valuable addition to the students futre.




10.4 IIST MUN 2015

The fifth edition of Indian Institute of Space Science and Technology Model United Nations was held on 2nd and 3rd April, 2015. MUN is an academic simulation of the real United Nations, aimed at providing experience of diplomacy and international laws and relations. One of the major MUNs in South India and the largest in Kerala, IIST MUN conducted its first independent installment, not combined with any college fest.

The tagline for this year was 'Discuss. Deliberate. Devise.' The agendas aim at recreating the global scenario present at the end of World War II. They were as follows:

1. August 4, 1945: Negotiation on Terms of Ending the War and Assessment of Post War Compensation.
2. Deliberation on Formulation of Guidelines for a Peaceful World.
3. With total prize money of INR 30,000 and around 40 participants from various colleges and schools, the main event comprised of four sessions spread over a span of two days.

Mr. T.P. Seenivasan IFS was the Guest of Honour for the event and he was inaugurated the event on 2nd April. Mr. Sreenivasan is the Vice-Chairman and Executive Head of the Kerala State Higher Education Council with the rank of Vice-Chancellor. A former Permanent Representative of India to the United Nations, Vienna and Governor for India of the International Atomic Energy Agency, Vienna and Ambassador to Austria and Slovenia, he has served in the Indian Foreign Service for 37 years and has the distinction of having attended the most number of UN sessions by any Indian.

Prizes:

Best Delegate: Pranay Prakash, NUALS, Kochi represented USA Outstanding performance: Neha PRS, IISER, Thiruvananthapuram represented Ireland

Special mentions: Siddhart Bhati, NUALS, Kochi represented Japan and Pawan Reddy, NUALS, Kochi represented East Germany

Best First-Timer: Mrinal Rajeev, Trivandrum International School, represented Belgium.

Faculty Coordinator: Dr. Shaijumon C S, Reader, Dept. of Humanities

Student Coordinators: Ms. Ritu Anil Kumar & Mr. B Nidish Narayana.

10.5 Konchords – The inhouse musical bonanza

Konchords was conducted in IIST on September 23, 2015. There were a multitude of performances ranging from singing to dancing to the usual much appreciated stand-up comedy. There were a bunch of brilliantly choreographed dances and melodies that lifted the moods of everybody irrespective of the rains attempting hard to play spoilsport.

10.6 Induction (Orientation) Programme

A two day intensive induction program was offered for the first semester students by the Department of Humanities. The workshops are designed to provide information and support on issues relevant to new students and also to facilitate the easing of transition into the life of IIST as well as encouraging academic and personal success. The workshops were handled by trainers in the field, Dr AS Manoj and Dr Sanjay Mattoo. Some of the topics covered include *Self Esteem and Motivation, Positive Attitude, Goal Setting,* and *Creativity*. The program had classroom sessions and outdoor training activities.

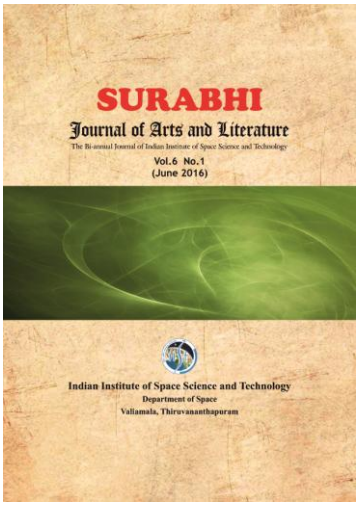
10.7 Neuro-Linguistic Programme (NLP)

The Department of Humanities organized an NLP programme for the first semester students. It was a three day orientation programme for individual groups of students. The session was handled by the "Mind Masters" fame Dr. Abraham Abraham. This programme is structured in such a way as to guide them properly through proper mind mapping, to identify their talents and hidden potentials, to understand their positives and negatives, and to improve their mental abilities and skills.

10.8 Inhouse Publications: Drishtikon, The Sounding Rocket & Surabhi

Drishtikon is the student newsletter of Indian Institute of Space Science and Technology. It is an annual newsletter which allows students as well as staff and faculty of the institute to showcase their artistic side. Drishtikon has separate sections for Hindi and English entries. Entries may range from prose and views on world issues like current affairs to poems, sketchings and paintings.

The Sounding Rocket (TSR) is the biannual student newsletter composed and designed by students at IIST chronicling life and times at the institute. Originally started by enthusiastic students who felt the need of a student newsletter in our institute, TSR started off as a crowd sourced entity. Currently, it is funded by the institute which provides resources for the printing of its hard copies, and a Publication Committee which oversees the content published.It includes news about latest developments in the institute, current affairs in general, pop culture, reviews, campus news, opinions, comic strips etc. Both students as well as faculty members contribute to it. The editorial body consists of interested students with a good representation of all years and streams. Through its columns, The Sounding Rocket aims to promote one's desire to read things and cultivate a literary and artistic appreciation of life, for which it conducts a Literary Fest with events like Movie Critique, Book Panel Discussion and Comic Panel Discussion. Release of each issue of TSR is avidly awaited by every one of its readers.



As a platform to showcase the creative aptitude of all employees of DOS, an Institute bi-annual Journal, Surabhi: Journal

of Arts and Literature is being published with Sri P. Radhakrishnan, retired Deputy Director, LPSC (Known as Space Radhakrishnan) as the Chief editor and Dr Gigy J Alex, Assistant Professor, Dept of Humanities as its Associate editor. It is a bi-annual journal that will publish poems, stories, memoirs, critical reviews, reports, interviews, sketches, paintings, and photographs. The journal has successfully completed its 6 issues and has currently invited articles for its next issue.

10. 9 IIST – SPIC MACAY collaboration

As part of "National Conference on Materials Science and Technology (NCMST-2015)" organised by Department of Chemistry, a cultural evening with a mind blowing **Rajasthani Folk dance and song theme** performance led by Shri Deen Mohammad Manganiar was arranged through Spic Macay on July 7, 2015.
SPIC MACAY and IIST hosted a workshop on **Tie & Dye- Rajasthani art** led by Mr Babulal Nama and his wife for five days from 9th to 13th August, 2015. As part of the workshop, an exhibition cum sale of the tie and dye products was aslo held.

IIST in collaboration with SPIC MACAY hosted the performance of **Smt Sujata Mohapatra**, one of the finest **Odissi dancer** in the country and the senior disciple of Guru Kelucharan Mohapatra on Nov 5th, 2015 which was indeed an enthralling expereince for dance lovers.

10.10 Fresher's Day @IIST

The second year IISTians organized a Fresher's Day on August 13th 2015 to welcome the first year students to the campus. This was followed by an orientation about the various clubs and membership drive for the various clubs.

10.11 Field Trip

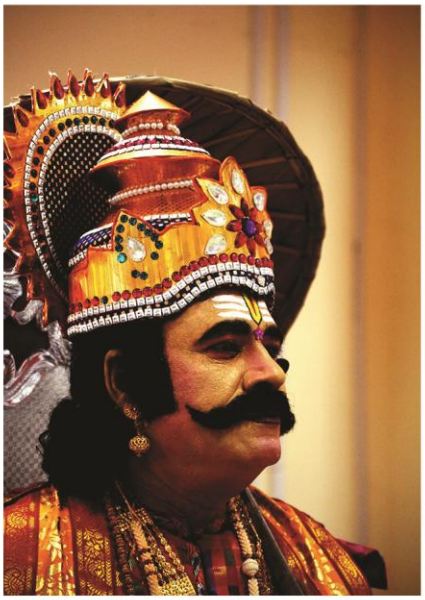
A trip to study the tribal community in Kodaikanal and Wayanad were organized for the 3rd year and 4th year students by the Department of Humanities from 28th -31st September 2015 and 3-5 February 2016 respectively. The students talked to the tribal people and tried to understand the primitive life and cultutre, the changes that is happening in the tribal community due to modernization as well as due to the climate change.

11 CELEBRATIONS @ IIST

11.1 National and Regional Festivals

The Institute celebrated Independence Day and Republic Day in all its dignity and fervour during the report year 2015-16. Other regional festivals such as Onam, Holi, Ganesh Chathurthi, Diwali, Raksha Bhandan were also celebrated.





The harvest festival of Kerala, Onam was celebrated with all enthusiasm in IIST on August 27th 2015. It witnessed the coming together of students, faculty members and staff of IIST as a family and tried to inculcate a Spirit of harmony and brotherhood. The program took off with the competition of intricately decorated athapookalam from 7.30am, followed by onam procession, onam message, exotic and traditional cultural programs, sumptuous onam feast and onam games. Shri T K A Nair IAS (Retd), Former Principal Secretary to the Prime Minister of India delivered the Onam message.

11.2 International Yoga Day Celebrations

Asatomā sad gamaya
Tamasomā jyotir gamaya
Mrityormā amritam gamaya
Oṁ śhānti śhānti śhāntiḥ

The first International Yoga Day was celebrated amidst an energetic group of students, faculty and staff members at IIST on 21st June, 2015. The inaugural function commencing at 9:30 in the morning was graced by Dr. Kuruvila Joseph (Dean, Student Affairs) who delivered to the gathering a inaugural address about the universal acceptance of Yoga for healthy lifestyle. This was followed by a Yoga practice session under the guidance of Yogacharaya Shri. Rayaroth Surendran, a trainer from International Shivananda Yoga Vedanta Center and two of his advanced pupils, Kumari Norin Pereira and Shri Kannan V. A.

Beginning with a motivational talk on health befits of yoga, Shri. Rayaroth Surendra directed the audience about right breathing before teaching warm up exercises for the eyes, neck, fingers, shoulders and the waist. Reiterating the validity of Swami Vivekananda's words "Health is wealth. Peace of mind is happiness. Yoga shows the way", his pupils demonstrated effortlessly the Surya Namaskara, and other aasanaas ending with Shavaasana, instantly inspiring majority of the audience to strive towards the same. Alongside the instructor, Dr. Priyadarshan (Assistant Professor, Avionics) and the volunteer students assisted the enthusiastic novices.

