ISRO - SPPU Space Technology Cell
Savitribai Phule Pune University
(formerly University of Pune)

Annual Report 2018-19

JPC Meetings on 19 & 20 February 2019

ISRO-SPPU
Space Technology Cell

Savitribai Phule Pune University
(Formerly University of Pune)

ANNUAL REPORT
2018-19

SUMMARY

This document presents details of the activities of ISRO-SPPU Space Technology Cell (STC) at Savitribai Phule Pune University for the year 2018-19. Studies in respect of ten projects have been completed this year and final technical reports submitted / under submission. Summary of findings of these projects is presented in the Report. Presently there are 24 ongoing projects including ten projects initiated in September 2018. Progress of these projects is monitored through periodical progress reports and reviews by Preliminary Evaluation Committee (PEC) and Joint Policy Committee (JPC). Current status of these projects is given in the Report. In response to ISRO-SPPU STC's call for new research proposals under Joint Research Programme, 53 study proposals were received from various Departments and affiliated colleges of the University. These proposals were evaluated by Preliminary Evaluation Committee (PEC) for making recommendation to Joint Policy Committee (JPC). JPC interacted with the prospective investigators and approved 7 proposals for funding in the financial year 2019-20. Technical summary of the approved proposals has been included in the Report. Major establishments of DOS and their areas of technical activities were highlighted in the Annual Report 2014-15. With a view to bring out the potential research areas for the benefit of prospective investigators from the University, salient features of technical activities of National Remote Sensing Centre (NRSC/ISRO), Hyderabad were added in the Annual Report 2015-16, on Satellite Application Center (SAC/ISRO) Ahmedabad in the Annual Report 2016-17 and on URSC & LEOS Bengaluru in the Annual Report 2017-18. To continue, brief history and technical activities (extracted from ISRO websites) of the most important centre, namely Vikram Sarabhai Space Centre (VSSC) in Thiruvananthapuram are given in Chapter 7 of the present Annual Report.

ISRO Proposal Format and thrust areas in the supported areas of research have been also included for the guidance of prospective Investigators

Contents

1. Introduction

Primary objective of Indian Space Programme is to harness the advanced research areas of space science and technology and to derive the maximum benefit for the people of India. To meet this goal, focus has been on applications in space communications, long distance education, earth resources mapping/survey, meteorology and geodesy. In addition, equal stress is given on indigenous design and development of orbiting satellites for scientific research and space applications, sounding rockets and satellite launch vehicles to become self reliant. With a view to encourage academia in participating and contributing in space related activities, RESPOND (Sponsored Research) programme started in the 1970s. Under RESPOND, projects are taken up by universities/academic institutions in the areas of relevance to Space Programme. Apart from this, ISRO has also set up Space Technology Cells at premiere institutions like Indian Institute of Technologies (IITs) - Bombay, Kanpur, Kharagpur & Madras; Indian Institute of Science (IISc), Bangalore and Joint Research Programme with Savitrybai Phule Pune University (SPPU) to carry out research activities in the areas of space technology and applications. These STCs and JRP are guided by Joint Policy Committee (JPC) chaired by Director/Vice Chancellor of the respective institution and with members from ISRO/DOS (Senior Scientists/Engineers) & the respective institution. Under STC and JRP, projects are taken up by faculty of the Institute.

Under this plan, a Memorandum of Understanding (MoU), initiating Joint Research Programme (JRP), was signed between ISRO and Savitribai Phule Pune University (SPPU) on 21 January 1998. Initially five broad disciplines were identified for carrying out research study under this JRP. Co-operation between the two organizations was found beneficial and as a result, while renewing the MoU on 24 February 2006, these areas were enlarged by identifying additional disciplines where more emphasis could be laid on. The areas currently recognized for development are:

- Origin of life
- Space Radiation
- Wind measurements and modeling
- Optical coatings and sensors
- Rural development and developmental communication
- Geo-informatics
- Remote sensing applications
- Material Sciences
- Biodiversity
- Instrumentation
- Image processing

With a view to strengthen the institutional interaction and thereby enhancing scope of the activities pursued under JRP commensurate with the programmatic goals of ISRO, Memorandum of Understanding was revisited and concluded afresh on 21 March 2017. It was agreed that Joint Research Programme should continue with special emphasis on advanced research in the areas of relevance to the future technological and programmatic needs of Indian Space Programme.

2. Management of Joint Research Programme (JRP)

A Joint Policy Committee (JPC) chaired by the Vice Chancellor, SPPU with members from both ISRO and SPPU has been constituted jointly by Vice Chancellor, SPPU and Chairman, ISRO to guide the JRP. JPC plans the research programmes of common interest and periodically reviews such research related activities. JPC is responsible for approving the budget of JRP. Honorary Director, ISRO-SPPU STC, is responsible for the administration, fund utilization and day-to-day functioning of the STC.

Preliminary Evaluation Committee (PEC) is a local Committee constituted to co-ordinate and assist in implementation of Joint Research Programme in Savitribai Phule Pune University. This Committee carries out preliminary evaluation of new research proposals and interacts with Investigators to make changes in the proposed study. The proposals recommended by the Committee are examined by the Joint Policy Committee for final approval. PEC also has the responsibility to periodically review the progress of the ongoing projects and take corrective measures. Following were the JPC and PEC Members during the year 2018-19.

Joint Policy Committee (JPC)

Prof (Dr) Nitin Karmalkar, Vice Chancellor, SPPU	Chairman
Dr MBN Murthy SDSC/ISRO	Member
Shri A S Laxmi Prasad, LEOS/ISRO	Member
Dr Benny K George, VSSC/ISRO	Member
Dr Rajeev Jyoti, SAC/ISRO	Member
Dr M V Ramana, NRSC/ISRO	Member
Dr M S Anurup, ISRO HQs	Member
Dr M A Paul, ISRO HQs	Member
Prof S Ananthakrishnan, SPPU	Member
Prof P P Kale, SPPU	Member
Prof M V Kulkarni, SPPU	Member
Prof P Pradeep Kumar, SPPU	Member
Prof Suresh Goswai, SPPU	Member
Director, COEP/SPPU	Member
Finance & Accounts Officer, SPPU	Member
Shri M C Uttam, SPPU	Member Secretary

Preliminary Evaluation Committee (PEC)

Prof S Ananthakrishnan	Chairman
Prof PP Kale	Member
Prof Deepti Deobagkar	Member
Prof V B Gaikwad	Member
Prof Suresh Goswai	Member
Prof P Pradeep Kumar	Member
Prof M V Kulkarni	Member
Prof A D Shaligram	Member
Prof Ravidra Jaybhya	Member
Prof D C Meshram	Member
Prof Sanjeev Sonawane	Member
Finance & Accounts Officer, SPPU	Member
Shri M C Uttam	Member Secretary

3. Completed research projects

Beginning in 1998-99, a total of 187 research projects were undertaken by the various departments of the University and its affiliated colleges under ISRO-SPPU Joint Research Programme and 153 of these projects were completed in the previous years ending in March 2018. During the year 2018-19 studies in respect of ten more projects, listed below have been completed and final technical reports received from six Investigators and four are under submission. In order to bring the results of the study to the notice of ISRO Scientists/Engineers, brief details along with summary of findings of the completed research projects are published from time to time. In addition, these details are put on the University's website for wider dissemination. Copies of full technical reports of the completed projects are also sent to concerned libraries of ISRO Centres.

List of Projects completed during the year 2018-19

1. Feasibility study on indigenous development of electrochemical based gas sensors and transmitters (Project No.137)
2. Development of nuclear batteries using radioactive sources (Project No. 152)
3. Design, fabrication and testing of a compact and robust Monochromator (Project No. 153)
4. Fabrication of magnetoelectric energy harvesters by utilizing piezoelectric – macro fiber composite (MFC) and magnetostrictive – Nickle / Metglas / magnetic oxide materials (Project No. 154)
5. Development of coating/manufacturing technology for friction stir coating/welding tool for welding of 3 mm thick stainless steel (Project No. 157)
6. Development of high current density thermal-field (T-f) cathodes (Project No. 161)
7. Studies on glare reduction techniques for indoor illumination systems (Project No. 163)
8. Valve-less linear compressor driven stirling cycle cryocooler for space applications systems (Project No. 164)
9. Drilling techniques/technology for drilling of miniature size holes of diameter less than 10 microns in super alloys for a depth of 1.0 mm (Project No. 165)
10. Astrobiology experiments on effect of impact and space related stress on micro-organisms isolated from rocks: Implications for origin of life and lithopanspermia (Project No.168)

Summary of findings along with brief details of the completed Projects:

Project No	137
Title	Feasibility Study on indigenous development of electrochemical based gas sensors and transmitters
Investigators (Principal Investigator PI & Co-Investigators Co-Is)	PI: Shaligram A D, Dept of Physics, SPPU Co-Is: Haram S, Pragati Thakur & Gangal S A
Co-PI/focal point /contact scientist from ISRO/DOS	Murthy M B N & Senthilkumar R SDSC SHAR
Duration	Two years (Started on: (November 2013)
Budget (₹ lakh)	29.6
Summary of findings	Project was jointly taken up by Department of Electronic Science and Department of Chemistry of SPPU. Aim was to carry out (i) feasibility of development of sensor heads and (ii) feasibility of development of potentiostat to transform sensor output into 4-20 mA range. Electrolyte, gas permeable membrane, electrodes, filters of the commercially available sensor etc were identified. Packaging, mounting and other structural aspects are studied. Four different models of electrochemical Cells for sensing NO_2 gas are developed. Model 1 was a preliminary model. In this three different working electrodes – gold disc, gold thin film on Teflon mesh and commercial carbon + activated carbon (1:1) – were investigated. They showed very small sensitivity and very short life (few cycles). In Model 2, focus was on the development of working electrode. Activated conducting carbon powder was prepared in-house and optimized and used for preparing porous membrane electrode by putting it on Teflon mesh. Housing for the membrane was designed and fabricated. This Model 2 showed improved sensitivity and was also tested for temperature effect on sensitivity and cross sensitivity with CO_2, NH_3 and H_2 gases. Response and recovery times were fast. Life span was little better (few days). In Model 3, porous membrane electrode was same as that of Model 2. Improvement was made in the design of the cell. This Model had problem in reproducing the cells. Sensitivity was found to be better but there was lot of performance variation from piece to piece. Life span was only for few days. Short life in these models is thought to be due to the leakage of electrolyte through working electrode because of increase in internal pressure during operation and evaporation of electrolyte during storage. Model 4 was designed, taking feedback from above three models and study done on the presently used electrochemical cell at SHAR. Sensor body was designed and fabricated in ABS 2 material (polymeric) with the help of 3D printing machine. Working electrode was gold coated Teflon mesh. Pt was used as counter electrode and $Ag/AgCl_3$ was reference electrode. Model 4 showed good sensitivity, long life and repeatability.

	Sensor is working for last 5 months and performance is found to be stable. Power supply, signal conditioning circuit and transmitter required for testing the electrochemical cell are designed, fabricated. The same was used for testing the performance of the Model 3 and Model 4 electrochemical cells. Work done and the results obtained demonstrate the feasibility of indigenous development of Electrochemical based gas sensors and corresponding transmitter.

Project No	152
Title	Development of nuclear batteries using radioactive sources
Investigators (Principal Investigator PI & Co-Investigators Co-Is)	PI: Dhole S D, Dept of Physics, SPPU Co-Is: Bhoraskar V N, Dahiwale S S & Patil B J
Co-PI/focal point /contact scientist from ISRO/DOS	Ilangovan S A VSSC Thiruvananthpuram
Duration	Two years (Started on: (June 2015)
Budget (₹ lakh)	19.98
Summary of findings	Final Report under submission

Project No	**153**
Title	Design, fabrication and testing of a compact and robust Monochromator
Investigators (Principal Investigator PI & Co-Investigators Co-Is)	PI: Garde C S, Vishwakarma Institute of Information Technology, Pune Co-Is: Rohini S Bhalerao-Panajkar, Vivek M Aranake, Shriganesh S Prabhu & Prathmesh Deshmukh
Co-PI/focal point /contact scientist from ISRO/DOS	Saji Kuriokose SAC Ahmedabad
Duration	Two years (Started on: (June 2015)
Budget (₹ lakh)	19.45
Summary of findings	Designing of Optics was carried out using the basic formulae for diffraction grating and parabolic mirrors. This was fine-tuned using simulation on COMSOL platform. Spectrum with order m = -1 was used to avoid overlap of higher order spectrum. Parabolic shape of Aluminium mirrors was obtained on a CNC end milling machine. The reflecting surface was buffed. The solid Aluminium block of parabolic mirror was bolted to the mounting plate after alignment to give rigidity and robustness to the optics. Enclosure was made of Aluminium plates with appropriate slots. These plates fit into

each other seamlessly ensuring perpendicularity and rigidity. These plates can be assembled and disassembled very easily and reproducibly. Holographic gratings were obtained from Edmund Optics and CMOS linear array detectors were obtained from Hamamatsu. Electronics for data acquisition was developed around an FPGA (Nexys 4 (Artix 7)). Analog Frontend Electronics (AFE) helps in acquiring the analog data from CMOS detector and converting it into 16-bit digital form. The initiation of the data acquisition from the detector and its transfer to FPGA was synchronized using appropriate clocks generated by FPGA. Several frames were added depending on the integration time to increase the Signal to Noise Ratio (SNR) without the detector going into saturation. The data was then transferred to a Computer using a FTDI IC. PCBs were designed/ fabricated and the circuit assembled/ tested through firmware developed for the FPGA. Data obtained from the detector using FPGA was checked on a DSO. Spectrum of Red LED, UV LED and white LED was obtained to check both the compartments. The obtained spectrum matched reasonably well with that obtained using Ocean optics Fx monochromator having dimensions similar to ours. Monochromator was demonstrated to Scientists of LEOS, Bengaluru. They appreciated the robust design but spectrum of Mercury Argon standard calibration source was not obtained. The monochromator was therefore modified in the following ways: (i) gold plated strip with roughness ~ λ/10 was stuck on the mirror to decrease scattering (ii) the two compartments were fed light independently using optical fibre splitter (iii) the common collimating mirror was split into two, one for each compartment (iv) integration time was increased (v) aperture was replaced by a slit as the shape of each pixel on the CMOS array detector was rectangular (14×120 microns).Thus the spectrum of Mercury Argon Calibration source was obtained. The pixel numbers were calibrated with wavelength using the standard source. The final spectrum obtained using 200ms integration time and a slit width of 100 microns encompasses wavelengths from 350nm to 1200nm with a resolution of ~1nm. The monochromator could be further improved by using Aluminium mirrors with roughness ~λ/10 at 200nm and finer slits.

Project No	**154**
Title	Fabrication of magnetoelectric energy harvesters by utilizing piezoelectric-macro fiber composite (MFC) and magnetostrictive Nickel/Metglas/Magnetic oxide materials
Investigators (Principal Investigator PI & Co-Investigators Co-Is)	PI: Kambale R C, Dept of Physics, SPPU Co-Is: Kolekar Y D
Co-PI/focal point /contact scientist from ISRO/DOS	Bhanu Pant & Sreemulanadhan H VSSC
Duration	Two years (Started on: (June 2016)

Budget (₹ lakh)	8.60
Summary of findings	Magnetoelectric energy harvesters consisting of piezoelectric macro-fiber composite bonded to a magnetostrictive Ni metal plate or Metglas or $CoFe_2O_4$ are capable of harnessing power from mechanical stimulations. The resulting potential and output power achieved in the case of Ni metal plated were up 196 Vp-p and 4.49 mW which is adequate to light 6-commercial red LED with traditional rectifier circuit and capacitor. Harvesters composed of piezoelectric macro-fiber composite and magnetostrictive Metglas exhibited excellent energy harvesting response to the vibrations. The resulting potential and output power were achieved up to 100Vp-p and 1.64mW, adequate enough to light 2-commercial red LED with traditional rectifier circuit and capacitor. Harvesters fabricated with MFC/ $CoFe_2O_4$, structure exhibited good energy harvesting response to the vibrations, resulting potential and output power were achieved up to 48 Vp-p and 0.205 mW. Fabricated ME laminate generator provides feasibility for designing the magnetic field sensors as well as for powering small consumer electronic devices and wireless sensor network system.

