JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH

ANNUAL REPORT
2015-16

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Smt. Nirmala Sitharaman, Minister of State for Commerce & Industry conferring IPO Special Mention Award to Prof K S Narayan, President In-Charge, and Dean (R&D), JNCASR, April 24, 2015.

Group Photo of IV India@DESY Steering Committee Meeting, in Goa on October 11-12, 2015. In the picture: front row (Left to Right) Ajay Sood, Helmut Dosch, Milan Sanyal, Praveer Asthana, A.N. Jayachandra. Second Row (Left to Right) Christian Schroer, Wolfgang Drube, Edgar Weckert, Dipankar Das Sarma, Frank Lehner, Chandrabhas Narayana

Student Buddy Programme, October 19, 2015
In the picture: A student from Jawahar Novodaya Vidyalaya participating in a lab activity with a student buddy from JNCASR.

In the picture: (from left to right)Mr Duncan Selbie, Chief Executive, PHE, Prof C N R Rao, Prof K S Narayan, Prof S S Vasan, PHE, (In last row) Mr A N Jayachandra, Sr Administrative Officer, JNCASR and Dr Jayanta Haldar, NCU, JNCASR

Conferment of Honorary Fellowship of JNCASR on Dr Kiran Mazumdar-Shaw, November 09, 2015
In the picture: (Left to Right) Prof V Nagaraja, President, JNCASR, Dr Kiran Mazumdar-Shaw, Chairman and Managing Director, Biocon Ltd., Bangalore and the Bharat Ratna Prof C N R Rao, Linus Pauling Research Professor, JNCASR.

Prof. Michael L. Klein, FRS, Temple University, Philadelphia, USA, conferred with the Honorary Fellowship of JNCASR on December 03, 2015.

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(A Deemed to be University)

Jakkur, Bangalore – 560 064

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THE CENTRE

FOREWORD

I am delighted to present the Annual Report for the year 2015-16 while JNCASR is emerging as one of the leading institutions in the country for higher learning and research in frontier areas of science and engineering. Recently, in a report on ranking of Indian educational and research institutions (published by Nature Group of Publishing), JNCASR was placed in the seventh position, pointing to our emergence.

Being a Deemed-to-be-University, the Centre awards degrees such as M.S. (Engg.), M.S. of Integrated Ph.D., Ph.D., and Post-graduate Diploma in Materials Science (PGDMS). In addition, Post-graduate Diploma in Science Education (PGDSE) is also offered to provide opportunities for science teachers in enhancing their teaching skills. There is a steady increase in the number of research students in the Centre pursuing various academic programmes. The present student strength is 305. Sixty-three students joined the Centre during August 2015 session and eight students joined during the mid-year admission in January 2016. Twenty-nine students were awarded Ph.D. and three with M.S. (Engg.). Under the M. S. of Integrated Ph. D. – eight students were awarded M. S. in Biological Sciences, five students with M. S. in Chemical Sciences and four students with M.S. in Materials Science. In addition, one student was awarded the Postgraduate Diploma in Science Education (PGDSE) and three with Postgraduate Diploma in Materials Science (PGDMS).

It is satisfying to note that academic, research, fellowship and extension programmes have been progressing as per the plan. A series of programmes were organized by Education Technology Unit (ETU) and Hall of Science toward the popularization of science within Karnataka as well as other remote areas of the Country.

It is a matter of great pride that Prof. Umesh V. Waghmare has received the prestigious Infosys Prize 2015 in the category of Engineering and Computer Science. Prof. C.N.R. Rao was felicitated with Honorary Doctor of Science from Institute of Liver and Biliary Sciences (ILBS), New Delhi and Honorary Doctor of Engineering from National Cheng Kung University, Tainan, Taiwan. A number of other faculty colleagues have received awards and honours during the year 2015-2016 (a detailed list is given under Awards/Distinctions in pg. no. 128). Students have also marked their presence in national and international conferences and received best poster awards. Hearty congratulations.

Researchers in JNCASR have continued to excellence in science through their discoveries and inventions. Increasing number of publications in reputed high-impact factor international journals is one of the indicators of our scientific performance. The quality of our research is also evident from the fact that during the financial year 2015-2016, 28 patent applications were filed (India-10, International Patent Application under PCT-4, USA-3, Europe-2, Australia-2, Canada-2, China-1, Japan-1, Korea-1, Brazil-1, Hong Kong-1) and 13 patents were granted (USA-5, Europe-4, China-2, Japan-1, Germany-1). Taken together, the Centre till date has filed 219 patent applications (India-73, PCT-45, USA-46, Europe-20, Japan-7, China-6, Korea-5, Australia-5, Brazil-3, Canada-3, S. Africa-2, Vietnam-1, Israel-1, Germany-1, Hong Kong-1) and obtained 53 patents (USA-25, India-8, Europe-8, Japan-4, China-3, S. Africa-2, Australia-1, Korea-1, Germany-1), in addition to registering one Industrial Design and One Trade Mark.