At the end of the long practice session tastily yet healthily cooked tapioca was served along with black tea as refreshments. A number of posters on yoga were on display. By means of attractive graphics in the context of health, stress relief, permanent cure to many common diseases, prenatal health, improving body metabolism, better lifestyle, closeness to nature etc., the posters more than conveyed how simple it could be to include Yoga in our daily life.

The post-break session commenced with the prize distribution for the Essay competition winners and for the best practitioners selected from the first session on yoga demo. This was followed by two talks on vast topics of "History, Concept and Philosophy of Yoga" by Shri. Jayaprakash and "Yoga and Diet" by Dr. Madhankumar.

Shri. Jayaprakash, a teacher of Yoga philosophy and theory at the Santhi Yoga Teacher Training Institute in Thiruvananthapuram, captivated the audience by dealing in simple terms the complex philosophy of Yoga. What is generally understood to be only a system of coordinated movement of muscles was revealed to be a path towards unison of the individual with the undivided. Emphasizing that Yoga is separate from any religion he explained in layman-terms the eight folds of Ashtaanga Yoga and also the four streams of Yoga tailored to suit people of different temperaments. A true Yogi, he quoted, is one who is akin to lotus growing in a marsh – neither the beauty nor the fragrance is tarnished by the state of the surroundings.

Dr. Madhankumar who is an Ayurveda Physician, Course Instructor and the Consultant physician at Vasudeva Vilasom Ayurveda Nursing home, took the dais at the hard time of the lunch hour having to deal with the stimulating topic of diet. He energetically kept firing questions at the audience inviting them to put forward their thoughts on questionable statements like "Yogis of past have lived for more than centuries!" Attributing everything to the maintenance of health Dr. Madhankumar

spoke about the science of cooking, serving, dining everything else one could think of with reference to food. The main points he stressed on in his talk included the classification of food based on taste by the Yogic tradition and the necessity of satisfaction of the five human senses by the diet we intake. He also explained the proper order, combination and quantity of intake of diet at breakfast, lunch and dinner. He connected the health and longevity of a human to the breating rate. Keeping good humour he conveyed effectively that for a healthy lifestyle it matters not only what we eat but also when we eat.

A wholesome meal was served as lunch. Among the delicacies were chappathi, vegetable kofta, porridge and sprouts with fruit salad, paruppu payasam and pappad perfectly complementing the main dishes. The rare healthy meal was hard to forget.

After lunch, an interactive session with Shri. Shreekumar, a practitioner of Yoga was held. He was a rare gem with more than three decades of consistent meditation practice. Those enthusiastic about experimentation oriented learning of mediation phase of Yoga had much to gain as Shri. Shreekumar behaved as a true guide in providing logical proof to each experiment proposed. Not allowing anyone to be caught up in only gathering of data he encouraged each one to be watchful of their own mental behaviours as a first step to conquering the mind.

At the successful conclusion of The International Yoga Day, 2015 everyone who participated left a changed person with more awareness towards their own physical, mental and social health.

11.3 National Remote Sensing Day Celebration

National Remote Sensing Day is celebrated on 12th of August every year to commemorate the birth anniversary of Dr. Vikram Sarabhai (Father of Indian Space Programme).

As part of the celebrations this year, the Department of Earth and Space Sciences-IIST, conducted quiz, essay writing and painting competitions for VIII-XII Std Govt school students of Vithura, Panacode, Karipur, Nedumangad and Aryanad.

11.4 Mathematics Day Celebration

On 22nd December 2015 as a part of the Mathematics day celebration Dr. Shrihari Sridharan, Dept. of Mathematics, IISER Trivandrum delivered lectures.

11.5 153rd Birthday celebration of Swami Vivekananda

In connection the 153rd birthday celebration of Swami Vivekananda, the Students Activities Board of IIST has organized a lecture on "Swami Vivekanda: The Awakening for India" by Shri T P Sreenivasan IAS, former Indian Ambassador to USA on 13th January 2016 Wednesday at 3pm.

12 CLUBS @ IIST

12.1 Aeroclub

AeroClub, IIST is a student endeavor in the campus that tries to instill the engineering and scientific aptitude among IISTians through its various activities. Founded back in November 2013, the club has since then organised various demonstrations, workshops, talks, sessions, seminars and competitions. The club is run by a mix of students from all batches and supported by two faculty mentors.

The concept of the club is to provide a platform for students at IIST to try out various innovative ideas that involves application of the fundamental engineering concepts. The club has conducted workshops, talks and competitions across various disciplines of aerospace, avionics and mechanical. By conducting the SpaceUp Unconference India 2015 with the IIST alumni, it has acted as a bridge between IIST and the outside industry. The club is one of its kind in the sense that the senior students guide the juniors regarding certain ideas and concepts while the juniors reciprocate them in terms of excellent work, and in the process, both of them learn something new, which is quite enthusiastic. The same has been showcased in the form of AeroClub Summer Projects, which recently completed its third consecutive year. Workshops on topics of interest such as Hovercraft, RC Glider, and Ornithopters organised by AeroClub are usually packed with immense participation from students of all discipline and batches and the projects done by the students in these fields have been quite innovative. Club's outreach has been to various industry experts both inside ISRO and outside of it, where it has invited eminent personalities to discuss topics in its OpenHouse sessions. Few noteworthy are talks given by RLV Project Director, Shri Shyam Mohan, Prof. K Ninan, Prof. R V Ramanan and from Airbus VP, Bangalore. The club also seeks out to merriment and fun occassionally, organising certain GoPublic events such as Kite Flying, Hot Air Balloons where for a short period of 30-40 minutes, the crowd enjoys pleasure of flying or the sight of flight.

Many projects undertaken by members of the club and others under it have been promising in results. These projects are partially funded by the Club and thoroughly reviewed by the faculty of IIST. Few notable are QuadCopter design, 3D Printer, RC Plane and Ornithopter, Two Stage Water Rocket. These works are regularly presented in the sessions organised by the club. All the activities of AeroClub are summed up in its annual magazine, UDAAN. Till date, two editions of UDAAN have been released with third one in the process.
Overall, the club seeks out to keep up to the principle, 'Knowledge and happiness are best enjoyed when shared', through the little efforts of it own. Its the students contributing to the club endeavors and the student participating in it who live this beautiful principle. Hope that

this spirit of collaborative engineering and learning grow stronger in the days to come in our marvellous campus.

12.2 Astronomy Club

The Astronomy Club of IIST is an active student club started way back in 2007 which holds it sessions every week on Friday nights. The sessions consist of informative presentations by students, dynamic discussions, educational videos on the topics of astronomy and astrophysics, lively quizzes, night sky watching sessions, and occasional guest lectures by members of faculty of IIST as well as other institutes. Along with its regular activities, in the past year the club has also organised overnight sky watching sessions during meteor showers. The club provides a platform for students to interact and share knowledge, indulge in self-education and encourages the pursuit of scientific learning outside the academic courses provided by the institute. The group is active on Facebook with posts related to recent discoveries and research in the field.

12.3 Satclub

The Satellite club of IIST Started in the year of 2015.The club is envisioned to foster the Ongoing nanosatellite program and train students to contribute.It also acts as a R&D wing for the ongoing program and platform for developing new ideas and innovations. The club has a prominent resposible hierarchy of Student as EB,Managers and engineers. The Engineers are the apprentise under thier dedicated Managers.The Subsytem-wise managers are inturn behelded by members of Executive Board. As another leap, the club is part of all recent collaborations in Small satellite designing with differrent institutions across the globe.

12.4 FOSS Group

The FOSS Group, IIST is IIST's FOSS chapter aimed at promoting the use of Free and Open Source Software tools in the fields of core research pertaining to Aerospace, Avionics and the physical sciences. The group, germinating from the basic idea of a shared and thus free community, is aimed at promoting a complete or near-complete adoption of FOSS based platforms for all academic research and development activities going on at IIST. The group revolves around conducting and hosting software workshops, lectures and other activities designed at improving the overall comfort of students with FOSS software and scientific computing in general. It must also be noted that the FOSS group at IIST is India's only FOSS group with special emphasis placed upon space science and related fields.

12.5 Eco Club

Eco Club @ IIST, inaugurated as a club for students and faculty on 19.09.2012, it a formal body to make our campus, clean and green. It deals with activities related to campus environment, maintenance of its ecology, hygiene, and waste disposal. This club is initiated under the special interst of students, teachers and staffs from various departments who are eagerly interested in nature and its preservation. The ultimate aim of this club is to emerge with a unique way of preserving our campus which may serve as a model system for institutes throughout the country. The Most frequent activities o fthe club are: Observance of Earth Hour, campus cleaning drives, disposal of non biodegradable waste, organic farming etc. Projects undertaken include Statistical Estimation of resources, Bio Gas Plant, classes for cleaning staff to do work efficianetly, frequent monitoring of garbage dump, waste segregation etc.

12.6 Photography Club

This club has a moto "Photography is an art of observation. It has little to do with the things you see, and everything to do with the way you see them." – Elliot Erwitt. We spread love for photography among the IISTians. We discuss about the works of different photographers and

their techniques. This club also teach about the technical aspects of camera and post-processing of images (Digital Image Processing)

12.7 Quiz Club

The Quiz Club of IIST is an informal gathering of quizzing enthusiasts which meets every Friday to hold a quizzing session. The club is one of the most regular clubs on campus. Teams of two take part in the quiz which is usually held by a volunteering member (or team). There is no prize as such, just respect from fellow members. Teams from this club represent the college in various intercollegiate events. One team, won Rasathanthra 2014, a national level renewable energy quiz and another team won the General Quiz held in CET, Trivandrum runners in 2016. The club members are also responsible for organising quizzing events during the annual cultural and technical festivals.

12.8 Movie and Performing Arts Club

The Movie and Performing Arts Club of IIST is an active student club which holds its sessions approximately once every two weeks on Saturday nights. These sessions usually consist of the screening of award-winning and critically acclaimed movies. In the past year, this club has seen an admirable increase in the staging of skits and short plays, written by the students themselves, which has popularised a healthy culture of performing arts and stagecraft in the college. Collaboration on these plays has strengthened relationship between the juniors and seniors.