Project No	**157**
Title	Development of coating/manufacturing technology for friction stir welding tool for welding of 3 mm thick stainless steel sheets
Investigators (Principal Investigator PI & Co-Investigators Co-Is)	PI: Rajesh Chaudhari, Vishwakarma Institute of Technology, Pune Co-Is: Ganesh Dongre
Co-PI/focal point /contact scientist from ISRO/DOS	Sivakumar D VSSC
Duration	Two years (Started on: (June 2015)
Budget (₹ lakh)	27.88
Summary of findings	Final Report under submission

Project No	**161**
Title	Development of high current density thermal-field (T-f) cathodes
Investigators (Principal Investigator PI & Co-Investigators Co-Is)	PI: More M A, Dept of Physics, SPPU Co-Is: Godbole V P

Co-PI/focal point /contact scientist from ISRO/DOS	Ananthakrishnan S
Duration	Two years (Started on: (June 2016)
Budget (₹lakh)	20.60
Summary of findings	Final Report under submission

Project No	**163**
Title	Studies on glare reduction techniques for indoor illumination systems
Investigators (Principal Investigator PI & Co-Investigators Co-Is)	PI: Jayashri A Bangali, Kaveri College of Arts, Science and Commerce, Pune
Co-PI/focal point /contact scientist from ISRO/DOS	Director, LEOS
Duration	Two years (Started on: (June 2016)
Budget (₹ lakh)	19.98
Summary of findings	Glare mainly depends on solid angle, absolute luminance, relative luminance and closeness to the line of sight of the glare source. Unified Glare Rating (UGR) is basically used to calculate glare due to artificial lighting sources. Daylight Glare Probability (DGP) is used to evaluate glare factor due to daylight. The DGI, UGR and DGP all require use of Guth's position index which indicate the change in discomfort glare related to the angular displacement (azimuth and elevation) of a glare source from the line of sight of an observer. In this research project, seven different workspaces were studied and its glare factor is evaluated using three methods; DIALux lighting simulation software, software model developed using Python and LMK system. To verify the glare rating predicted by these methods, feedback is taken from the users/occupants of all the workspaces. The glare prediction by human subjects stated in feedback form would specify whether UGR values calculated using all three methods are closer to human perception or no. There are various ways to prevent glare. First and easy way to avoid glare is correct placement of luminaires in the workspace. The light from the luminaires should be directed to workspace in such a way that light reflected from any visible objects will not be directed into the eyes of the occupant when he/she is in the usual seating or working position. The second recommendation is to use large lunimaires with low luminance or use diffusers in front of luminaires. Luminaires with appropriate distribution of luminous density should be used. The following strategies can be used to reduce glare:

i. Use of indirect lighting that throws more light in upward direction than in downward direction.
ii. Parabolic louvers, special lens or other diffusing material can be used on fixtures that diffuse the light output.
iii. Relocation of the light source.
iv. Changing the orientation/angle of the luminaire until glare is removed.
v. Changing the surface reflectance of the task.
vi. Use of blinds or shades on windows to control the amount of sunlight/daylight entering into the workspace.
vii. Surface shading in the form of overhangs and fins or smaller pans and deep mullions.

Project No	**164**
Title	Valve-less linear compressor driven stirling cycle cryocooler for space applications
Investigators (Principal Investigator PI & Co-Investigators Co-Is)	PI: Virendra K Bhojwani, Jaywantrao Sawant College of Engineering, Pune Co-Is: Suneeta V Phadkule & Amit V Jomde
Co-PI/focal point /contact scientist from ISRO/DOS	Alok Shrivastava URSC Bengaluru
Duration	Three years (Started on: (July 2016)
Budget (₹ lakh)	22.10
Summary of findings	Final Report under submission

Project No	**165**
Title	Drilling techniques/technology for drilling of miniature size holes of diameter less than 10 microns in super alloys for a depth of 1.0 mm
Investigators (Principal Investigator PI & Co-Investigators Co-Is)	PI: Ganesh G Dongre, Vishwakarma Institute of Technology, Pune Co-Is: Avadhoot Rajurkar, Pankaj Gaigole
Co-PI/focal point /contact scientist from ISRO/DOS	Jacob Philip VSSC Thiruvananthapuram
Duration	Two years (Started on: (June 2016)
Budget (₹ lakh)	38.32

Summary of findings	Objective of this study is to understand effect of laser beam process parameters on the characteristics of micro- holes (i.e Entry diameter, Exit Diameter, Hole taper and Hole circularity) drilled in Stainless steel 316L, Inconel718 and Titanium (grade v) material. These micro holes with high aspect ratio are required in aerospace applications for injection, cooling, diffusion, transpiration etc. This study has resulted in Micro-drilling using µ-EDM and laser, selecting the optimum method to fabricate the micro-holes, investigating effect of process parameters on profiles and dimensions of the laser micro-drilled holes. From the current study it can be concluded that among the different methods of fabrication of micro-holes, ns pulsed laser micro-drilling is suitable for drilling high aspect ratio holes with minimum hole size.

Project No	**168**
Title	Astrobiology experiments on Effect of impact and space related stress on micro-organisms isolated from rocks: Implications for origin of life and Lithopanspermia
Investigators (Principal Investigator PI & Co-Investigators Co-Is)	PI: Rebecca S Thombre, PE Society's Modern College of Arts, Science and Commerce, Pune
Co-PI/focal point /contact scientist from ISRO/DOS	Bhalamurugan Sivaram PRL Ahmedabad
Duration	Two years (Started on: (November 2017)
Budget (₹ lakh)	14.50
Summary of findings	Carbonaceous meteorites are known to provide early clues to prebiotic chemistry and origin of life.A meteorite fall was recorded in Mukundpura, Rajasthan in India on 6 June 2017. The meteorite was identified as a carbonaceous chondrite and was found to contain more than 13 amino acids like alanine, valine, serine indicating that it is a rare primitive extraterrestrial object that may provide insights for understanding the primitive solar nebular processes.A study to evaluate the microbial community structure that may have survived the meteorite impact was undertaken in the present study. 16S rRNAmetagenomic sequencing was used to investigate the culturable and unculturable microbial community structure present in the meteorite impact soil. The metagenome sequence analysis indicated the presence of Actinobacteria, Proteobacteria, Firmicutes and Acidobacteria in abundance in both meteorite impact soil and non impact soil and most organisms wererecruited to hitherto unknown groups and unculturable phyla.Comparative recruitment and phylogenetic studiesrevealed the intriguing abundance in the occurrence of class Bacilli in meteorite impact

soil in comparison to non impact soil. Bacteria were further isolated from impact pit soil using cultural methods and were identified on the basis of biochemical, physiological characteristics and 16S rRNA gene sequencing as Bacillus thermocopriae IR-1, Bacillus thermocopriaea IB-5, Brevibacillus borstenlensis IB1,IB3 and IM3. Bacillus thermocopriae IR-1, a moderately thermotolerant organism that survived the meteorite impact was further exposed to impact shock in Reddy shock tube at 2.5 bar pressure. B. thermocopriae IR-1 demonstrated high resistance to the effect of shock waves and survived impact shock in comparison to Escherichia coli and Staphylococcus aureus that were completely inhibited in the presence of impact shock. Meteorite impacts have been thought to play a significant role in shaping the evolution of life on Earth. The current study presents the first report on isolation of extremely shock resistant organism, Bacillus thermocopriaeIR-1 that survived the impact of Mukundpurameteorite fall. The ability of micro-organisms to survive meteorite impact has now introduced a new dimension in Astrobiology to explore the probability of cellular life in impact pits and craters created by meteorites on earth, other planets and habitable zones.

4. Ongoing research projects

Presently there are 24 ongoing projects (listed below) including ten projects initiated in September 2018. Progress of these projects is monitored through periodical progress reports and reviews by Preliminary Evaluation Committee (PEC) and Joint Policy Committee (JPC). Investigators are invited to make detailed presentation highlighting the technical milestones achieved in their studies. Midcourse correction is suggested by PEC wherever necessary. PEC meeting chaired by Prof S Ananthakrishnan, was held on 19 October 2018 to assess the progress of the ongoing projects and to make midcourse correction. JPC in its meeting held on 19 & 20 February 2019, reviewed the progress of ongoing projects and also interacted with the Investigators of those projects where study has been completed and the Final Report was under submission. Members made valuable suggestions in regard to future course of action after completion of the projects.

List of Ongoing projects

1. Development of Prequal engineering model of "SEAPS" (300 KHz to 30 MHz) RF front-end electronics and data acquisition system for low frequency space science studies (Project No.159)

2. Converting energy derivable from low energy sources into electrical power for autonomous sensors applications (Project No.160)

3. Fabrication of a small satellite for monitoring radiations in different orbits of outer atmosphere where orbit maneuvering will be controlled by solar sail (Project No.162)

4. Bioleaching of Electronics Wastes (E – wastes) (Project No.166)

5. Study of cloud parameters observed by Ceilometer with the satellite retrieved and Mesoscale model generated, cloud parameters (Project No.167)

6. Wear corrosion and impact thoughness of the high nitrogen martensitic stainless steel (XD15NW) (16Cr, 0.20N, 0.42C, 1.8Mo, 0.35V, balance Fe (in wt%) (Project No.169)

7. Miniaturized microstrip antenna designs for 3U cubesat covering UHF, L- and S- band frequency spectrum and their interference study for earth observations (Project No.170)

8. Design and development of work function measurement set up and its use to measure work function of thrusters (Project No.171)

9. Development of solders for use in cryogenic applications (Project No.172)

10. Selective capture and conversion of CO_2 to methanol from direct air using MOFs supported polyamines (Project No. 173)

11. Conducting polymer supported bimetallic nanostructures for fuel cell and hydrogen storage applications (Project No.174)

12. Investigations on ZnSe:Te quantum dot scintillators for charge particle detection in space radiation environment (Project No.175)

13. Development of Aluminium nitride and alumina based ceramics for high temperature electrical insulation (Project No.176)