Vibrant research collaborations within and across the Units, with institutions in India and abroad have contributed in no small measure to our success. One such example is the signing of the Memorandum of Understanding (MoU) with Public Health of England for the research and development of antimicrobial compounds and

exploration of their pharmaceutical applications. We have achieved success in translating our discoveries and innovations and also explored ways to get them licensed. The inauguration of our first start up called Sankhya Sutra Labs Pvt. Ltd., is in that direction. This start up is of importance to the strategic sector of the country as well. The visit of European Union (EU) delegation on October 28, 2015, led by Mr. Denis Dambois, First Counsellor and Head of Research and Innovation along with members from different EU countries has given us an opportunity to increase and expand our international collaborations. To enhance interaction between academia and industry with an objective to license our discoveries, Industry Meet at JNCASR was held on March 08, 2016. Technical Research Centre (TRC) has been established at JNCASR in early 2016 with support from the Department of Science & Technology, GoI as an in-house multifaceted platform to escalate JNCASR's efforts in translating its research and development into products and processes for greater economic and societal benefits. Accordingly, TRC has been working to achieve the said objectives through multiple means, viz., building R&D infrastructure required to graduate its select technologies/know-how/IP to next technology readiness level, creating and nurturing start-ups based on IP developed at JNCASR, transferring/licensing JNCASR's technologies/IP for commercial exploitation, and collaborating with industrial partners to undertake joint R&D projects of techno-commercial importance. The visit of Shell Global R&D team and Singapore Astar team has given us an opportunity to further expand our international collaborations. Hon'ble Union Minister of Science and Technology and Earth Sciences, Dr. Harsh Vardhan inaugurated the Neuroscience Building at the Centre on February 09, 2016 and addressed the faculty members. Prof. K. VijayRaghavan, Secretary, DBT also visited the Centre and had a discussion with the faculty.

The Centre maintains its vibrant academic activities through conferences, seminars, colloquia and discussion meetings.

The progress and the developments at JNCASR were possible with the continuous support from the Department of Science and Technology, Govt. of India. Now we are hoping to further improve the infrastructure and augment facilities through the funding from Department of Science and Technology (DST), Department of Biotechnology (DBT) and other sources. We have also begun embarking on some new initiatives and areas of research to remain as an emergent institution of higher learning.

Prof. V. Nagaraja
President, JNCASR

INTRODUCTION

The Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore, a premier research institute in the country, was established in the year 1989, the birth centenary year of Pandit Jawaharlal Nehru, by the Department of Science and Technology. The objectives of the institute are to pursue and promote scientific research and training at the highest level in the frontier and interdisciplinary areas of science and engineering. The number of publications in international journals of repute and the filing of patents is steadily increasing year by year. The Centre, which is now twenty-seven years old, is creating news regularly in the scientific world with its breakthrough discoveries. The Centre has research collaborations with several national and international institutions. In recognition of the achievements of the Centre, the Ministry of Human Resource Development (GOI) has accorded the status of Deemed-to-be-University, to enable the Centre to train quality manpower. The faculty members of the Centre have received national and international recognitions. Several faculty members of the Centre are Fellows of National and International science and engineering academies.

Prof. C.N.R. Rao, the founder of the Centre, held the office of President from 1989 to 1999. He is presently the Honorary President of the Centre. Prof. V. Krishnan, who succeeded him, served as President from 2000 to 2003. Prof. M.R.S. Rao was President from 2003 to 2013 and Prof. K.S. Narayan was In-charge President from 2013 to 2015. Prof. V. Nagaraja is the current President since October 2015.

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OBJECTIVES

The objectives of the Centre are:

1. Establish and conduct world-class research in science and engineering;
2. Foster interdisciplinary and collaborative research;
3. Establish state-of-the-art laboratories, computational and infrastructural facilities for conduct of scientific research;
4. Generate human capital through high-quality Ph.Ds in science and engineering;
5. Increase awareness about science and research among school and college students through science outreach and extension activities;
6. Take research from laboratory to society.

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PROGRESS

We have accounted several memorable and exciting moments including some major discoveries and innovations during the reporting year. Significant progress has been reported by all the research units of the Centre.