12.9 Social Outreach Clubs

Nirmaan

It's an IIST students initiative started in the year 2015 to give a helping hand and counselling to deprived students. In initial phases members used to go to tribal schools nearby and later started the weekend classes at IIST. As the institute aim towards social development of the surrounding area, the members of Nirmaan are trying to achieve this by providing weekend classes to students nearby the institute.It organizes classes twice a week for 2 hour. And members help students to explore the area of basic sciences and moral values.Nirmaan has helped students to look at sciences in an experimental way by demonstrations and also by giving guidance for their future endeavours. It conducts small competitions to encourage students to show up their skills.

Panacea

It is the social outreach club of IIST. Every week end the students from the neighbouring schools and villages in the class of 5-12 are brought to IIST and given remedial teaching by the students of IIST. Remedial coaching is offered in the subjects of science, maths, english and social studies. The students of IIST have visited 2 orphanages such as "Nirmala Shishu Bhavan", "Divine Children's Home, Poojapura" and are helping the students out there in their studies. These students were also brought to IIST during Dhanak to give a feel of the cultural fest of iist and also to witness the exhibition organized as part of Dhanak. A blood donation camp was also organized during Dhanak. Most of the festivals were celebrated with the orphans and the elderly who are left alone in the old age homes. The students of IIST have been donating generously for these social cause and have also been arranging dresses, toys, bags and books for the kids in the orphanages and for the elderly in the different old age homes.

13 ALUMNI ACTIVITIES

SPACE-UP

Alumni of IIST proudly organized the much-awaited third edition of SpaceUp in India, the unconference of space, in IIST campus on 5th September 2015. Around 300 participants took active part in the discussions pertaining to Space Sciences. There were sessions dealing with a multitude of topics ranging from space biology, which talked of the possibility of lifeforms we three dimensional beings are unable to comprehend, to the theory of black holes.

Astronomy and Astrophysics

The morning session in the Seminar hall was presided over by Dr.Umesh R. Khadane where a discussion on black holes, white holes and supernovas took place.

"The cosmos is within us. We are made of star-stuff. We are a way for the universe to know itself."

This quote by Carl Sagan signaled the beginning of the discussion on supernova. Nuclear fusion generated pressure balances self gravity of a star, and throughout the life of a star, there is a constant tug-of-war between these two forces. After a few billion years, when the lighter nuclei become rare in the core, the hydrogen in the region b/w core and crust fuse. The resulting pressure will expand the star, and compress the core. The core keeps getting compressed, till the gravitational pressure equals electron degeneracy pressure. Beyond that it explodes as a supernova. Elements up to iron can be formed by the fusion reaction in the star's core. But once iron is formed, it won't fuse, as it highly stable. As a result, gravity overcomes fusion pressure, and a supernova is triggered. Heavier elements in the periodic table are formed due to the fusion of iron DURING a supernova due to the extremely high energy of the explosion.

The discussion on black holes talked about a general introduction to the concept including their formation when supermassive stars collapse under gravity. Other topics discussed included event horizon, singularity, Schwarzschild radius, time dilation and also, the concept of gravitational lensing. The discussion on white holes were of a similar basis, only many weren't aware of the term white holes. White holes, to put in simple words is exactly the opposite of a Black Hole. You cannot enter a white hole, you only come out of it. There was a heated debate as to whether a Black Hole and a White Hole could be the two ends of a wormhole, as you can only enter a Black Hole, and only exit from a White Hole.

Dhruva Space

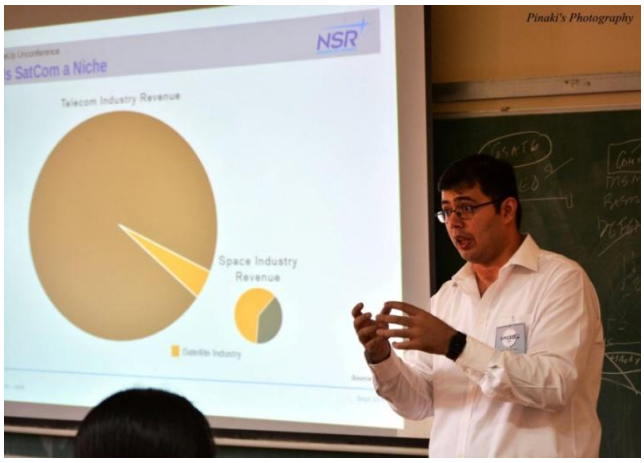
Dhruva space, who helped organize this edition of SpaceUp, had begun as one of India's first dedicated space startups. A very interesting point discussed was the setting up of Space Parks, much like the IT parks prevalent today. They could be office spaces with advanced equipment provided for the use by a large number of industries. Co-founder Mr. Narayan Prasad addressed the absolute need of exploiting the private space industries. Ventures between ISRO and private space companies (public private partnerships) were emphasized. While there were arguments regarding viewing private industries as competition, the

possibility of technological advancements made by private industries backed by the research based approach of governmental organizations made clear that the aforesaid private companies are neither out to destroy the credibility of governmental organizations, nor take away their jobs.

Supercharging the future of Indian Space: National Space Society

The session by the National Space Society official Mr. Mark Barthelemy explored areas of outreach programs to inspire and encourage students to explore space education. While suggestions such as outreach programs to high schools and videoconferencing sessions were deliberated, exhibitions during Technical fests of colleges were accounted for as an option. Opportunities regarding internships and projects were encouraged and the possibility of across university collaboration especially with KAIST and other Korean Universities for projects were seen as upright options. Participation at the annual International Space Development Conference conducted by NSS was also welcomed. The next conference is in Puerto Rico and is expected to bring together leaders in space technology and applications.

Northern Sky Research



A Senior Analyst at Northern Sky Research, Mr. Prashant Butani talked about Business of Satellite Communication. He compared the revenue generation of the telecom industry and satellite industry as well as the advantages of satellite communication and brought out the needs for popularizing the area. He then talked about High Throughput Satellite (HTS) which provide better throughput for the same orbital spectrum as that of a Fixed Satellite. These new generation satellite can provide considerably better coverage at remote location with significantly reduced cost. Mr. Bhutani, while talking about the Wi-Fi speed at IIST, suggested the use of a VSAT to speed things up a little bit.

Mr Ramesh Nagasamudram

Mr Ramesh is the Engineering & Services VP at Aniara communications LLC and spoke about commercialization of satellites. Aniara focusses mostly on DTH and telecommunications because as was explained in the lecture by Mr. Prashant Bhutani, the two account for more than 90% of space applications. The current scenario of Indian policy is not encouraging for companies like Aniara due to which they are based in the USA and operational in India. The work involves the design and manufacture of satellites which are often designated to other firms but final rights lie with the original company which enters into agreements with parties requiring the services.

Rocketeers

The talk was given by Divyanshu Poddar, co-founder of rocketeers and an IIST Alumnus. Rocketeers conduct model rocketry workshops all over the country. They aim to help students understand rocket science in a cooler, more exciting fashion. DivyanshuPoddar

talked about the different kind of rockets they developed and the difficulties which they faced. They have successfully built 3 model rockets. Smallest of which goes up to 300 feet and the largest which goes to 1100 feet and has a payload capacity of 10-12 grams. They have done approximately 1300 successful launches. The most fascinating part is that the motor is made from paper (and it sustains that much of thermal and structural loads). Using model rockets as an educational tool was also discussed, not only for school students but Aerospace undergrads as well. Model rockets can be used to understand flight mechanics, propulsion and many disciplines easily.

Space Law

The discussion on Space Law by Dr. RanjanaKaul brought out the legal concerns of Space Technology. It started with a discussion on the demarcation of Airspace and Outer Space and the laws governing their use. The Moon Treaty with its 5 ratifications and 11 signatories and Anti-Satellite Weapons were discussed next, highlighting the space in Space Law that parties use to act in their own interest. A further discussion on Kessler's Law and Liability in case of damages brought out the need for accurate analysis of accidents in space for Space Laws to be upheld. The intriguing talk brought out the socio-political side of a branch considered completely scientific. Dr. Kaul concluded by asking the audience to not limit their multi-dimensional human brains and absorb information wherever and however possible.

Space Generation Advisory Council: Ms Joyeeta Chatterjee

SGAC is a volunteering organisation with a volunteer base across the continents. The discussion was regarding the work of the SGAC and its functioning. Aspects of scholarships provided and conferences held were discussed and the possibility of joint ventures were also discussed. Ms. Joyeeta having studied space law also took questions and participated in discussions pertaining to the legal concerns a Space Entrepreneur might have.

Team Indus

Team Indus began when a bunch of techies came across the words Moon 2.0. With a wonderful twist of fate, they ended up being India's only team participating for the Google Lunar X prize and to make the fairy tale even more magical, they won 1 million USD in January 2015 for successful completion of their test of landing. SpaceUp, Trivandrum saw an incredible amount of enthusiasm of participants in interacting with the team represented by MrDhruvBatra and Mr Nakul Kukar. They spoke of the present ventures and also a few future ventures such as satellite busses of high altitudes and long endurance. The team consists of 60 or so engineers working towards making their lunar dream come true along with the guidance of former ISRO scientists. We wish them the very best of luck.

Overall, the participants were of the view that this was a unique and brilliant initiative that is definitely something that should be a regular feature. Quoting one of the participants, 'we at IIST see the space industry as a very ISRO centric universe. SpaceUp helped us understand that there are so many more exciting areas of study related to Space and so much scope for a life beyond the government sector. Another participant was very enthusiastic about the opportunities and the ideas that SpaceUp helped realize. They found it wonderful that it was a forum where anybody could speak irrespective of qualification and just based on interest. On a concluding note, TSR, on behalf of all participants, congratulates the organisers of Spaceup on bringing such an enriching experience to the students with minimum road bumps, and hopes to have the pleasure of reporting more such events in the future.

Audit Report
2015-2016

INDEPENDENT AUDITOR'S REPORT

We have audited the accompanying financial statements of M/s **INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY (Society), Valiamala PO, Trivandrum-695547** which comprise the Balance Sheet as at 31 March 2016 & the Income and Expenditure Statement for the year then ended, and a summary of significant accounting policies and other explanatory information.