14. QPSK demodulator based on wideband acquisition technique (Project No.177)

15. Development of an NDT technique for through thickness measurement of non uniform residual stresses in metallic materials (Project No.178)

16. An investigation of tropical mesospheric echoes: causative mechanisms and application to study mesospheric turbulence (Project No.179)

17. Development of image processing algorithms for blur reduction and noise elimination in satellite imagery/radiometric data (Project No.180)

18. Development of Optical Disdrometer (Project No.181)

19. Ontology enabled disaster management web service using data integration (Project No.182)

20. Effects of simulated microgravity on expression profile of microRNA in human cardiomyocytes (Project No.183)

21. Applications of plasmonic nanoshapes in hybrid flexible solar cells (Project No.184)

22. Development of sequestration and biotransformation strategies for the treatment of ammonium perchlorate (Project No.185)

23. Development of Nano - material Smart Coating for Anti - Reflection and Thermal Control of Space Structures (Project No.186)

24. Characterization of AISI 321 stainless steel at low temperatures (Project No. 187)

Current status of ongoing Projects

Sr No.	Project title, Name of Investigator, Budget, Duration, Contact Scientist & Objectives	Current status and observations
1.	Development of Prequal engineering model of "SEAPS" (300 KHz to 30 MHz) RF front-end electronics and data acquisition system for low frequency space science studies (Project No.159) PIs: Gharpure D C Budget: ₹ 28.20 Duration: 2 years (Started on: August 2014) ISRO/DOS Contact Scientists: Rajeev Jyoti, SAC Objectives: To design and develop engineering model of LEAPS: Antennas, Trans impedance amplifiers along with data acquisition system	Design and testing of Amplifier gain block partially completed. Support from SAC for design of Electrical and Magnetic loop antennas as per mechanical, electrical requirements of space payloads required.
2.	Converting energy derivable from low energy sources into electrical power for autonomous sensors applications (Project No.160) PI: Arvind D Shaligram / Subhash V Ghaisas Budget: ₹ 8.08 lakhs Duration: 2 years (Started on:June 2016) ISRO/DOS Contact Scientist:Pramod Kale Objectives: To design and fabricate prototype device and to do field testing in open outdoor winds and under rainfall conditions.	Fabrication of energy harvester mount completed and integrated with cantilever – coil. A new technique to sense fluid turbulence using accelerometer chip has been developed.
3.	Fabrication of a small satellite for monitoring radiations in different orbits of outer atmosphere where orbit maneuvering will be controlled by solar sail (Project No.162) PI: Mudhalwadkar R P Budget: ₹ 20.60 lakhs Duration: 2 years (Started on:June 2016) ISRO/DOS Contact Scientist: Kannan S A, URSC Bengaluru Objectives: To demonstrate orbit maneuvering using solar sails, deployment of solar sail in space and detection of changes in orbital speed or height of the satellite.	Feasibility Review conducted at URSC. Components required for testing of electronics of Power, Communication and On-board computer subsystems procured. PCBs of Communication and Power subsystems designed and fabricated. Other components like Load Cell, Li-ion cells are being procured.

4.	Bioleaching of Electronics Wastes (E – wastes), (Project No.166) PI: Ameeta Ravikumar Budget: ₹ 20.94 lakhs Duration:2 years (Started on: June 2016) ISRO/DOS Contact Scientist: Saboo T, VSSC Objectives: Certain micro-organisms are able to mobilize metals from solid materials (minerals, ores and wastes) by the formation of organic and inorganic acids (protons). Objective is to explore the capability of such microorganisms for the removal of toxic and recovery of precious metals from e-wastes.	Identified microorganisms which are able to leach metals from PCBs and succeeded in bio-leaching upto 10-30% of the metals from PCBs. Initiated the experiments that can design and formulate a media for efficient bioleaching of the metals from PCBs.
5.	Study of cloud parameters observed by Ceilometer with the satellite retrieved and Mesoscale model generated, cloud parameters (Project No.167) PI: Pradeepkumar Budget: ₹ 9.30 lakhs Duration: 2 years (Started on: November 2017) ISRO/DOS Contact Scientist: Amit Kesarkar, NARL Gadanki Objectives: To find the diurnal cycle of cloud base during different seasons, to compare the cloud base observed by Ceilometer with the INSAT derived Lifting Condensation Level (LCL) and Convective Condensation Level (CCL) estimated from Temperature and Humidity profiles.	Study of Diurnal cycle for different seasons considering hourly synoptic and daily average is completed till monsoon 2018. LCL for year 2017 monsoon has been done. Calculation of LCL and CCL using INSAT data is in progress for years 2017 and 2018. WRF model will be used to simulate the cloud base height.
6.	Wear corrosion and impact toughness of the high nitrogen martensitic stainless steel (XD15NW) (16Cr, 0.20N, 0.42C, 1.8Mo, 0.35V, balance Fe (in wt%) (Project No.169) PI: Dhokey N B Budget: ₹ 15.00 lakhs Duration: 2 years (Started on: November 2017) ISRO/DOS Contact Scientist:Thomas Tharian K, VSSC Objectives: A martensitic stainless steel developed by VSSC will be cut into suitable specimen typically used for wear test and material characterization. Solutionizing treatment at 1100^{o}C will be conducted in muffle furnace followed by tempering at varying temperatures 200 to 550^{o}C. Applications of cryogenic treatment before or after tempering will be carried out.	Studies related to optimization of hardening (1075^{o}C), double tempering (500^{o}C, cryogenic soaking 8h and soft temperature (-100^{o}C) completed and observed improved wear resistance and reduction in surface roughness in subzero regimes. Also observed is shift in DBTT from -60 to -90^{o}C.Improved properties are attributed to nanoscale precipitates and proportionate decrease in 3D fracture roughness is in tune with surface roughness.

7.	Miniaturized microstrip antenna designs for 3U cubesat covering UHF, L- and S- band frequency spectrum and their interference study for earth observations, (Project No.170) PI: Pratap Shinde Budget: ₹ 16.66 lakhs Duration: 2 years (Started on: November 2017) ISRO/DOS Contact Scientist: Senthilkumar V, URSC Objectives: Design and development of miniaturized electrically small UHF microstrip antennas for two different orientations of 3U CubeSat. To present the technique for enhancement in gain and bandwidth of circularly polarized UHF antennas to cover spectrum from 500 MHz - 1.15 GHz. To develop physically small dual band antenna prototype for covering S-band (2 GHz-4 GHz) and L-band for earth observation 3U CubeSat.	Design of miniaturized Slotted Rhombus Antenna of CubeSat size with Corner Feed using copper material on FR4 is implemented to cover circularly polarized UHF, L and S bands. Corrugated edge antenna of CubeSat size covers circularly polarized UHF, L and S bands. Gain improvement by miniaturized corrugated edge antenna is 4.61dB and 3.34 dB for UHF and S band respectively.
8.	Design and development of work function measurement set up and its use to measure work function of thrusters, (Project No.171) PI: Mathe V L Budget: ₹ 18.70 lakhs Duration: 2 years (Started on: November 2017) ISRO/DOS Contact Scientist: Ajit M R, VSSC Objectives: To develop work function measurement set up using retarding field diode geometry and thermionic emission. To compare the results obtained from above two set up and carry out pre and post investigation of cathode material using X-ray diffraction	Realization of sample holder and heater to measure the work function of the samples completed. Collection of the data and establishment of co-relation in progress. Measurement of the work function using other techniques such as ultraviolet photo-electron spectroscopy and comparing the results with the values obtained in the present method planned.
9.	Development of solders for use in cryogenic applications (Project No.172) PI: Madhuri Deshpande Budget: ₹ 20.06 lakhs Duration: 2 years (started on: November 2017) ISRO/DOS Contact Scientist: Ramesh Narayanan P, VSSC Objectives: To prepare solders that would remain ductile at cryogenic temperatures. Solders would be	Selection of indium based solder alloys, preparation of alloys of different compositions and characterization of the prepared alloys completed. Manufacturing/purchase of the experimental set-ups for mechanical testing and preparation of specimens for mechanical testing is in