There was a good intake of students into the different degree programmes during August 2015 and January 2016 academic sessions, wherein 63 students joined in August 2015, and 8 in the mid-year admissions during January 2016. The current student strength at the Centre is 305. After completing a successful tenure at the Centre, 53 students have received their degrees this year under the different degree programmes which include the award of 29 Ph.D. and 3 M.S. (Engg.) degrees. Under M.S. of Integrated Ph.D. out of total 17 degrees awarded - 8 were in Biological Sciences, 5 in Chemical Sciences and 4 in Materials Science. In addition, 1 student was awarded Postgraduate Diploma in Science Education (PGDSE) and 3 students were awarded the Postgraduate Diploma in Materials Science (PGDMS). Thus far the research and training at the Centre have led to the award of a total of 208 Ph.D. degrees, 58 M.S. (Engg.), 3 M.S. (Research), 103 M.S. (of Int. Ph.D.), and 1 M.Sc. (by Research) degrees, and 8 PGDSE and 12 PGDMS.

The Centre has emerged as a place for interdisciplinary research, with effective interactions among scientists with backgrounds in biology, chemistry, engineering and physics. The JNC community has been working not only in pursuit of research but also on dissemination of science-related activities reaching out to the common man. In recognition of its contributions to research and training, the Centre and its faculty members have received various national and international honors and accolades during the year. In recognition of the Centre's significant achievements in the field of patent oriented R&D and intellectual property promotion, the Centre received the IPO Motivation Award from Indian Patent Office in the National IP Awards 2015 function.

Among faculty members, Prof. C.N.R. Rao received several prestigious awards including the Japanese Government's highest civilian award, the Order of the Rising Sun, Gold and Silver Star and Kanbirkar Award 2016 of Shivaji University, Kolhapur; as well as Honoris Causa Doctorate of Science from Institutes and Universities namely, Institute of Liver and Biliary Sciences (ILBS), New Delhi, National Cheng Kung University, Tainan, Taiwan, D. Y. Patil University, Pune, and Indian Institute of Technology (IIT) Kanpur. Prof. Roddam Narasimha received Guru Shreshta Award-2015 from the Institution of Engineering and Technology and Distinguished Alumnus from University of Mysore Alumni Association. Prof. M.R.S. Rao received Goyal Prize in Life Sciences for 2012-2013. Prof. Umesh V. Waghmare received the prestigious Infosys Prize in Engineering and Computer Science (2015) and C.N.R. Rao Prize Lecture in Advanced Materials from Materials Research Society of India, 2016. Prof. K.R. Sreenivas was felicitated with Prof. Satish Dhawan Award for Young Engineers for the year 2013 and Dr. T. Govindaraju received Sir C V Raman State Award for Young Scientists for the year 2014 from Karnataka State Council for Science and Technology (KSCST) and Department of Information Technology, Biotechnology and Science & Technology, Government of Karnataka. Prof. Tapas Kumar Kundu received Dr. Nitya Anand Endowment Lecture Award by Indian National Science Academy, 2015 and G.P. Chatterjee Memorial Award for 2015-2016, awarded by the Indian Science Congress Association. Prof. Srikanth Sastry received the Distinguished Alumnus Award, Indian Institute of Technology, Bombay, 2015. Dr. Sebastian C. Peter was the recipient of MRSI (Materials Research Society of India) Medal for 2016. Dr. Subi J. George received NASI-SCOPUS Young Scientist Award 2015 in Chemistry. Dr. Santosh Ansumali was named as 2016 Outstanding Referee of American Physical Society (APS) journals. Dr. Kanishka Biswas received NASI-Young Scientist Platinum Jubilee Award (2015) in Chemical Sciences; Young Scientist Research Award, DAE-BRNS, India (2015) and Emerging Investigator 2015 in inorganic chemistry by Inorganic Chemistry Frontiers, Royal Society of Chemistry (RSC).

Several Ph.D. students have received awards and Best Poster prizes at national and international fora as a recognition of their contributions to science.

The Faculty members of the Centre have published around 257 scientific papers in reputed international journals, conference proceedings and books during the year 2015-2016. Most of the publications are from journals with a high impact factor. The average impact factor of the total 250 journal articles published for the year 2015 is 4.561.

Many patent applications were filed for new inventions. Details are provided in a separate section on "Intellectual Property".

The interactions with academic institutions and universities globally have continued and the Centre is expanding its formal ties in respect of collaborative research, exchange of graduate students and consultancy projects.

Honorary Faculty Members of the Centre have continued to play an important role in guiding academic and extension activities of the Centre.