Management's Responsibility for the Financial Statements

Management is responsible for the preparation of these financial statements that give a true and fair view of the financial position & financial performance of the Institute in accordance with the Accounting Standards issued by the Institute of Chartered Accountants of India. This responsibility includes the design, implementation and maintenance of internal control relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

Auditor's Responsibility

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with the Standards on auditing issued by the Institute of Chartered Accountants of India. Those Standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgement, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or

error. In making those risk assessments, the auditor considers internal control relevant to the Institute's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of the accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Basis of Qualified Opinion:

1. The balances in personal accounts are subject to confirmation by respective parties.

2. No provision for gratuity, pension and leave encashment has been provided in the accounts as specified in 4.d of Notes forming part of accounts.

Qualified Opinion

In our opinion and to the best of our information and according to the explanations given to us, subject to the above mentioned opinion, the financial statements give the information required by the Act in the manner so required and give a true and fair view in conformity with the accounting principles generally accepted in India:

i in the case of the balance sheet, of the state of affairs of the Institute as at 31st March 2016;

ii in the case of the Income and Expenditure statement, of the deficit for the year ended on that date;

SUBRAMONI & MADHUKUMAR * CHARTERED ACCOUNTANTS * TRIVANDRUM

For SUBRAMONI & MADHUKUMAR
Chartered Accountants

C.A. SUBRAMONI. J. Bsc.FCA
M.No.204157 (Mg. Partner)
FRN.008570S

Place: Thiruvananthapuram

Date : 27th September,2016

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

BALANCE SHEET AS AT 31ST MARCH, 2016

(Amount in Rs.)

	Schedule	As at 31.03.2016	As at 31.03.2015
CORPUS/CAPITAL FUND AND LIABILITIES			
Corpus / Capital Fund	1	2,40,18,26,461	2,49,45,66,190
Reserves and Surplus		2	2
Earmarked Funds / Endowment Funds	2	28,31,975	57,72,464
Long Term Liabilities and Provisions	3	6,31,76,610	3,26,59,681
Current Liabilities and Provisions	4	19,29,02,942	6,16,21,461
TOTAL		**2,66,07,37,990**	**2,59,46,19,798**
ASSETS			
Fixed Assets	5	2,01,44,20,962	2,10,53,85,917
Long Term Assets, Loans, Advances etc	6	6,06,02,050	5,98,71,919
Current Assets, Loans, Advances etc	7	58,57,14,978	42,93,61,962
TOTAL		**2,66,07,37,990**	**2,59,46,19,798**
Significant Accounting Policies & Notes on Accounts	16		

As per our report of even date attached.

For Subramoni & Madhukumar
Chartered Accountants
FRN : 008570S

C.A. Subramoni J.
(Partner, Mem No. 204157)

Place : Thiruvananthapuram
Date : 27th September, 2016

For and on behalf of
Indian Institute of Space Science and Technology (IIST)

Dr. V. K. Dadhwal
Director

R. Hari Prasad
Finance Officer

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2016

(Amount in Rs.)

	Schedule	2015-16	2014-15
INCOME			
Grants / Subsidies	8	56,50,00,000	43,00,00,000
Fees / Subscriptions	9	94,80,645	4,80,58,629
Interest Earned	10	87,44,833	99,14,490
Other Income	11	30,37,245	23,64,499
Surplus/Deficit of Canteen Accounting Committee		43,83,931	19,36,171
Surplus/Deficit of Student Activities Account		(7,10,617)	83,132
TOTAL (A)		**58,99,36,037**	**49,23,56,921**
EXPENDITURE			
Establishment Expenses - Regular	12	16,09,56,717	15,02,32,609
Establishment Expenses - Support Services	13	9,12,82,223	9,07,58,569
Academic & Other Student Expenses	14	14,83,09,987	13,66,04,766
Other Administrative Expenses	15	10,43,59,055	9,26,27,225
Depreciation	5	19,55,76,567	20,49,24,916
TOTAL (B)		**70,04,84,549**	**67,51,48,085**
Excess of Income over Expenditure (A-B)		(11,05,48,512)	(18,27,91,164)
Less : Prior Period Items		(2,63,08,783)	1,48,24,193
Balance being Surplus/(Deficit) carried over to Corpus/Capital Fund		**(8,42,39,729)**	**(19,76,15,357)**
Significant Accounting Policies & Notes on Accounts	16		

As per our report of even date attached.

For Subramoni & Madhukumar
Chartered Accountants
FRN : 008570S

SUBRAMONI & MADHUKUMAR * CHARTERED ACCOUNTANTS * TRIVANDRUM *

C.A. Subramoni J.
(Partner, Mem No. 204157)

Place : Thiruvananthapuram
Date : 27th September, 2016

For and on behalf of
Indian Institute of Space Science and Technology (IIST)

Dr. V. K. Dadhwal
Director

R. Hari Prasad
Finance Officer

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2016

(Amount in Rs.)

	As at 31.03.2016	As at 31.03.2015
Schedule 1 :: CORPUS / CAPITAL FUND		
Total Grant Received - Capital and Revenue (A)		
Opening Balance of Total Grant Received	5,14,77,24,987	4,34,77,24,987
Add : Grant received during the year	65,65,00,000	80,00,00,000
	5,80,42,24,987	5,14,77,24,987
Total transfer to Revenue Grant (B)		
Opening Balance of amount transferred to Revenue Grant	1,27,46,72,442	84,46,72,442
Add : Transfer to Revenue Grant of 2015-16	56,50,00,000	0
Add : Transfer to Revenue Grant of 2014-15	10,00,00,000	43,00,00,000
	1,93,96,72,442	1,27,46,72,442
Surplus / Deficit transferred from Income & Expenditure Account (C)		
Opening Balance of net income / (expenditure)	(1,37,84,86,355)	(1,18,08,70,998)
Add/Deduct : - Current Year Surplus / (Deficit)	(8,42,39,729)	(19,76,15,357)
	(1,46,27,26,084)	(1,37,84,86,355)
Balance at the year end (A - B + C)	2,40,18,26,461	2,49,45,66,190

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2016

Schedule 2 :: EARMARKED/ENDOWMENT FUNDS	1 Ministry of Earth & Space Science	2 ISRO-GBP - ABLN & C Project	3 DST Inspire - Dr. Sakthivel	4 DST Inspire - Dr. Mahesh	5 SERB - Dr. Seena V	6 DST Inspire - Dr. Ambili K M	7 DOS-SAC- Dr. Rajesh V J
a) Opening balance of the funds	1,30,582	42,83,192	6,06,497	33,988	6,00,000	0	0
b) Additions to the Fund							
i) Donation/Grants	0	0	3,95,159	8,67,955	0	19,00,000	5,00,000
ii) Income from Investment made on account of Funds	0	0	0	0	40,947	0	0
iii) Other additions (Specify Nature)	0	0	0	0	0	0	0
Total (a + b)	1,30,582	42,83,192	10,01,656	9,01,943	6,40,947	19,00,000	5,00,000
c) Utilisation/Expenditure towards objective of funds							
i) Capital Expenditure							
- Fixed Assets	0	35,60,022	0	0	14,250	0	0
- Others	0	0	0	0	0	0	0
Sub Total	0	35,60,022	0	0	14,250	0	0
ii) Revenue Expenditure							
- Salaries, Wages & Allowance	0	0	10,46,272	12,09,580	75,000	8,02,667	92,862
- Rent/Consumables	0	0	44,266	43,360	0	0	46,949
- Other Administrative Expenses	0	0	35,000	41,025	1,14,297	11,198	5,701
Sub Total	0	0	11,25,538	12,93,965	1,89,297	8,13,865	1,45,512
iii) Fund Returned to the Funding Agency	0	0	0	0	0	0	0
Total (c)	0	35,60,022	11,25,538	12,93,965	2,03,547	8,13,865	1,45,512
Net Balance payable as at the year-end (a+b-c)	**1,30,582**	**7,23,170**	**0**	**0**	**4,37,400**	**10,86,135**	**3,54,488**
Net Balance receivable as at the year-end (c-a-b)	**0**	**0**	**1,23,882**	**3,92,022**	**0**	**0**	**0**

Note : Classified under Current Assets under Sch 8

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2016

Schedule 2 :: EARMARKED/ENDOWMENT FUNDS (contd.)	8	9	10	11	TOTAL	
	AICTE - INAE - PhD - R S Mohankumar	NBHM-DAE-PDF- Dr. V.Govindraj	DBT - Robotics in Medicine	SERB - Preeti Manjari Mishra	2015-16	2014-15
a) Opening balance of the funds	0	0	1,15,593	2,612	57,72,464	57,12,865
b) Additions to the Fund						
i) Donation/Grants	2,35,000	5,50,400	0	0	44,48,514	44,61,974
ii) Income from Investment made on account of Funds	0	0	0	0	40,947	0
iii) Other additions (Specify Nature)	0	0	0	0	0	2,262
Total (a + b)	2,35,000	5,50,400	1,15,593	2,612	1,02,61,925	1,01,77,101
c) Utilisation/Expenditure towards objective of funds						
i) Capital Expenditure						
- Fixed Assets	0	0	0	0	35,74,272	2,75,133
- Others	0	0	0	0	0	0
Sub Total	0	0	0	0	35,74,272	2,75,133
ii) Revenue Expenditure						
- Salaries, Wages & Allowance	2,10,000	4,75,200	0	0	39,11,581	22,37,005
- Rent/Consumables	0	0	0	0	1,34,575	1,34,450
- Other Administrative Expenses	0	0	30,000	2,612	2,39,833	15,46,771
Sub Total	2,10,000	4,75,200	30,000	2,612	42,85,989	39,18,226
iii) Fund Returned to the Funding Agency	0	0	85,593	0	85,593	2,11,278
Total (c)	2,10,000	4,75,200	1,15,593	2,612	79,45,854	44,04,637
Net Balance payable as at the year-end (a+b-c)	**25,000**	**75,200**	**0**	**0**	**28,31,975**	**57,72,464**
Net Balance receivable as at the year-end (c-a-b)	**0**	**0**	**0**	**0**	**5,15,904**	**0**
Note : Classified under Current Assets under Sch 7						

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2016

(Amount in Rs.)