	compatible to the substrate and possess sufficient wettability. This will be achieved by preparing solders of different compositions of In-Bi, In-Ag, In +Ag +Sn & In+ Bi+ Sn. These solders would be characterized to achieve most appropriate composition that would remain ductile at cryogenic temperatures.	progress. Mechanical and non-destructive testing of solder materials at room temperature and cryogenic temperatures are being planned.
10.	Selective capture and conversion of CO_2 to methanol from direct air using MOFs supported polyamines, (Project No. 173) PI: Shobha Waghmode Budget: ₹ 15.00 lakhs Duration: 2 years (started on: November 2017) ISRO/DOS Contact Scientist: Benny K George, VSSC Objectives: Synthesis of polyamines and MOFs using ditopic ligands, Synthesis of MOFs decorated with polyamines. Screening of MOFs by molecular modelling. Actual capture and conversion of CO_2 to methanol with concentrated CO_2 or synthetic air in PARR reactor followed by optimization of reaction conditions. CO_2 capture quantization will be planned with VSSC using temperature pressure desorption studies (TPD).	Screening of MOFs by computational method completed and synthesis of MOF has started.
11.	Conducting polymer supported bimetallic nanostructures for fuel cell and hydrogen storage applications, (Project No.174) PI: Geeta Sharma Budget: ₹ 17.00 lakhs Duration: 2 years (Started on: November 2017) ISRO/DOS Contact Scientist: Benny K George, VSSC Objectives: Synthesis of porous bimetallic Pt-Ni, Pd-Ni nanostructures supported on conducting polymers like Polyaniline, Polypyrrole and PEDOT using radiation and / or chemical techniques. The obtained polymer supported nanostructures will be tested for their activity in Direct Methanol Fuel Cells (DMFC) and hydrogen storage applications.	Conducting Polyaniline polymer has been synthesized by Oxidative polymerization and characterized by U.V, XRD, I.R, and SEM analysis. Palladium nanoparticles are synthesized by radiolytic synthesis method and Nickel nanoparticles by chemical reduction method. These synthesized Pd and Ni nanoparticles are also characterized by different techniques.

12. Investigations on ZnSe:Te quantum dot scintillators for charge particle detection in space radiation environment, (Project No.175)
PI: Shweta Jagtap
Budget: ₹ 16.50 lakhs
Duration: 2 years (Started on: November 2017)
ISRO/DOS Contact Scientist: Srikar Paavan Tadepalli URSC
Objectives: Chemical synthesize of ZnSe:Te quantum dots to fabricate planar thick films. Tune the material properties to achieve higher efficiency of the scintillator.

Synthesis of ZnSe has been done by Hydrothermal method achieving particle size of 10-15nm. Optimizaton to achieve particle size less than 10 nm is in progress. Physico-chemical characterization of the synthesized ZnSe particles using various characterization techniques is in progress. Films of synthesized samples have been made using drop casting method.

13. Development of Aluminium nitride and alumina based ceramics for high temperature electrical insulation, (Project No.176)
PI: Kaustubh Kambale
Budget: ₹ 9.48 lakhs
Duration: 2 years (started on: November 2017)
ISRO/DOS Contact Scientist: Shanbhogue K M, LPSC Bengaluru
Objectives: AlN based ceramics would be fabricated by vacuum sintering as well as spark plasma sintering. Structural characterization of sintered ceramics would be carried out using X – ray diffraction

Spark Plasma Sintering of AlN ceramics carried out. High temperature dielectric characterization of AlN completed and Ceramics fabricated. Fabrication of dense polycrystalline AlN ceramics by conventional sintering route in progress.

14. QPSK demodulator based on wideband acquisition technique, (Project No.177)
PI: Vishal Wankhede
Budget: ₹ 3.78 lakhs
Duration: 2 years (started on: Nov 2017)
ISRO/DOS Contact Scientist: Chandrsekharam K, SAC
Objectives: Development of ground based configurable receiver to support PCM-BPSK, PCM-PSK-Phase Modulation (PM) modulation formats for variable data rates and support the wideband acquisition range.

Development of Simulation Model of QPSK Transmitter and Receiver in MATLAB completed. QPSK Demodulator using GNU Radio and SDR Kit implemented.

15. Development of an NDT technique for through thickness measurement of non uniform residual stresses in metallic materials (project No.178) PI: Vikas Dive Budget: ₹ 10.48 lakhs Duration: 2 years (Started on: September 2018) ISRO/DOS Contact Scientist: Krishnakumar R, LPSC Objectives: Devise NDT method to measure and determine non uniform residual stresses @ 5 to 6 mm depth.Study effect of change of welding method of Friction Stir Welding over TIG on weld pool and residual Stresses in weld. Finite Element Welding Simulation and Ultrasonic Stress Measurement using the LCR Wave.	Literature survey completed and contact done with identified ISRO expert. Equipment has been purchased and installation is in progress.
16. An investigation of tropical mesospheric echoes: causative mechanisms and application to study mesospheric turbulence (Project No.179) PI: Kishor Kumar G Budget: ₹ 7.80 lakhs Duration: 2 years (started on: September 2018) ISRO/DOS Contact Scientist: Venkat Ratnam M N RAL Gadanki Objectives: To determine properties of low latitude mesospheric echoes and to reveal their causative mechanisms. To identify diurnal variations of mesospheric echoes to address their source mechanism. To identify long term variations of low latitude mesospheric dynamics and to classify/quantify the turbulence structure at mesospheric heights.	Progress to be reviewed
17. Development of image processing algorithms for blur reduction and noise elimination in satellite imagery/radiometric data (Project No.180) PI: Ashwini Deshpande Budget: ₹ 8.70 lakhs Duration: 2 years (started on: September 2018) ISRO/DOS Contact Scientist: V Senthilkumar	Progress to be reviewed

18. Development of Optical Disdrometer, Aditee Joshi (Project No.181) PI: Mathe V LBudget: ₹ 18.70 lakhs Duration: 2 years (started on: September 2018) ISRO/DOS Contact Scientist: Sampa Roy, SAC Objectives: To develop new image processing algorithms for estimating point spread function from observed images and to obtain deblurred and denoised images. An experimental set-up employing a programmable camera will demonstrate acquisition of ground truth PSF models of motion and atmospheric turbulence. Effectiveness of proposed algorithms will be verified through the image quality metrics.	Progress to be reviewed
19. Ontology enabled disaster management web service using data integration (Project No.182) PI: Shilpa Pimpalkar Budget: ₹ 0.60 lakhs Duration: 2 years (started on: September 2018) ISRO/DOS Contact Scientist: Nitant Dube SAC Objectives: Design of web application addressing the information needs covering all the phases of disaster management such as, preparedness, early warning.	Progress to be reviewed
20. Effects of simulated microgravity on expression profile of microRNA in human cardiomyocytes (Project No.183) PI: Varsha W Wankhade Budget: ₹ 20.00 lakhs Duration: 2 years (started on: September 2018) ISRO/DOS Contact Scientist: Maulesh Gadani SAC Objectives: To explore the changes in expression of microRNA under simulated microgravity condition in 2D cell culture model. To study the expression of important genes related to heart physiology in 2D cardiomyocyte. To understand the status of cellular stress in cardiomyocytes under the influence of micro-gravity	Progress to be reviewed

21. Applications of plasmonic nanoshapes in hybrid flexible solar cells (Project No.184) PI: Chaure N B Budget: ₹ 16.00 lakhs Duration: 2 years (started on: September 2018) ISRO/DOS Contact Scientist: Objectives: Synthesis of metal (plamonic) Au, Ag and Al nanoparticles of different sizes as well as shapes by wet chemical processable techniques and their incorporation (cross linking/blending) into the conducting polymer matrix to form polymer nanocomposites (PNCs). These PNCs will be used at targeted areas in solar cell.	Progress to be reviewed
22. Development of sequestration and biotransformation strategies for the treatment of ammonium perchlorate (Project No.185) PI: Kisan Kodam Budget: ₹ 5.00 lakhs Duration: 1 year (Started on: September 2018)ISRO/DOS Contact Scientist: Benny K George, VSSC Objectives: Some species of bacteria are known for their biochelation ability to sequester ammonia and phosphate in the form of struvite ($NH_4MgPO_4.6H_2O$). This type of bacteria can be used for sequestration of ammonia from the ammonium perchlorate and remaining perchlorate will be reduced with Co/Ni-doped titanium dioxide and/or Co/Ni-dopedzinc oxide based photocatalysis or with the help of bacterial granules in a bioreactor.	Progress to be reviewed
23. Development of Nano - material Smart Coating for Anti - Reflection and Thermal Control of Space Structures (Project No.186) PI: Kunal U Shinde Budget: ₹ 16.50 lakhs Duration: 1 year (Started on: September 2018) ISRO/DOS Contact Scientist: Sri Ram, LEOS Objectives: Fully-dispersible zeolite MFI/Beta nano crystals will be synthesized and mixed with zeolite seeds and non-ionic surfactants for preparing AR coating. For thermal control applications, VO_2 nano particles and vanadium silicalite-1 zeolite nano precursors will be synthesized using hydrothermal method.	Progress to be reviewed

24. Characterization of AISI 321 stainless steel at low temperatures (Project No. 187) PI: Rajesh Chaudhari Budget: ₹ 28.30 lakhs Duration: 2 years (Started on: September 2018) ISRO/DOS Contact Scientist:Chandrasekharam K Objectives: Characterization of microstructures and mechanical properties of AISI 321stainless steel at low temperatures and different strain rates.	Progress to be reviewed

5. New research projects

Against our invitation for new research proposals, 53 proposals were received and after scrutiny by the Preliminary Evaluation Committee (PEC), Chaired by Prof S Ananthakrishnan, 12 were recommended for the consideration of JPC. Investigators of the recommended proposals made detailed technical presentation to JPC on 19 Feburary 2019. JPC interacted with the prospective investigators and approved 7 proposals for funding in the financial year 2019-20. Technical summary of each of the approved proposals is given below:

Proposal No.	1
Title	Estimation of inter laminar transverse shear stresses in sandwiched structures using a higher order shear and normal deformation theory
Investigator	PI: Shiyekar S M, D Y Patil College of Engineering, Akurdi, Pune
Contact Scientist	K Renji URSC Bengaluru
Duration	2 years
Budget (₹ lakh)	14.25
Objectives of the proposed study	i. Development of analytical formulation for accurate estimation of inter laminar transverse shear stresses in sandwiched structures using a higher order shear and normal deformation theory under standard loading and support conditions. ii. Finite Element Modeling of sandwiched structures in commercial software under general loading and boundary conditions, results and its validation. ii. Assessment of dis bond of Honeycomb Composite Sandwich Structures at ISRO, using present formulation and methodology.