Summer Research Fellowships, Project Oriented Chemistry Education Programme, Project Oriented Biology Education Programme, Visiting Fellowships Programmes and several other academic exchange programmes have attracted wide attention and have been highly successful. Thirteen scientists from research institutions across the country were selected for the Centre's Visiting Fellowships 2015-2016. The selected scientists were hosted by the faculty of CPMU, EOBU, MBGU, NCU, NSU, and TSU. Sixty-nine students availed the scholarship for Summer Research Fellowship Programme 2015 and received research training in various areas of physics, chemistry, biology or engineering at research institutes in Bangalore, and elsewhere in the country. Thirteen students were awarded the Rajiv Gandhi Fellowship for the year 2015. For Project Oriented Biology Education (POBE), out of 171 applications received, 10 students have been selected and under Project Oriented Chemical Education (POCE), out of 263 applications received, 11 students were selected. Nine students of POCE 2013-2015 have completed the programme successfully. Six scientists who were shortlisted under the JNCASR-CICS Fellowship Programme 2015-16 are from Nigeria, Uzbekistan, Ethiopia, Sri Lanka, Zambia and Cameroon.

During the financial year 2015-2016, 10 Discussion Meetings, 12 international conferences, workshops, and symposia were supported, either wholly or partially by the Centre. Around 47 seminars were held in addition to 13 Endowment Lectures, 8 Fluid Dynamic Colloquia, and 1 special lecture were delivered by eminent scientists.

HIGHLIGHTS OF RESEARCH AND OTHER ACTIVITIES

Chemistry and Physics of Materials Unit (CPMU)

The Molecular Modeling Group has made vital contributions in several areas, including gas storage, enzymatic catalysis, supramolecular assemblies and room temperature ionic liquids (RTIL). The vibrational and diffusional dynamics in the plastic crystalline phase of several RTILs have been studied using MD simulations. In Prof. S.M. Shivaprasad's research group, studies were pursued on the epitaxial growth of thin films and nanostructures which has resulted in interesting observations made in the growth of Gallium and Indium Nitride nanostructures. The research group discovered the mechanism of bond formation in the gallium nanowall network. Dr. M. Eswaramoorthy's research group worked on metal-free, electrocatalysts potential for hydrogen production (in electrochemical water splitting) and oxygen reduction (in fuel cells) with the focus to replace traditional Pt based catalysts. Direct synthesis of hydrogen peroxide using bimetallic catalysts, and gas separations through 2-dimensional layered membranes were few other areas of focus. Prof. A. Sundaresan's research group has discovered linear magnetoelectric effect in several A-site antiferromagnetic oxides, Co_3O_4 and MnB_2O_4 (B = Al, Ga), which belong to the family of AB_2O_4 oxides with spinel structure ($Fd\bar{3}m$). In these normal spinels, the magnetic ions (Co_{2+} and Mn_{2+}) located at the A-site, undergo collinear antiferromagnetic ordering at low temperatures where it exhibits magnetoelectric properties. Dr. Sridhar Rajaram's research group has developed a clear understanding of the charge transfer dynamics in twisted perylene solar cells. The Molecular Materials Group has explored various porous materials over the year and has studied a wide range of properties starting from gas adsorption, catalysis and sensing to super-hydrophobicity. The Light Scattering Laboratory has continued with the work on using SERS to study drug-protein interactions in p300 for its histone acetyl transferase activity, understanding the importance of Mg_{2+} ion on transcription co-activator kpn1, developing a credible non-PCR based nucleic acid detection. Prof. K. S. Narayan's research group has demonstrated the utility of electric field application during the fabrication process which enables higher performance characteristics of organic transistors and solar cells.

Education Technology Unit (ETU)