	As at 31.03.2016	As at 31.03.2015
Schedule 3 :: LONG TERM LIABILITIES AND PROVISIONS		
a) Employee Provident Funds and Retirement Benefits		
- General Provident Fund	2,51,69,708	1,90,87,478
- Contributory Provident Fund	37,90,672	7,67,533
- Other Retirement Benefits	2,77,21,230	80,92,670
Sub Total (a)	**5,66,81,610**	**2,79,47,681**
b) Caution Deposit		
- Caution Deposit from Students	64,95,000	47,12,000
Sub Total (b)	**64,95,000**	**47,12,000**
TOTAL	**6,31,76,610**	**3,26,59,681**
Schedule 4 :: CURRENT LIABILITIES AND PROVISIONS		
a) Current Liabilities		
1. Sundry Creditors		
- For Goods		
Capital Goods	2,11,79,200	1,34,28,376
Revenue Expenditure	21,433	0
- For Services	1,57,83,834	1,93,23,546
2. Statutory Liabilities		
- Overdue	0	0
- Others	8,77,013	3,75,346
3. Other Current Liabilities		
- Interest refundable to DOS (received)	2,15,15,969	1,82,78,355
- Interest refundable to DOS (accrued)	1,06,65,324	36,39,289
- B.Tech Fees refundable to DOS	11,38,95,925	0
- Others	89,64,244	65,76,549
Sub Total (a)	**19,29,02,942**	**6,16,21,461**
TOTAL	**19,29,02,942**	**6,16,21,461**

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2016

(Amount in Rs.)

Schedule 5 :: FIXED ASSETS

Particulars	Gross Block (at cost) as at 01.4.2015	Additions		Transfer to Installed from Uninstalled	Deletions	Gross Block (at cost) as at 31.03.2016	Rate of Depreciation	Depreciation					Net Block as at 31.3.2016	Net Block as at 31.3.2015
		Installed	Under Installation					As at 01.04.2015	For the year	Prior Period	Deletions	As at 31.3.2016		
Land	3,32,52,002	0	0	0	0	3,32,52,002	0.00%	0	0	0	0	0	3,32,52,002	3,32,52,002
Building	1,26,38,50,484	3,74,16,386	0	0	0	1,30,12,66,870	10.00%	39,14,71,855	9,16,59,498	(67,99,946)	0	47,63,31,407	82,49,35,463	87,23,78,629
Plant & Machinery	68,88,99,425	6,27,13,855	0	0	0	75,16,13,280	15.00%	25,78,38,632	7,30,46,205	67,99,946	0	33,76,84,783	41,39,28,497	43,10,60,793
Furniture & Fittings	14,87,67,285	11,22,372	0	0	0	14,98,89,657	10.00%	5,66,54,464	93,23,519	0	0	6,59,77,983	8,39,11,674	9,21,12,821
Ambulance	8,80,644	0	0	0	0	8,80,644	15.00%	3,39,819	81,124	0	0	4,20,943	4,59,701	5,40,825
Motor Cars & Bikes	1,12,62,430	0	0	0	0	1,12,62,430	15.00%	67,41,596	6,78,125	0	0	74,19,721	38,42,709	45,20,834
Motor Buses & Truck	61,29,906	0	0	0	0	61,29,906	15.00%	34,78,026	3,97,782	0	0	38,75,808	22,54,098	26,51,880
Computers	7,93,33,019	68,95,059	0	0	0	8,62,28,078	60.00%	7,76,18,585	51,65,696	0	0	8,27,84,281	34,43,797	17,14,434
Software	5,41,25,264	1,07,74,214	0	0	0	6,48,99,478	60.00%	4,60,17,527	84,65,971	0	0	5,44,83,498	1,04,15,980	81,07,737
Library Books	4,80,91,125	27,50,030	0	0	0	5,08,41,155	60.00%	4,42,74,480	39,40,005	0	0	4,82,14,485	26,26,670	38,16,645
Campus networking	2,97,56,516	4,92,435	0	0	0	3,02,48,951	60.00%	2,74,23,294	16,95,394	0	0	2,91,18,688	11,30,263	23,33,222
Canteen Equipments	1,60,98,047	15,235	0	0	0	1,61,13,282	15.00%	86,24,965	11,23,248	0	0	97,48,213	63,65,069	74,73,082
Soft Furnishing	10,43,023	0	0	0	0	10,43,023	100.00%	10,43,023	0	0	0	10,43,023	0	0
Uninstalled Assets														
Plant & Machinery	5,71,94,733	0	2,43,45,129	3,53,12,061	0	4,62,27,801	0.00%	0	0	0	0	0	4,62,27,801	5,71,94,733
TOTAL	2,43,86,83,903	12,21,79,586	2,43,45,129	3,53,12,061	0	2,54,98,96,557		92,15,26,266	19,55,76,567	0	0	1,11,71,02,833	1,43,27,93,724	1,51,71,57,637
Previous Year	2,19,52,96,788	20,60,22,498	5,59,69,641	1,70,50,782	15,54,242	2,43,86,83,903		70,64,82,796	20,49,24,916	1,06,63,760	5,45,206	92,15,26,266	1,51,71,57,637	1,48,88,13,992
Capital Work in progress	58,82,28,280	0	3,30,70,790	3,96,71,832	0	58,16,27,238		0	0	0	0	0	58,16,27,238	58,82,28,280
TOTAL													2,01,44,20,962	2,10,53,85,917

SUBRAMONI & MADHUKUMAR * CHARTERED ACCOUNTANTS * TRIVANDRUM

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2016

(Amount in Rs.)

	As at 31.03.2016	As at 31.03.2015
Schedule 6 :: LONG TERM ASSETS, LOANS, ADVANCES ETC		
a) Loans		
- Staff	18,85,380	17,13,321
b) Advances and other amounts on capital account recoverable in cash or in kind or for value to be received		
- Mobilisation Advance to SPCL	0	0
- Interim Advance to SPCL	5,43,00,000	5,43,00,000
c) Security Deposits	44,16,670	38,58,598
TOTAL	**6,06,02,050**	**5,98,71,919**
Schedule 7 :: CURRENT ASSETS, LOANS, ADVANCES ETC		
a) Current Assets		
1. Inventories		
- Canteen inventories	4,83,641	3,68,225
2. Sundry Debtors		
- Debtors outstanding for a period exceeding six months		0
- Others		0
3. Cash Balances in hand (including cheques/drafts and imprest)	5,048	20,942
4. Bank Balances		
a) With Scheduled Banks		
- On Current Accounts	1,36,59,566	2,60,04,661
- On Deposit Accounts	47,73,44,706	34,51,04,313
- On Earmarked & Retirement Benefits Accounts	5,82,52,821	3,44,23,086
Sub Total (a)	**54,97,45,783**	**40,59,21,227**
b) Loans, Advances and Other Assets		
1. Advances and other amounts recoverable in cash or in kind or for value to be received		
- On Capital Account	15,87,635	21,030
- Prepayments	1,35,50,389	94,46,025
- Others	68,41,553	70,57,278
2. Income Accrued		
- On Bank Deposits	1,38,08,975	67,63,525
- On Other Deposits	1,80,643	1,52,877
Sub Total (b)	**3,59,69,195**	**2,34,40,735**
TOTAL (a+b)	**58,57,14,978**	**42,93,61,962**

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT
FOR THE YEAR ENDED 31ST MARCH, 2016

(Amount in Rs.)

	2015-16	2014-15
Schedule 8 :: GRANTS / SUBSIDIES		
(irrevocable Grants & Subsidies Recovered)		
1. Central Government	56,50,00,000	43,00,00,000
TOTAL	**56,50,00,000**	**43,00,00,000**
Schedule 9 :: FEES / SUBSCRIPTIONS		
1. Entrance Fees	33,38,175	54,93,825
2. Annual Fees/Subscriptions	61,42,470	4,25,64,804
TOTAL	**94,80,645**	**4,80,58,629**
Schedule 10 :: INTEREST EARNED		
1. On Term Deposit		
a) With Scheduled Banks	86,97,893	98,66,299
b) Others	0	0
2. On Loans / Advances		
a) Employee/Staff	46,940	48,191
TOTAL	**87,44,833**	**99,14,490**
Schedule 11 :: OTHER INCOME		
1. Rent Receipts	7,92,018	6,94,416
2. Sale of Tender Forms	1,18,897	1,29,958
3. Sale of Scrap / Vehicles / Trees	3,42,612	1,53,023
4. Miscellaneous Income	17,83,718	13,87,102
TOTAL	**30,37,245**	**23,64,499**
Schedule 12 :: ESTABLISHMENT EXPENSES - REGULAR		
1. Salaries & Allowances	14,69,40,895	13,60,13,934
2. Contribution to NPS	89,33,755	77,08,136
3. Contribution to CPF	90,936	90,052
4. Medical Expense- Staff	36,24,074	36,72,564
5. Expense on Employees Retirement & Terminal Benefits	13,47,987	12,73,508
6. Interest on PF Contribution	0	14,23,507
7. Staff Training Expense	19,070	50,908
TOTAL	**16,09,56,717**	**15,02,32,609**

SUBRAMONI & MADHUKUMAR CHARTERED ACCOUNTANTS TRIVANDRUM

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2016

(Amount in Rs.)