Proposal No.	2
Title	Data driven modeling of morphology and formation of impact craters in Basalt: A case study of Lonar
Investigators	PI: Bhalchandra Pujari**,** Centre for Modeling & Simulation, SPPU Co-Is: Raymond Duraiswami, Dept. of Geology, SPPU
Contact Scientist	Arya A S & Satadru Bhattacharya SAC Ahmedabad
Duration	2 years
Budget (₹lakh)	29.60

Objectives of the proposed study	i. Field work to generate multidimensional database for rocks of Lonar ii. Construct an Artificial Intelligent model to classify rocks iii. Perform hydrodynamical simulations of impact of various types of meteors on basalt surface

Proposal No.	3
Title	Ab initio study of thermal properties of transition metal ceramics for thermal barrier coating
Investigators	PI: Ankita Katre, Centre for Modeling and Simulation, SPPU
Contact Scientist	Vijayalakshmi K P VSSC Thiruvananthapuram
Duration	2 years
Budget (₹ lakh)	10.50
Objectives of the proposed study	i. To find an appropriate thermal barrier coating (TBC) material for rocket engines which operate at ultra-high temperatures of ~3000 K. ii. To understand the thermal properties of such materials and find ways to tune their thermal properties for TBC application. iii. To conduct DFT based study of thermal transport and thermal expansion of ultra-high temperature transition metal diborides as ZrB_2 and HfB_2. iv. To further investigate the effect of intrinsic defects as vacancies on the thermal conductivity of the above mentioned transition metal diborides from DFT calcualtions

Proposal No.	4
Title	Effect of altered gravity on gene expression of human blood mononuclear cells and bone cell with special reference to immunity and differentiation
Investigators	PI: Kalpana Pai & Richa Ashma, Dept of Zoology, SPPU Co-Is: Rama Phadake, Dept of Biotechnology, Modern College of Arts, Science and Commerce, Pune
Contact Scientist	Maulesh Gadani, SAC Ahmedabad
Duration	2 years
Budget (₹lakh)	33.55
Objectives of the proposed study	Preparation of peripheral blood mononuclear cells (PBMCs) to use it as *ex situ* human whole blood as tissue and to study

i. The changes in gene expression profiles of cells under the effect of altered gravity

ii. The effect of Ayurvedic immunomodulator like *Tinospora cordifolia (Guduchi)* and *Withania somnifera (Ashwagandha)* on peripheral blood mononuclear cells (PBMCs) with reference to expression of inflammatory and anti-inflammatory markers

iii. Gene expression profile of cells exposed to immunomodulators/adaptogen by Real Time PCR/microarray analysis

iv. *In vitro* effect of plumbagin to counteract the microgravity mediated –inhibition on osteoblast differentiation and its molecular mechanism of action

v. *In vitro* effect of plumbagin to counteract the microgravity enhanced osteoclast differentiation and its molecular mechanism of action on osteoclast formation

Proposal No.	5
Title	Development of anti-erosion coatings on polymers for Low Earth Orbit space applications
Investigators	PI: Sanjay D Dhole, Dept of Physics, SPPU Co-Is: Dahiwale S S & Bhoraskar V N
Contact Scientist	Deepa Devapal VSSC Thiruvananthapuram
Duration	2 years
Budget (₹lakh)	24.50
Objectives of the proposed study	i. To develop different type of coatings on polymers ii. To study their resistance to the erosion under simultaneous exposure of atomic oxygen and ultra violet radiation

Proposal No.	6
Title	Process development and optimization of novel electro discharge machining variants for machining of super alloys (Titanium Ti6Al4V, Inconel 600/718, Haynes 25, Molybdenum, Columbium 103)
Investigators	PI: Ganesh G. Dongre, VIT Pune Co-Is: Avadhoot Rajurkar
Contact Scientist	Jacob Philip VSSC Thiruvananthapuram
Duration	2 years

Budget (₹lakh)	22.00
Objectives of the proposed study	i. To develop EDM process for difficult-to-cut materials and optimize process parameters, ii. To demonstrate feasibility of different EDM variants like :Micro-EDM, EDM Texturing, Dry and Near Dry EDM, Powder Mixed EDM and Hybrid EDM for machining of difficult-to-cut materials, iii. To demonstrate the feasibility of drilling high aspect ratio holes in difficult-to-cut materials, fabrication of micro-patterned areas minimum achievable sharp internal corner with a shaped electrode and minimum achievable corner radius of a sharp V-notch iv. To assess EDM machined surfaces for quality parameters like MRR, Surface Finish, Recast Layer, heat affected zone (HAZ), Hardness and assess hole quality parameters like hole taper, hole ovality, entry and exit diameter and melt re-deposition
Proposal No.	7
Title	Development of Nano- polishing technology for metal mirrors
Investigators	PI: Girish N Kotwal Co-Is: Sunil S. Kuber & Ramkrishna S Bharsakade
Contact Scientist	Sr. Engineer, LEOS Bengaluru
Duration	2 years
Budget (₹lakh)	22.36
Objectives of the proposed study	i. To evaluate feasible process for nano-polishing and figuring of metal mirrors ii. To develop respective process setup for the specific metal mirror materials iii. To optimize process parameters according the specific quality requirements iv. To characterize the quality of finish and profile with methods like Zygo white light interferometer / SEM / Z-focus stacking microscopy v. To make the process and set-up, scalable in order to commercialize the process. vi. Delivering information of finally selected process as-Process parameters, variables, iterations, types of abrasives to be used, polishing wheel materials, slurry materials, polishing parameters e.g. wheel diameter, slurry particles, sizes, speed etc

6. Major events in the STC calendar

The PEC carries out preliminary evaluation of new research proposals and interacts with the Investigators to modify the proposals wherever needed. The proposals recommended by the Committee are examined by the Joint Policy Committee (JPC) for final approval. PEC also has the responsibility to periodically review the progress of the ongoing projects and take corrective measures. There were three PEC meetings held during the year 2018-19. JPC had its two-day's meeting on 19 and 20th February 2019. Highlights of these events are given below.

1. 35th PEC meeting held on 19 October 2018

Member Secretary mentioned that as on this day, a total of 187 projects have been taken up under ISRO-SPPU Joint Research Programme and 153 are completed by 31 March 2018. In the remaining 34 projects, 10 are projects which have been initiated only in the month of September 2018. Progress in respect of these projects will be assessed after completion of six months. PIs of the remaining 24 projects were invited to make technical presentation to PEC in regard to the status of their projects. Ex-ISRO Scientists AV Patki, Suresh Naik and A K Sinha also participated as invitees and made valuable contribution in the assessment of the progress of these ongoing projects.

2. 36th PEC meeting held on 17 December 2018

Meeting was held for initial evaluation of new research proposals. Against our invitation, 53 research proposals were received from various Departments and affiliated colleges of the University. CD carrying soft copy of the detailed proposals was sent to the Members for their advance study. Committee examined the new proposals and noted that there are several proposals where similar study has been done in the past under ISRO-SPPU Joint Research Programme and such studies need not be repeated. After deliberation, Committee short listed 26 proposals for technical presentation by the prospective investigators. In addition, Committee recommended three proposals to be forwarded to the University for consideration and funding under ASPIRE program as the objective of these study proposals was found to be more appropriate in that area. Existing guide lines in evaluation of the new proposals are:

- Relevance of study with respect to overall goals as spelled out in ISRO-SPPU Memorandum
- Relevance of study with respect to developing new science/technology – innovative idea
- Deliverable products as a result of the study
- Publications of research findings in refereed journals

3. 37th PEC meeting held on 2 & 3 January 2019

The prospective investigators of the shortlisted 26 new proposals were invited to make technical presentation to the Committee. With the help of power point presentation, PIs of the proposals explained the technical details of their proposed studies and provided clarifications to the Members. Shri A V Patki and Dr M M Ali, ex-ISRO Scientists participated as invitees, in evaluation of the new proposals. After detailed interaction with the investigators, Committee recommended a list of 12 projects for consideration of Joint Policy Committee (JPC).