The Unit was involved in the concept, development, and production of books and multimedia CD-ROMs dealing with various disciplines of science for school students and teachers. The lectures/workshops for students and teachers were highly popular. These lectures and workshops are conducted on subjects such as Physics, Chemistry, and Biology. The Summer 2015 - Science Outreach Programme sponsored by the C.N.R. Rao Hall of Science, JNCASR was conducted in association with Himalayan Gram Vikas Samiti, Gangolihat by Prof. K.S. Valdiya during April 29-30, 2015. The Science Outreach Program conducted at Dashaithal, Gangolihat, Pithoragarh, Uttarakhand had participation from 122 students and teachers from various schools in the region. The Centre in collaboration with the C.N.R. Rao Education Foundation presented the National Award of Chemical Education (Donated by AVRA Laboratories, Hyderabad) to Prof. Uday Maitra. The C.N.R. Rao Education Foundation sponsored 2014 prizes for Outstanding Science Teachers were awarded to Smt. Meenu Wadhwa and Shri. Prakash Ramachandra Garagatti. A Science Orientation Workshop for Jawahar Navodaya Vidyalaya (JNV) students was organised for Class XI students from various JNV's across Karnataka. A workshop on '100 years of the chemical bond' was specially organized on January 29, 2016, to commemorate the centenary of the discovery of the chemical bond. The National Science Day programme had a short talk on the wonders of science followed by a demonstration of experiments in physics and chemistry by faculty and students of the Centre. The programme attended by 150 students and teachers was held on February 25, 2016. A Programme in chemistry was organized on December 8, 2015, where Prof. C.N.R. Rao, Prof. Andy Cooper, Prof. Ashok Ganguli and Prof. S. Balasubramanian delivered lectures on the theme of the chemical bond. 200

students and teachers participated in the programme. A 'Festival of Science' was organized in association with an NGO, Parikrama on January 21-23, 2016 for 200 children from about 40 schools. The theme of the festival was `Energy'. Prof. C.N.R. Rao inaugurated the festival and addressed the students.

Engineering Mechanics Unit (EMU)

For the year 2015-2016, activities in the Engineering Mechanics Unit include study of convection and instabilities in vibrated granular bed, fluid exchange between chambers having different density fluids through vertical and horizontal openings, shock-waves in dilute granular gases, development of an improved algorithm based on delayed difference scheme for large scale scientific simulations, implementation of lattice scheme for three dimensional multiphase simulations with high density ratios. Experimental study on drag-reducing polymer (DRP) indicated the occurrence of a delayed transition, the shift of instability to longer wavelengths in the DRP solution compared to that for plain-water. Considerable progress has been made during the year on DNS studies of the flow past a low pressure turbine blade. A very high resolution (190 million grids) direct Navier Stokes computer simulation has provided for the first time pressure distributions on the blade that are very close to measured values. The novel low drag wing planforms for turbo-prop aircraft, obtained by using optimization techniques, has now received patents from US, South Korea, and Japan.

Evolutionary and Organismal Biology Unit (EOBU)

The Unit also continues to train personnel in the area of whole organismal biology through Ph.D., Integrated Ph.D. and M.S. programmes, as well as through participation of the faculty in POBE and SRFP programmes of JNCASR as well as similar outreach programmes run by the three Indian Science Academies and by DST and KVPY. A theory to understand why not only density (eggs per unit volume of food) but also the total height of the food column in Drosophila culture vials affects the nature of selection in crowded cultures and potentially leads to the evolution of competitive ability via different sets of traits has been developed. Work on the social structure of female Asian elephants was continued in Nagarahole and Bandipur National Parks. Distinct clans within the population was detected. It was found that clan membership did not change across years, that there were preferred associations within clans, and that there were significant correlations in pairwise association strengths across years, suggesting a fair degree of stability in this social structure. Observations on common myna foraging showed that there was a high degree of ephemerality in food resources at the level of the grids examined, and resource depletion within a day. In collaboration with colleagues at IISER Mohali researchers at EOBU had established NMR-based metabolomics combined with multivariate statistical analysis as a useful method for future studies on the interactions between circadian clocks and metabolic processes. Studies of the interaction between circadian pacemakers and sleep homeostat show that PDF+ neurons promote daytime wakefulness by silencing sleep-promoting dorsal Fan shaped Body neurons. In a study it was found that *D. melanogaster* populations selected for evening adult emergence exhibit delayed pupation and development times, higher fecundity, and reduced adult lifespan. *D. melanogaster* populations selected for evening adult emergence evolve circadian clocks composed of weak oscillators, greater developmental plasticity and higher period plasticity. The effects of polygamy were established on the activity/rest rhythm of male fruit flies Drosophila Pair-wise social interaction in males results in clock-independent sleep-enrichment in fruit flies *D. melanogaster*. Or47b olfactory sensory neurons regulate male-mating success in fruit flies D. melanogaster.