	2015-16	2014-15
Schedule 13 :: ESTABLISHMENT EXPENSES - SUPPORT SERVICES		
1. Consultancy & Manpower Charges	7,37,46,954	6,99,34,831
2. Remuneration to Contract Employees	1,75,35,269	2,08,23,738
TOTAL	**9,12,82,223**	**9,07,58,569**
Schedule 14 :: ACADEMIC & OTHER STUDENT EXPENSES		
1. Admission Expense	1,20,34,517	1,22,71,055
2. Assistanceship to Students	4,20,84,741	4,49,03,269
3. Library Services	2,68,61,136	3,04,71,924
4. Academic Expense	5,15,63,793	3,91,39,765
5. Supplies & Materials	1,43,01,364	84,28,162
6. Student Activities Expense	14,64,436	13,90,591
TOTAL	**14,83,09,987**	**13,66,04,766**
Schedule 15 :: OTHER ADMINISTRATIVE EXPENSES		
1. Maintenance & Upkeep		
Repairs & Maintenance - CMD	1,84,07,063	1,69,68,354
Repairs & Maintenance	80,15,408	49,02,454
House Keeping Expense	7,43,271	10,16,089
Sub Total (a)	**2,71,65,742**	**2,28,86,897**
2. Professional Charges		
Audit Fees	1,54,000	84,270
Legal Expense	2,65,320	6,52,812
Sub Total (b)	**4,19,320**	**7,37,082**
3. Administrative Expenses - Others		
Vehicle Operating Expense	2,05,34,284	2,06,18,723
Electricity & Water Charges	2,23,79,201	2,31,20,762
Travelling Expense	66,19,955	48,95,361
Research & Development Expense	84,26,102	29,28,993
Printing & Stationery	35,28,886	49,47,739
Advertisement & Publicity	13,98,836	8,86,680
Hospitality Expense	42,37,556	44,31,839
Telephone & Internet Expense	29,16,140	28,82,471
Office Expense	26,27,443	27,84,565
Recruitment Expense	40,93,336	14,49,404
Security Expense - Others	0	46,222
Bank Charges	12,254	10,487
Sub Total (c)	**7,67,73,993**	**6,90,03,246**
TOTAL	**10,43,59,055**	**9,26,27,225**

SUBRAMONI & MADHUKUMAR CHARTERED ACCOUNTANTS TRIVANDRUM

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

Schedule 16 :: SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH, 2016

A. Significant Accounting Policies

1. Basis of Accounting
   The financial statements have been prepared in accordance with the Generally Accepted Accounting Principles in India (Indian GAAP) and are prepared on accrual basis under the historical cost convention. The accounting policies adopted in the preparation of the financial statements are consistent with those followed in the previous year.

2. Use of estimates
   The preparation of the financial statements in conformity with Indian GAAP requires the Management to make estimates and assumptions considered in the reported amounts of assets and liabilities (including contingent liabilities) and the reported income and expenses during the year. The Management believes that the estimates used in preparation of the financial statements are prudent and reasonable. Future results could differ due to these estimates and the differences between the actual results and the estimates are recognized in the periods in which the results are known / materialize.

3. Inventories
   The inventories represents canteen inventories and is valued at lower of cost or net realizable value as certified by the Canteen Manager.

4. Depreciation
   a. Depreciation has been provided on the written down value method as per the rates prescribed in the Income Tax Act, 1961.
   b. Depreciation on assets acquired in a particular year is provided for the whole year irrespective of date of addition.
   c. Depreciation has not been charged on capital work in progress and on those assets under installation as on 31.03.2016.
   d. Software not having perpetual licenses are written off over the license period.

5. Revenue Recognition
   a. Grant in aid received from the Department of Space, is accounted on accrual basis. Out of the total grant received, the amount received towards revenue expenditure is treated as Revenue Grant / income over the period necessary to match them with the costs for which they are intended to compensate, on a systematic basis. The remaining grant forms part of the Corpus Fund along with other grant received.
   b. Tuition fees, fines and other recoveries from underperforming students (as per the policy of the institute) are accounted on cash basis. As per Department of Space instructions, Fees received from B.Tech students (performing and non-performing students) is not recognized as income and is shown as a liability payable to Department to Space after adjusting related costs.
   c. Interest income is accounted on accrual basis. Interest on deposits created out of grant received is not recognized as income and is shown as a liability payable to Department to Space.

6. Fixed Assets
   a. Land - Land at Ponmudi has been valued at cost of acquisition. The present activity of the Institute is in the Valiamala campus which has been handed over by LPSC vide letter no. VSSC/CMG/2010 dated 05.08.2010, and has been measured at 53.43 acres. No value has been provided in the books. Land received free of cost from Government of Kerala has been shown at a nominal value of Re. 1/- (*for each property*) in the books.

Schedule 16 :: SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH, 2016 (contd)

a. Building – Construction of buildings is still in progress. Buildings, the construction of which are more than 90% complete, certified by the Construction and Maintenance Division and which have been put into use have been transferred from Capital Work-in-Progress to Buildings based on actual payments made.
b. Plant and Machinery – It mainly constitutes Laboratory Equipment, Office Equipment, Electricals & Electronics and other Machinery.
c. Buildings and other Fixed Assets are carried at cost less accumulated depreciation. Cost comprises the purchase price or acquisition cost, installation charges and any attributable cost of bringing the assets to working condition for its intended use. Exchange differences arising on restatement / settlement of foreign currency payables relating to acquisition of depreciable fixed assets are adjusted to the cost of the respective assets and depreciated over the remaining useful life of such assets.
d. Capital Work-in-Progress pertains to construction in progress at Valiamala.
e. Assets that have been delivered to IIST up to 31.03.2016 have been recognized as assets but depreciation has not been charged on Assets under installation.

7. Foreign currency transactions
Foreign currency monetary items outstanding at the Balance Sheet date are restated at the year-end rates. Non-monetary items are carried at historical cost. The exchange differences arising on restatement / settlement of long-term foreign currency monetary items are capitalised as part of the depreciable fixed assets to which the monetary item relates and depreciated over the remaining useful life of such assets.

8. Earmarked / Endowment Funds
Earmarked / Endowment Funds mainly include external agency funding received for research & development purpose and conduct of seminars & workshops. Value of assets procured out of such funds for the purpose specified have gone to reduce the value of Fund in hand and have not been treated as an asset of the Institute as the ownership of the same vests with the funding agency. Earmarked / Endowment Funds are held in a separate Current Account linked to Term Deposits. The interest received in the account has been taken as the Institutes Income. Interest claims in the future, if any, from the disbursing parties of such Earmarked / Endowment Funds will be met at the time of the claim based on the deposit rates prevailing during the period of holding of the particular Fund.

9. Employee Benefits
Employee benefits include General Provident Fund (GPF), Contributory Provident Fund (CPF), New Pension Scheme (NPS), and Group Insurance Scheme (GIS). The Institute's contribution to CPF and NPS are considered as defined contribution plans and are charged as an expense as they fall due based on the amount of contribution required to be made.
GPF and CPF funds are maintained separately by the Institute in Savings Bank Account and linked Flexi deposits. Annual Interest provision on GPF and CPF balance is made from Interest earned during the year from investment of such funds in flexi deposits. Interest earned over and above the provision made is transferred to an Interest Fluctuation Reserve and in the event of a shortfall in interest earned, the difference is met from such Reserve, and any balance shortfall after adjustment with Reserve is met by IIST.
Retirement Benefits consisting of pension fund, gratuity and leave encashment received from previous employers of employees joining from other Government organizations have been maintained separately in a Current Account and linked Term Deposits.

SUBRAMONI & MADHUKUMAR CHARTERED ACCOUNTANTS TRIVANDRUM

Schedule 16 :: SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH, 2016 (contd)

10. Taxes on income
Being a non-profit institution existing solely for education purposes and being wholly financed by the Government of India, the income of the Institute is exempt under section 10[(23C)][iiiab] of the Income Tax Act, 1961.

11. Research and Development Expenses
Revenue expenditure pertaining to research is charged to the Income and Expenditure Account. Fixed assets utilized for research and development are capitalized and depreciated in accordance with the policies stated for Fixed Assets.

12. Provisions and Contingencies
A provision is recognised when the Institute has a present obligation as a result of past events and it is probable that an outflow of resources will be required to settle the obligation in respect of which a reliable estimate can be made. Provisions (excluding retirement benefits) are not discounted to their present value and are determined based on the best estimate required to settle the obligation at the Balance Sheet date. These are reviewed at each Balance Sheet date and adjusted to reflect the current best estimates.

B. Notes to the Accounts

1. Depreciation
Assets are depreciated at written down value method as per rates prescribed in the Income Tax Act, 1961 as recommended by the Office of the Principal Director of Audit, Scientific Departments, Bangalore. Software not having perpetual licenses are written off over the license period

2. Revenue
   a. Out of Grant of Rs. 65,65,00,000/- received during 2015-16, Rs. 56,50,00,000/- received specifically towards revenue expenditure has been transferred to Revenue Grant. In 2014-15, out of Grant of Rs. 80,00,00,000/- received, Rs. 43,00,00,000/- received specifically towards revenue expenditure has been transferred to Revenue Grant. DOS had subsequently reallocated Rs.10,00,00,000/- of funds received from Capital Grant to Revenue Grant. By oversight, the same was not incorporated in the accounts for 2014-15. The same has been effected by accounting Rs. 10,00,00,000/- under prior period item during 2015-16.
   b. Interest earned (actually received) on funds from grant-in-aid maintained in deposits is refundable to DOS. Interest of Rs. 2,15,15,969/- (excluding the interest received on the Provident Fund Accounts and Earmarked Funds) has been actually received during 2015-16 and the same has been shown as refundable to DOS.
   c. Department of Space has, vide Letter No. B. 12011/7/2015-Sec.2 dated 21.10.2015, instructed that "Fees paid back by students on receipt of Assistanceship package and receipts from non-performing students" are to be remitted back to Government Account. Total receipts on account of such fees earned till 31.03.2015 comes to Rs. 7,25,90,780.00 which has been recognised as income in previous years and the same has been charged to prior period item during the current year. Rs. 4,13,05,145/- pertains to Fees for 2015-16 and the same has been shown as refundable to DOS.
   d. Canteen Accounting Committee accounts is maintained separately and the deficit / surplus is recognised in the Income and Expenditure Account.
   e. Student Activities Account is maintained separately and the deficit / surplus is recognised in the Income and Expenditure Account.