4. 21st JPC meetings held on 19 and 20 February 2019

Joint Policy Committee (JPC) supervises the overall management of the ISRO-SPPU Interaction Programme, recommends the funds requirement to ISRO HQs and suggests new areas of activities as and when necessary. JPC meeting was held on 19 & 20 February 2019 to take a stock of the ongoing projects and consider new research proposals for the year 2019-20. JPC meeting was chaired by Hon'ble Vice Chancellor Prof Nitin Karmalkar and attended by the following Members/invitees. JPC approved 7 new research proposals for funding under ISRO-SPPU Joint Research Programme and recommended a total budget of Rs 233.01 lakhs for the year 2019-20.

Shri P P Kale (SPPU)
Prof A D Shaligram (SPPU)
Prof Pradeep Kumar (SPPU)
Prof Suresh Goswai (SPPU)
Prof M V Kulkarni (SPPU)
Dr M V Ramana (ISRO)
Dr M A Paul (ISRO)
Dr Benny George (ISRO)
Shri A S Laxmiprasad (ISRO)
Shri M B N Murthy (ISRO)
Dr S Sreedharan (ISRO)
Shri M Ganeshan (ISRO)
Shri Sidharth Singh (ISRO)
Shri A V Patki (ex-ISRO)
Shri Suresh Naik (ex-ISRO)
Shri A K Sinha (ex-ISRO)
Shri V B Lal (ex-ISRO)
Dr M M Ali (ex-ISRO)
Shri M C Uttam (Member Secretary)

5. Commencement of new projects

After the receipt of Grants-in-aid from DOS, for the year 2018-19, ten research projects, (Eleven projects were approved in the JPC meeting held on 20 & 21st March 2017), made a beginning in the month of August-September 2018 with the release of first installment of funds. However one project on **Studies on microbial diversity and bioburden estimation of ISRO spacecraft assembly clean rooms** by *Neelima M Deshpande, Abasaheb Garware College Pune,* could not be started as permission to sampling at clean rooms was not given by the Centre and hence this project was dropped.

7. R/D activities in DOS/ISRO establishments

With a view to bring out the potential research areas to the notice of prospective investigators, brief description of major establishments of DOS and their areas of technical activities were highlighted earlier in ISRO-SPPU STC's Annual Report 2014-15. This was followed by adding salient features of technical activities of National Remote Sensing Centre (NRSC/ISRO), Hyderabad in the Annual Report 2015-16, Satellite Application Centre (SAC/ISRO) Ahmedabad in the Annual Report 2016-17 and U R Rao Satellite Centre - URSC (formerly ISAC) and Laboratory for Electro-Optics Systems (LEOS) in the Annual Report 2017-18. To continue, brief history and technical activities (extracted from ISRO websites) of Vikram Sarabhai Space Centre (VSSC) located in Thiruvananthapuram are included here.

Vikram Sarabhai Space Centre (VSSC) is the lead Centre of Indian Space Research Organisation (ISRO). The Centre is named in memory of Dr Vikram A Sarabhai, the great visionary and the father of Indian Space Programme. In the early 1960s, the Indian National Committee on Space Research (INCOSPAR), the Indian counterpart of the Committee for Space Research (COSPAR) of the United Nations, was formed under the leadership of Dr Vikram A Sarabhai. INCOSPAR pioneered studies on the phenomenon of equatorial electrojet, which is a narrow belt of electrons moving from west to east above the magnetic equator. The height at which this current flows, is beyond the reach of instrumented balloons and too low for satellites. The best way to study the phenomenon is to launch instrumented rockets (sounding rockets) into this region to make in-situ measurements. Thumba, a coastal village at Thiruvananthapuram, was a unique choice because of its proximity to the geomagnetic equator. The Thumba Equatorial Rocket Launch Station (TERLS) was established in 1962 for this purpose under UN sponsorship. On November 21, 1963, a two stage sounding rocket, 'Nike-Apache', was launched from TERLS marking the beginning of Space exploration in India. While initial sounding rockets were imported, India went on to establish indigenous capability in manufacturing and launching sounding rockets under the Rohini Sounding Rockets Programme (RSR). Gaining confidence from the RSR programme, the Space Science and Technology Centre (SSTC), established in 1965 initiated research on the development of systems and components for launch vehicles. Rocket Propellant Plant (RPP) was commissioned in 1969 by the Chemical Engineering Division of Bhabha Atomic Research Centre (BARC) for the production of solid propellant blocks. With increase in the number of rockets fabricated, another facility called Rocket Fabrication Facility (RFF) was commissioned in 1971, for undertaking production of rockets and hardware developed in SSTC. Propellant Fuel Complex (PFC) was also established to develop indigenous polymeric materials for making solid propellant. In 1969, the Indian Space Research Organisation (ISRO) was formed under the Department of Atomic Energy to coordinate and conduct space research in the country. On account of the limitations of space imposed by range safety considerations, a second rocket launching station was established on the east coast of India at Sriharikota Island, situated north of Pulikat in Andhrapradesh. This station, then known as Shriharikota Range (SHAR) and subsequently renamed SDSC SHAR, is now the space port of India. In July 1972, TERLS, SSTC, RPP, RFF, PFC and the Indian Scientific Satellite Project (ISSP), Bangalore came under the umbrella of Vikram Sarabhai Space Centre (VSSC). ISSP at Bangalore was reconstituted as ISRO Satellite Centre (ISAC) in November 1976 and subsequently renamed as U R Rao Satellite Centre (URSC). In 1972, Government of India constituted Department of Space (DOS) and Space Commission and brought ISRO under DOS.

VSSC pioneers in rocket research and launch vehicle projects of ISRO. The Centre pursues research and development activities in areas like propellants, solid propulsion technology, aerodynamics, aero structural and aero thermal fields, avionics, polymers and composites, guidance, control &

simulation, computer and information, mechanical engineering, aerospace mechanisms, vehicle integration and testing, space ordnance, chemicals and materials. Systems reliability and quality assurance of all aspects of engineering and operations are studied and evaluated in each field. Space Physics Laboratory (SPL) at VSSC carries out research and studies in atmospheric science and other related space science activities. Ammonium Perchlorate Experimental Plant (APEP) at Aluva in Kerala and the ISRO Inertial Systems Unit (IISU) at Thiruvananthapuram in Kerala also form part of VSSC.

The ongoing programmes at VSSC include launch vehicle projects like Polar Satellite Launch Vehicle (PSLV), Geosynchronous Satellite Launch Vehicle (GSLV), Rohini Sounding Rockets and Space-capsule Recovery Experiments. The next generation launcher GSLV MkIII (also known as LVM3) has successfully undergone an experimental flight with passive cryo stage and proved the atmospheric regime. LVM3 flight with an active cryo stage, Reusable Launch Vehicle (RLV) and Air Breathing Propulsion for Advanced Reusable Launch Vehicle, Human Spaceflight Project etc are on the anvil.

Research Areas

Aerospace Engineering: Flight dynamics, orbital mechanics Wind tunnel studies, CFD, Flow field analysis, Aero thermal engineering

Launch Vehicle structures: Structural Analysis modeling and simulation stability analysis, structural dynamics & testing, honey comb structures, experimental mechanics.

Space Materials & Processing: Light Alloys, Super alloys, precision fabrication techniques, Heat treatment, surface treatment, welding technology, powder metallurgy, foundry technology, ceramics, materials characterization

Composite Materials: Composite Materials processing and control, characterization & testing, NDT, development of composite structure for launch vehicles and spacecraft carbon-carbon composites

Propellants, Polymers, Chemicals & Space Ordnance: Propellant processing, characterization, testing, thermal protection materials, adhesive ceramics/matrix products, thermal paints, polyimides, avionics batteries, fuel cell, space ordnance materials, characterization, nozzle design, advanced propulsion technology, CFD, Heat transfer, performance simulation

Avionics, Guidance & Control: Sensors & instrumentation, power electronics Data acquisition, signal processing, technology ASIC/FPGA, onboard inertial systems, servo mechanisms, guidance and control, trajectory simulation and analysis and MEMS inclinometer is also taking place.