Geodynamics Unit (GDU)

During the reporting period, the previously initiated studies on the plate deformation and the long-term tsunami

recurrence in the Andaman region continued. The ongoing research was also focused on the neotectonics and earthquake generation in the central Himalaya in addition to the Holocene climate evolution. The activities also included initiatives in organizing science outreach programmes in various districts of Uttarakhand. Work was continued to develop a robust chronological database on the Indian Ocean tsunami history from deep coring the tidal inlets and wetlands of South Andaman. Around 10-m long cores were collected from several sites near Port Blair that preserve bands of tsunami depositions alternating with regular cycles of tidal sedimentation. Research work on crustal deformation in the Andaman region involved the collection of GPS data from permanent sites established in the Andamans - a collaborative project with Centre for Earthquake Research and Information, University of Memphis, US. The work on the pre-earthquake campaign mode (before the great 2004 earthquake) acquisitions at Port Blair showed that the site started to subside between 2003 and 2004. In addition, during this period, the horizontal displacement of Port Blair with respect to India, deduced from 1996-2000 GPS data, changed its orientation from to that obtained during the 26th Dec 2004 co-seismic. As part of the studies on the earthquake recurrence along the Himalaya, varying techniques were employed. Stalagmites were used within the caves of the central Himalaya as proxies to characterize earthquake induced damage and developed a chronology of deformations identified on them. Earthquake induced liquefaction features was also used within the flood plains of Bihar and eastern Uttar Pradesh and a time series of major earthquakes was generated that affected the Bihar region. From studies related to the past climatic changes in Kashmir Himalaya, it was found that the Himalaya displays complex climatic variability as the mountains act as a barrier to atmospheric circulation for both the summer monsoon and the winter westerlies. Continuing climate change is predicted to lead to major changes in the strength and timing of the Asian monsoon, inner Asian high pressure systems, and winter westerlies are the main systems affecting the climate of the Himalayan region.

Molecular Biology and Genetics Unit (MBGU)

In studies related to autophagy and autophagy related pathways in health and disease, the laboratory has identified small molecules that regulate autophagy in both yeast and mammalian systems. To identify these small molecules, a high throughput screening of several libraries consisting of ~ 200,000 compounds was carried out at University of California, Los Angeles (UCLA) using an in house developed real time autophagy assay.

In the studies dealing with the definition and epigenetic definition of centromeres, Molecular Mycology Laboratory (MML) has identified centromeres in related Candida and Cryptococcus species complex and established rapid evolution of centromere sequence and organization of centromere DNA elements in closely related species. This group also showed that the physical chromosomal location, rather than the DNA sequence per se, plays a determining role in centromere identity in Candida.

In Transcription regulation and chromatin dynamics studies, the Transcription and Disease Laboratory has discovered that highly abundant, multifunctional nuclear protein, PC4 is a bonafide chromatin component involved in the chromatin compaction and thereby genome organization and transcription regulation. PC4 knockdown stable cell line was generated and it was found that PC4 is indeed involved in genome stability. Interestingly, in a large number of breast cancer samples, PC4 expression was found to be down regulated.

Research related to stem cell potency and cardiovascular development, the research group has integrated small molecule mediated and microparticle engineering approaches to modulate the mesenchymal stem cell (MSC) secretome in a non-genetic approach for stem cell manipulation. Through this, the pro-inflammatory components were inhibited, yet generally the beneficial anti-inflammatory and pro-angiogenic components were maintained.

In HIV-1 subtype-C strain research, the research group has been actively engaged in understanding how HIV-1 establishes and maintains viral latency. It was found that stronger the viral promoter, the faster the rate of latency establishment which appears to be paradoxical. However, the process of latency is controlled by Tat. The process of viral latency is more intriguing in the context of subtype C of HIV-1 as these viral strains are acquiring a greater magnitude of variation in the viral promoter.

In the studies related to molecular genetics of hereditary, prelingual, sensorineural hearing impairment, over 500 families with at least two members with congenital, autosomal recessive, prelingual, non-syndromic, severe-to-profound deafness were examined. A detailed examination of seven deafness-causing genes was carried out: Cx26 (connexin 26), Cx30 (connexin 30), TMPRSS3 (transmembrane serine protease 3), TMC1 (transmembrane cochlear-expressed gene 1), HAR (Harmonin), CDH23 (cadherin 23) and TMIE (Transmembrane inner ear expressed gene). This work has revealed a large spectrum of pathogenic mutations in these genes: 18 mutations in Cx26, 1 mutation in Cx30, 8 mutations in TMC1, 4 mutations in TMPRSS3, 6 mutations in HAR, 4 mutations in CDH23 and 4 in TMIE.

In protein engineering and molecular parasitology research, the Laboratory has continued its studies on mitochondrial metabolism in Plasmodium falciparum and on molecular enzymology with focus on enzymes involved in purine nucleotide metabolism in the parasite. Using biochemical and X-Ray crystallography tools, the group has established for the first time a molecular basis for ammonia channeling in GMPS. Further, a highly stable succinimide and its role in stability of HjGATase has been established. In collaboration with the groups of Prof. S. Balasubramanian and Dr. Meher Prakash, the molecular mechanism of the activation of parasite HGXPRT was established using experimental approaches and MD simulation.