SUBRAMANIAM & SUBRAMANIAM CHARTERED ACCOUNTANTS TRIVANDRUM

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

Schedule 16 :: SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH, 2016 (contd)

3. Fixed Assets
   a. Land – There is a stay by the Honorable High Court of Kerala on carrying out construction activities on a part of land (approximately 80 acres) purchased at Ponmudi in Trivandrum District for setting up the Institute. Over and above this 80 acres, approximately 20 acres of land at Ponmudi and 44.18928 acres at Valiamala has been transferred by the Government of Kerala free of cost in December 2007 and April 2009 respectively. These two properties have been brought into the books of accounts in 2013-14 by assigning a nominal value of Re. 1/- each. The present activity of the Institute is in the Valiamala campus which has been handed over by LPSC vide letter no. VSSC/CMG/2010 dated 05.08.2010, and has been measured at 53.43 acres. No separate lease agreement / transfer of ownership of land was obtained by IIST.
   b. Capital Work-in-Progress includes a sum of Rs. 2,92,10,277/- towards project management and consultancy charges and service tax of Rs. 6,02,47,147/-, both pending for appropriation to fixed assets on final completion of all buildings..
   c. An amount of Rs. 4,62,27,801/- pertaining to assets that have been delivered to IIST before 31.03.2016 but under installation as on 31.03.2016 have been accounted as fixed assets & depreciation has not been charged on the same.
   d. Assets that were put into use in earlier years but were not transferred from Work in Progress to Installed Assets have been capitalised during 2014-15 and prior period depreciation amounting to Rs. 1,06,63,760/- pertaining to these assets has been accounted during 2014-15. Of Rs. 1,06,63,760/-, Rs. 87,31,853/- related to Machinery & Equipments and Rs.19,31,907/- related to Buildings have, by oversight, been charged to Buildings and Machinery & Equipments respectively. The same has been corrected in the accounts for 2015-16.

4. Employee Benefits
   a. Employer and Employee contribution to New Pension Scheme is being transferred to NSDL.
   b. The Institute has entered into a Group Insurance Scheme (GIS) agreement with Life Insurance Corporation of India from 2011-12 onwards.
   c. Provision for interest on PF Contribution, at the rates prescribed, have been made and the corresponding expenditure has been adjusted against Interest earned on GPF and CPF funds parked in Savings Accounts (linked to flexi deposits) and the balance interest earned has been retained as Interest Fluctuation Reserve. Interest earned over and above the interest provision created for PF accounts in previous years (Rs. 1,60,719/- for GPF and Rs. 24,233/- for CPF), has been transferred to Interest Fluctuation Reserve in 2015-16 by adjusting Prior Period Item.
   d. Provision for liability in respect of gratuity, pension and leave encashment has not been made. Permission from DOS for creation & maintenance of a separate pension fund has been received during 2013-14. The actuarial valuation amount will be brought into the books of accounts on obtaining necessary approval for the same from the Board of Management. In addition, the retirement benefits from the previous employers for the members governed under the GPF have not been received in all cases.

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
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Schedule 16 :: SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH, 2016 (contd)

5. Prior Period Item
Details of prior period items are as given below :-

Details	Prior period expenses
Interest received in Pension Funds Account in 2012-13	1,15,519.00
Leave recovery accounted twice in 2014-15	53,760.00
GPF Interest Fluctuation Reserve (2013-15)	1,60,719.00
CPF Interest Fluctuation Reserve (2013-15)	24,233.00
Cost of Printer Cartridges issued by VSSC during 2009-11	7,85,598.00
B.Tech fees (2007-2015) refundable to DOS	7,25,90,780.00
Total (A)	**7,37,30,609.00**

Details	Prior period income
HBA Interest wrongly classified as Overtime	3,652.00
Excess GPF interest provision reversed (Dr. Deepak TG)	35,740.00
Transfer to Revenue Grant (2014-15)	10,00,00,000.00
Total (B)	**10,00,39,392.00**

Net prior period income (B-A) = Rs. 2,63,08,783.00

6. Academic Expenses
Academic Expenses mainly include expenses towards Lectures for students, Project & Internship expenses, stipend / fellowship paid to PhD and M.Tech students and expenses incurred on Seminars, Symposiums and Conferences.

7. Admission Expenses
Admission expenses include expenses incurred towards B.Tech, M.Tech and PhD admissions

8. Assistanceship to Students
As per the approval of The Chairman, Board of Management-IIST / Secretary, DOS vide Letter No. PP & PM : IIST : 09-10 dated July 17th, 2009, the B. Tech students of the Institute are entitled for an assistanceship of Rs. 49,000/- [increased to Rs. 51,400/- from Even semester 2014-15] for each semester towards Statutory Semester Fee, Student Amenity Fee, Hostel & Dining, Establishment charges and Medical cover. The assistanceship amount of Rs. 48,400/- (exclusive of book grant) for one semester has been disbursed to eligible students based on the performance of the previous semester. The assistanceship amount disbursed has been remitted back by the students to the Institute and expenditure corresponding to the assistanceship so received (under Hostel, Dining & Medical cover) has been set off against the assistanceship amount. During 2015-16, an amount of Rs. 3,98,81,600/- was disbursed as assistanceship.

9. Supplies and Materials
Supplies and Materials mostly consist of lab consumables.

10. Bank balances
The negative balance in the SBI and UBI Current Accounts represents the cheques issued on the closing date of the financial year which are not presented for payment. The Institute has sufficient balance to cover these cheques issued in the linked deposit accounts maintained with SBI and the flexi deposits maintained with UBI. Hence, the negative balance does not represent any Overdraft.

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

Schedule 16 :: SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH, 2016 (contd)

11. Format of accounts
The accounts of the Institute are prepared as per proforma suggested by the Office of the Principal Director of Audit, Scientific Departments, Bangalore.

12. Insurance
The Institute being an autonomous body under the Department of Space (DOS), it is governed by the rules and regulations as applicable to DOS. As per the "Book of Financial Powers" prescribed by DOS "No Government property whether movable or immovable shall be insured. No liability shall be incurred in connection with the insurance of such property without the prior approval of the Department of Space in consultation with the Member for Finance." The matter was taken up for consultation with the Department of Space during 2012-13 and it was decided in the Seventh Finance Committee meeting of IIST dated 3rd June, 2014 not to insure the assets of the institute.

13. Balances in personal accounts
Balances in personal accounts are subject to confirmation from respective parties.

14. Contingent Liabilities
    a. The unexecuted portion of the contracts entered into by the Institute will form part of the current liability of the Institute. However, the same could not be quantified.
    b. Interest earned on Earmarked / Endowment Funds held in a separate Current Account linked to Term Deposits has been taken as the Institutes Income. Interest claims in the future, if any, from the disbursing parties of such Earmarked / Endowment Funds will be met at the time of the claim based on the deposit rates prevailing during the period of holding of the particular Fund.
    c. In the case of buildings / structures completed by SPCL, only 90% has been billed by SPCL and subsequently paid by IIST. The balance 10% (approximately Rs. 12.56 crores) has not been billed and the same will be paid only on completion of the project. In case of all other works completed by SPCL and not billed as on 31.03.2016, provision has not been made in the books of accounts since the same is not quantifiable.

15. Building Construction:
The institute entered into a contract with SPCL, Mumbai on 27.08.2008 for Rs. 278.60 crores with a completion period of 18 months for setting up building and infrastructure at its campus in Valiamala on turnkey basis. As per the note provided by the CMD office the project was delayed due to various unforeseen reasons and the extension of the contract was given up to 26.11.2016 without prejudice to the right of the institute to impose the levy of compensation for the delay. As per clause 2 of the agreement the institute can levy penalty on the works which will have an impact on the accounts. The same could not be quantified due to want of details. As on 31.03.2016, advance amount paid to SPCL towards interim advance amounts to Rs. 5.43 crores. The Institute currently holds the following instruments as security with respect to the contract with SPCL.

Nature of security	Amount (in crores)
Security Deposit – Bank guarantee	13.93
Performance Bank guarantee	13.93
Bank guarantee against Interim Advance	5.43

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

Schedule 16 :: SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH, 2016 (contd)

16. Figures for the previous year
Figures for the previous year have been regrouped and/or reclassified wherever considered necessary.

As per our report of even date attached

For Subramoni & Madhukumar
Chartered Accountants
FRN : 008570S

SUBRAMONI & MADHUKUMAR * TRIVANDRUM * CHARTERED ACCOUNTANTS

C.A. Subramoni J.
(Partner, Mem No. 204157)

For and on behalf of
Indian Institute of Space Science and Technology (IIST)

Dr. V. K. Dadhwal
Director

R. Hari Prasad
Finance Officer

Place : Thiruvananthapuram
Date : 27th September, 2016

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 31ST MARCH, 2016

(Amount in Rs.)