8. ISRO Proposal Format

Faculty Members of SPPU and its affiliated colleges are required to follow the ISRO format as given in http://www.isro.gov.in/scripts/srrespond.aspx and reproduced below for making research proposals and seeking financial grant from ISRO. Requirement is that Principal Investigator(s) should be full-time employee(s) of the concerned institution and proposal is to be forwarded through Head of the academic institution. Research proposals from individuals not affiliated to any recognized institution of the University are not considered. Institutions proposing a project for support are expected to commit the use of the existing infrastructure available with them. ISRO provides financial grants to support fellowship, materials, consumables, internal travel, testing charges, data etc. Funds for purchase of essential minor equipments which are not available in the institution and would be useful for future projects are also provided. There is no provision for any kind of payment to the Principal Investigator (or other staff) belonging to the Institution. The allocated funds cannot be used for travel abroad for any reasons.

Generally invitation for making research proposals is sent in the month of September-October and processing of the proposals is completed in 4-5 months time. For any information/clarification, Faculty Members may contact the ISRO-SPPU Space Technology Cell or visit our website www.unipune.ac.in/isro to get the required information.

Application for grant of funds

1. Application Institution
2. Title of the Research Proposal
3. Name of the Principal Investigator
4. Name(s) of other investigator(s) with the name(s) of their Institution
5. Proposed duration of Research Project
6. Amount of grant requested (in `)

	1st Year	**2nd Year**	**Total**
Staff			
Equipment and Supplies			
Others			
Total			

7. a) Bio-data of all the Investigators (Format-A).
   b) Brief description of the Research Proposal with details of budget (Format-B).
   c) Declaration (Format-C).

8. I/We have carefully read the terms and conditions for ISRO Research Grants and agree to abide by them. It is certified that if the research proposal is approved for financial support by ISRO, all basic facilities including administrative support available at our Institution and needed to execute the project will be extended to the Principal Investigator and other Investigators.

	Name	Institution	Designation
Principal Investigator			
Co-Investigator(s)			
Head of the Department/Area			
Head of the Institution			

Format A

Bio-data of the Investigator(s)*

1.	Name
2.	Date of Birth (dd/mm/yyyy)
3.	Designation
4.	Degrees conferred (begin with Bachelor's degree)

Degree	Institution conferring the degree	Field(s)	Year

5. Research/training experience (in chronological order)

Duration	Institution	Name of work done

6.	Major scientific fields of Interest:
7.	List of publications:
8.	Email id and Telephone number of PI :
9.	Email id of the Head of the academic institution:

* Bio-data for all the investigators should be given, each on a separate sheet.

Format B

Proposal Preparation Format

1. *Title of the research proposal*

2. *Summary of the proposed research*
A simple concise statement about investigation, its conduct and anticipated results in no more than 200 words

3. *Objectives*
A brief definition of the objectives and their scientific, technical and techno- economic importance

4. *Major scientific fields of interest*
A brief history and basis for the proposal and a demonstration of the need for such an investigation preferably with reference to the possible application of the results to ISRO's activities. A reference should also be made to the latest work being carried out in the field and the present state-of-art of the subject.

5. *Approach*
A clear description of the concepts to be used in the investigation should be given. Details of the method and procedures for carrying out the investigation with necessary instrumentation and expected time schedules should be included. All supporting studies necessary for the investigation should be identified. Necessary information of any collaborative arrangement, if existing with other investigators for such studies, should be furnished. The Principal Investigator is expected to have worked out his collaborative arrangement himself. For the development of balloon, rocket and satellite-borne payloads it will be necessary to provide relevant details of their design. ISRO should also be informed whether the Institution has adequate facilities for such payload development or will be dependent on ISRO or some other Institution for this purpose.

6. *Data reduction and analysis*
A brief description of the data reduction and analysis plan should be included. If any assistance is required from ISRO for data reduction purposes, it should be indicated clearly.

7. *Available Institutional facilities*
Facilities such as equipments, test instruments etc available at the parent Institution for the proposed investigation should be listed.

8. *Fund Requirement*
Detailed year wise break-up for the Project budget should be given as follows

	1st Year	**2nd Year**	**Total**
8.1 Salaries:			
8.1.1 Research Fellows/ Project Assistant			
8.1.2 Supporting Technical Staff			
8.1.3 Other staff, if any			

Total:

(Note: please specify designation and rate of salary per month for each category)

8.2 Equipment

	1st Year	2nd Year	Total

Total:

(Note: Please specify various individual items of equipment and indicate foreign exchange requirement, if any)

8.3 Consumables and Supplies

	1st Year	2nd Year	Total

Total:

(Note: Please specify the items and indicate foreign exchange requirement, if any.)

8.4 Travel

	1st Year	2nd Year	Total

Total:

8.5 Other project costs, if any (give details)

	1st Year	2nd Year	Total

a. Grand Total

9. Whether the same or similar proposal has been submitted to other funding agencies of Government of India. If yes, please provide details of the Institution & status of the proposal.

Format C

Declaration

I/We hereby agree to abide by the rules and regulations of ISRO research grants and accept to be governed by all the terms and conditions laid down for this purpose.

I/We certify that I/We have not received any grant-in-aid for the same purpose from any other department of the central government/state government/public sector enterprise during the period to which the grant relates.

	Name	Designation	Signature
Principal Investigator			
Head of the Department/Area			
Head of the Institution			

Seal of the Head of the Institution

9. Supported areas of research

Research proposals are supported by ISRO in any area of relevance to the space programme of which the following are few examples:

Space Science : Physics of the ionosphere and magnetosphere; meteorology, dynamics of the atmosphere; geophysics, geology; astronomy; cosmology; astrophysics; planetary and interplanetary space physics and climatology.

Space Technology : Rocket and satellite technology; propulsion systems design and optimization; aerodynamics and heat transfer problems related to space vehicles; guidance and control systems for launch vehicles and spacecraft; polymer chemistry, propellant technology; ultra-light-weight structure; satellite energy systems; space electronics, space communication systems; orbital mechanics, computer sciences and new material development.

Space Application : Remote sensing of earth's resources: space communication; satellite geodesy image processing, satellite meteorology including weather forecasting, Space Education and Ecology.

Keeping national space programme in mind, ISRO Headquarters has brought out a comprehensive document on Research Areas in Space to help the prospective researchers in preparing research proposals of relevance to ISRO. The document brings out the research topics under five categories namely Launch Vehicle, Satellite Communication, Earth Observations, Space Sciences and Meteorology. Specific research topics are spelled out under various sub-categories of the above, as shown below:

Launch Vehicle

1. Aerospace Engineering
2. Propulsion
3. Propellants, Polymers & Chemicals
4. Control, Guidance & simulation
5. Materials & Metallurgy
6. Composites
7. Transducers & Sensors
8. Structures & Fabrication
9. Avionics
10. Launch Vehicle Inertial Systems Area
11. Advanced Inertial Systems Area
12. Mechanical Design and Production Group
13. Launch vehicle tracking system, Range
14. Operation, System Engineeing
15. Project and Programme Management
16. Testing of liquid propulsion system

Satellite Communication

1. SATCOM Applications
2. Electronics Support Services
3. Antenna
4. Mission Development Area
5. Communication and Power
6. Integration and Checkout
7. Mechanical Systems
8. Controls and Digital
9. Reliability and Components
10. Systems Production
11. VLSI Design
12. CMOS Process Technology
13. MEMS Design & Process Technology
14. SATCOM & Navigation Payload
15. SATCOM & SATNAV Applications & Associated Technologies
16. Mechanical Engineering Systems
17. Systems Reliability
18. Material Characterization
19. Semiconductors
20. Spacecraft Inertial Systems Area
21. Bearing and Space Tribology

Earth Observations

1. Mission development and Remote Sensing-Sensor Technology
2. Remote Sensing Signal and Image Processing and Software Development
3. Satellite Data Reception & Ground Station
4. Earth, Ocean Sciences Applications
5. Aerial Remote Sensing
6. Earth and climate sciences
7. Disaster Management
8. Urban and Regional Studies/Processes

Space Sciences

1. Investigation on Near Earth Environment
2. Atmospheric dynamics and coupling
3. Sun and Solar System
4. Astronomy and Astrophysics
5. Space Instrumentation
6. Remote sensing data analysis from Planetary Exploration Missions
7. Laboratory study of Astromaterials
8. Study of terrestrial analogues of Moon and Mars
9. Payloads for upcoming Planetary Missions

Meteorology

1. Weather and Climate
2. Space Physics
3. Signal and Data processing
4. Radar and Lidar instrumentation for atmospheric probing

In addition to above, ISRO Headquarters has also brought out a RESPOND BASKET comprising of aroud 150 urgent and most important research areas with a brief write up about the topic for the researchers to select and prepare detailed proposals on a priority basis. For each identified project under RESPOND Basket, a Co-Principal Investigator has been identified from the respective centre for any further clarification and coordination while preparing the proposals and during the tenure of the project.

These two documents are available in the ISRO website under the link **www.isro.gov.in/research-and-academia-interface/submission-of-research-proposal**

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Evaluation of New Research Proposals

Ongoing Projects Review

Technical Presentation in PEC Meeting

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