With regard to mechanisms underlying pathogenesis of human cerebral malaria, the Molecular Parasitology Laboratory has focused its research activities last year on functional characterization of autophagy proteins in Plasmodium falciparum, which is relatively an unknown field.

Mrhl is a long non-coding RNA that was discovered in Prof. M.R.S. Rao's laboratory encoded within meiotic recombination hotspot locus. It is a 2.4 kb, unspliced, polyadenylated transcript, transcribed from the 15th intron of PHKB gene present in chromosome 8 of mouse. The expression of lncRNA is significantly altered in hormone responsive cancer tissues. The RNA is down-regulated in breast cancer tissue and cell lines and ectopic expression of the RNA in breast cancer cells reduced cell proliferation and migration suggesting a possible role of LOC284454 RNA in breast cancer pathobiology.

Neuroscience Unit (NSU)

Epilepsy is a relatively common brain disorder defined by recurrent and unprovoked seizures. Genetic generalized epilepsies (GGE) account for 50% of all epilepsies and have substantially complex genetic basis to their etiology. In an earlier work in this laboratory it was identified that a number of mutations in CASR present exclusively among genetic generalized epilepsy patients. The six mutations, identified by the researchers of the group led by Prof. Anuranjan Anand, are rare, missense changes altering highly conserved CASR residues: p.Glu354Ala, p.Asp433His, p.Ser580Asn, p.Ile686Val, p.Arg898Gln and p.Ala988Val. A functional analysis was carried out comprising a (i) MAPK (mitogen-activated protein kinase) assay and (ii) Inositol monophosphate (IP1) accumulation assay, in cultured mammalian cells for the six CASR mutations identified.

In collaboration with colleagues at IISER Mohali, Dr. Sheeba Vasu's research group has established NMR-based metabolomics combined with multivariate statistical analysis as a useful method for future studies on the interactions between circadian clocks and metabolic processes. Their studies reveal that the oscillations in neuropeptide levels in the axonal arbors of critical circadian neurons are not causal agents of circadian activity/rest rhythms unlike previously believed.

In Dr. Chellaiah's lab, efforts were made to understanding the functions of SYNGAP1 in brain development. One of the questions the Group has attempted to answer is how does Syngap1 heterozygous mutation affects the function of GABA by modulating the switch of Cl- transporters during development. Their preliminary results show that this mutation advances the switch of Cl-transporters during development, thereby regulating the function of GABA during development.

Organic polymers serve as the active biomaterials for the bioelectronic interface in the field of neuroprosthesis based on their opto-electronic properties, mimicking the natural photosystems. In this study, Prof. K. S. Narayan's research group used a human neuronal in vitro model, SH-SY5Y & in vivo model, BALB/c, to access the viability and proliferation of cells towards different substrates and converting them into mature human neurons by differentiation process.

New Chemistry Unit (NCU)

Several aspects of the chemistry of materials were pursued by Prof. C.N.R. Rao. For more than five decades, Prof. Rao has been working on transition metal oxides. His group has initiated two major programmes on energy research: one related to artificial photosynthesis involving photocatalytic oxidation of water by nanoparticles of Mn and Co oxides and the other on photocatalytic H2 generation by hybrid nanostructures by using the Z-scheme. He is continuing to conduct research on graphene and graphene mimics. Graphene mimics include a few layer or single layer materials formed by layered inorganic compounds such as MoS_2 and TaS_2.

Dr. T. Govindaraju's major research efforts were in the development of diagnostics and therapeutics for currently incurable neurodegenerative diseases such as Alzheimer's (AD) and Parkinson diseases (PD). Several solutions were explored to address issues related these diseases by elegantly combining the multidisciplinary-chemical biology approaches. Hybrid peptoids and small molecule-based molecular tools were developed in his laboratory, which are capable of clearing the toxic plaques through the natural cellular process.

Efforts were made by Dr. Jayanta Haldar's research group to design various strategies to prevent and treat pathogenic infections, especially towards pathogens that have developed resistance to the already marketed drugs. One such strategy utilizes lipidated vancomycins and their sugar conjugates, which is the most active drug against vancomycin resistant Enterobacter sp. reported so far. Catheters coated with organo-soluble antimicrobial polymers developed by the group, were found to prevent the formation of biofilms in sub-cutaneous models of infection in mice (GYTI-BIRAC award, 2016). An injectable hydrogel with superior antimicrobial properties has also been designed that could act as an adhesive or sealant.