Receipts	2015-16	2014-15	Payments	2015-16	2014-15
I. Opening Balance			**I. Expenses**		
a.Cash and DD's in hand	20,942	21,492	**a.Establishment Expenses - Regular**		
b.Bank Balances			Salaries & Allowances (admin & faculty)	14,71,85,469	13,50,93,052
In current accounts	2,60,04,661	(51,86,822)	Contribution to NPS	89,33,755	77,08,136
In deposit accounts	34,51,04,313	21,30,46,043	Contribution to CPF	90,936	90,052
In earmarked/retirement benefits accounts	3,44,23,086	2,92,57,012	Medical Expense- Staff	36,69,508	38,41,199
			Employees Retirement Benefits	13,47,987	12,73,508
II.Grants Received			Interest on PF Contribution	0	1,47,275
a.From Government of India	65,65,00,000	80,00,00,000	Staff Training Expenses	19,070	50,908
III. Interest Received			**b.Establishment Expenses - Support Services**		
a.On Bank Deposits	87,62,951	95,84,351	Consultancy & Manpower Charges	7,39,84,822	6,87,96,267
b.On Other Deposits	0	0	Remuneration to Contract Employees	1,75,35,269	2,08,23,738
c.Loans, Advances etc.	46,940	48,191			
			c. Academic & Other Student Expenses		
IV. Other Income			Admission Expense	1,20,34,517	1,22,84,906
a.Entrance Fees	33,38,175	54,87,850	Assistanceship to Students	4,27,98,903	4,55,44,852
b.Annual Fees/Subscriptions	53,91,082	4,40,26,406	Library Services	3,32,43,802	3,41,23,874
c.Other Income	31,15,575	23,87,522	Academic Expense	5,08,46,229	3,86,18,899
			Supplies & Materials	1,37,87,108	84,43,208
V. Any other receipts			Student Activities Expense	14,31,378	13,90,591
a. Refund from Branches	0	1,80,272			
b.Security Deposits received	26,80,009	10,93,127	**d. Other Administrative Expenses**		
c.Earnest Money Deposits received	73,98,577	16,00,596	Repairs & Maintenance	83,34,083	46,37,567
d.Performance Guarantee	9,73,947	13,02,864	Repairs & Maintenance - CMD	1,91,83,612	1,70,49,513
e.Advance for Research & Seminars	44,89,461	44,64,236	House Keeping Expense	7,43,271	10,30,506
f. B.Tech Fees refundable to DOS	4,13,05,145	0	Audit Fees	1,54,000	84,270
g.Caution Deposit from Students	17,83,000	19,34,000	Legal Expense	2,72,822	6,45,310
h.Security Deposit (Asset)	6,498	0	Vehicle Operating Expense	2,12,10,990	2,26,19,830
i.Stale cheques	99,870	2,94,611	Electricity & Water Charges	2,26,98,964	2,17,36,546
j.Canteen Accounting Committee	2,03,32,533	2,06,60,455	Travelling Expense	61,91,996	48,32,498
k.Employee recovery - interest	3,20,183	0	Research & Development Expense	82,48,844	27,08,130
l.Interest received and payable to DOS	2,15,15,969	1,82,78,355	Printing & Stationery	37,76,024	46,00,277
m.Contingency advance	2,48,207	0	Advertisement & Publicity	13,98,836	8,90,825

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 31ST MARCH, 2016

(Amount in Rs.)

Receipts	2015-16	2014-15	Payments	2015-16	2014-15
n.Mediclaim recovery	(2,41,200)	0	Hospitality Expense	42,22,589	43,75,459
o.Student Activities Account	10,90,490	14,36,420	Telephone & Internet Expense	29,31,327	27,70,478
p.Recovery of loans to staff	11,35,644	3,06,190	Office Expense	24,52,977	25,46,957
q. Miscellaneous receipts	0	2,70,587	Recruitment Expense	39,42,733	14,47,732
r. Receipts from debtors	450	1,89,146	Security Expense - Others	0	46,222
s.Increase in TDS, VAT & Labour Cess	5,01,667	(61,182)	Bank Charges	12,254	10,487
t. Net addition to Statutory Liabilities(Staff)	2,83,79,197	36,60,153			
			II. Payments made against funds for various projects		
			ISRO-GBP - ABLN & C Projec	35,60,022	2,16,808
			DST Inspire - Dr. Sakthivel	11,25,538	11,09,634
			DST Inspire - Dr. Mahesh	12,93,965	13,38,361
			SERB - Dr. Seena V	2,03,547	0
			DST Inspire - Dr. Ambili K M	8,13,865	0
			DOS-SAC- Dr. Rajesh V J	1,45,512	0
			AICTE - INAE - PhD - R S Mohankumar	2,10,000	75,000
			NBHM-DAE-PDF- Dr. V.Govindraj	4,75,200	0
			DBT - Robotics in Medicine	1,15,593	8,34,407
			SERB - Preeti Manjari Mishra	2,612	0
			NCM - 2014	0	9,780
			TIFR - 2014	0	34,534
			DST - SERB - Dr. Sanjeev Kumar Mishra	0	1,00,853
			ICM - Dr. Gnanvel	0	1,80,000
			ICM - Dr. Sakthivel	0	1,80,000
			SERB - Harsha K V	0	92,631
			SERB - Preeti Manjari Mishra	0	2,32,629
			III. Expenditure on Fixed Assets & Capital Work-in-Progress		
			a.Purchase of Fixed Assets	6,62,78,868	19,90,56,885
			b.Expenditure on Capital Work-in-progress	3,08,31,177	2,52,49,944
			IV. Other Payments		
			Security Deposits (Asset) paid	5,64,570	16,40,306
			Security Deposits repaid to Contractors	26,86,582	18,38,967

SUBRAMONI & MADHUKUMAR CHARTERED ACCOUNTANTS TRIVANDRUM

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 31ST MARCH, 2016

(Amount in Rs.)

Receipts	2015-16	2014-15	Payments	2015-16	2014-15
			Earnest Money Deposits repaid	56,96,339	12,75,615
			Performance Guarantee	9,97,906	21,46,836
			Contingency Advance to Staff	0	1,48,542
			Loans to staff	13,07,703	1,89,169
			Canteen Accounting Committee	1,59,07,574	1,89,96,735
			Sundry debtors	1,22,479	12,688
			Interest repayment to DOS	1,82,78,355	2,21,49,749
			Stale Cheques - paid	1,63,050	25,055
			Repayment of miscellaneous receipts	25,380	0
			Student Activities Account	19,75,319	13,30,674
			V. Closing Balances		
			a.Cash in hand	5,048	20,942
			b.Bank Balances		
			In current accounts	1,36,59,566	2,60,04,661
			In deposit accounts	47,73,44,706	34,51,04,313
			In earmarked/retirement benefits accounts	5,82,52,821	3,44,23,086
Total	**1,21,47,27,372**	**1,15,42,81,875**	**Total**	**1,21,47,27,372**	**1,15,42,81,875**

Significant Accounting Policies & Notes on Accounts 16

As per our report of even date attached.

For Subramoni & Madhukumar
Chartered Accountants
FRN : 008570S

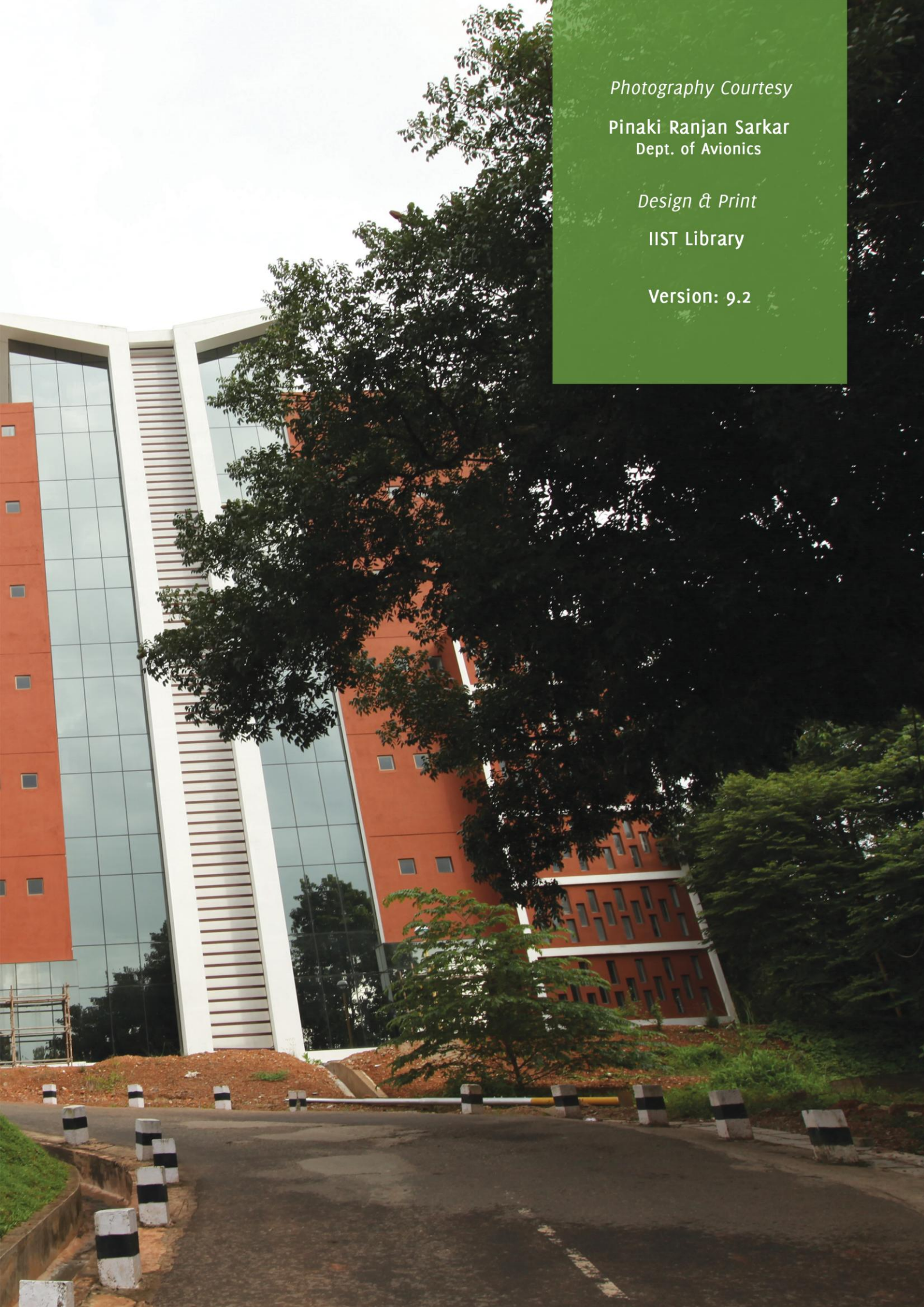
C.A. Subramoni J.
(Partner, Mem No. 204157)
Place : Thiruvananthapuram
Date : 27th September, 2016

SUBRAMONI & MADHUKUMAR * CHARTERED ACCOUNTANTS * TRIVANDRUM *

For and on behalf of
Indian Institute of Space Science and Technology (IIST)

Dr. V. K. Dadhwal
Director

R. Hari Prasad
Finance Officer



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INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
(Declared as Deemed to be University under Section 3 of the UGC Act, 1956)
Valiamala P O, Thiruvananthapuram- 695 547, Kerala