Dr. Kanishka Biswas's research group discovered several new classes of inorganic metal chalcogenides, which exhibit high thermoelectric performance owing to ultralow thermal conductivity. The research group has also investigated the intergrowth layered structures which are natural heterostructure which resembles van der Waals heterostructure. Two-dimensional few-layer nanosheet intergrowth PbmBi2nTe3n+m, by solution phase synthesis have been synthesized. These few-layered materials exhibit a semiconducting band gap, with exotic electronic transport properties.

Dr. Ranjani Viswanatha worked extensively on doping transition metals into quantum dots and using them as nanosensors to probe the electronic structure of the host quantum dots. The research group has worked on the synthesis of uniformly doped semiconductor nanocrystals with the constructive use of diffusion of dopants out of the nanocrystal with a wide range of dopants like Mn, Fe, Co, and Ni. Consecutively, some extremely important and promising magnetic, optical and magneto-optical responses compared to earlier materials have been studied.

In Dr. Sebastian C. Peter's Laboratory, the low cost nanomaterials in the form of alloys, intermetallics, bimetallics,

core-shell etc. was developed as the replacement for Pt and other expensive current state-of-the-art materials for the production of green energy in fuel cell and CO2 reduction. The group also designed novel inorganic-organic hybrids based on polyoxometalates for their potential applications in energy and catalysis. The group also focused on the application of these materials as supercapacitors, topological insulator, catalysts of various important industrial chemical reactions, battery, thermoelectric and so on.

Dr. Subi George's research group targeted the electronic, optical and self-assembling properties of the π-conjugated backbone for the design of materials. During the last year, the research group has made significant contributions in the field of supramolecular optoelectronics and on the fundamental understanding of supramolecular polymerization. This group also introduced a novel concept of chirality driven self-sorting for controlling the organization of donor and acceptor molecules.

Dr. Sarit Agasti's research group has worked towards developing new techniques along with generating compatible molecular probes so that the group can overcome the diffraction limit (~200-300 nm) of light microscopy and localize molecules inside cells in nanometer precession. In addition, an important feature has been integrated with this imaging technique, the ability to simultaneously image and quantitate 100s of target molecules from a single cell.

Research work of Prof. H. Ila's group revolve mainly around design and development of new general, highly efficient synthetic methods for biologically important five and six membered heterocyclic compounds using novel organosulphur building blocks/synthons derived from a broad range of active methylene compounds. The various methodologies involve design and development of new domino and multi component reactions, transition metal (especially palladium and copper) catalyzed C-C and C-N bond formation reactions, regio- and chemoselective C-C and C-heteroatom bond formations with various carbon and heteronucleophiles on these synthons, heteroaromatic annulations with bifunctional heteronucleophiles and cycloadditions with activated isocyano methylene compounds on these substrates.

Dr. Sridhar Rajaram developed a clear understanding of the charge transfer dynamics in twisted perylene solar cells. The nature of phase segregation in blends of polymer and twisted perylene was studied using a ferroelectric matrix. Using these input the research group has further pushed the efficiencies of perylene containing cells. In the area of catalysis, the research group has shown that sodium cations can be used to control the conformation of organo–catalysts.

Theoretical Science Unit (TSU)

Members of the Materials Theory group of Prof. Umesh V Waghmare demonstrated (a) controlled confinment of electrons to 2-D in oxide based polar superlattices; (b) how electronic topology influences thermopower of thermoelectrics; (c) atomistic processes inside electrodes during charging and discharging of a battery. They also developed phonon eigenspectrum-based formulation of the atomistic Green'd function method for thermal transport across interfaces; and developed derivation of a model Hamiltonian for Neel transition and associated magnetoelastic effect in multiferroic YMnO3.

Dr. N. S. Vidhyadhiraja's research group focused on three issues: quantum criticality, combined effect of disorder and interactions and phonon localisation due to disorder. A variety of model Hamiltonians like the Anderson-Hubbard model, a Kondo insulator-metal bilayer model, and a gapped Anderson impurity model were investigated.

Dr. Kavita Jain's research group studied an autocorrelation function in a class of non-equilibrium processes. Research work was initiated to understand the properties of eigenvalues in a class of random matrices. The group obtained an exact solution of a population genetics model with beneficial mutations.

The research group of Prof. Shobhana Narasimhan continued to use ab initio density functional theory to study

nanosystems computationally. Some of the significant research findings of this group are: doping graphene with boron nitride significantly increases the binding of methanol; a new way to make a topological insulator was found; discovered that growing Fe films on an Ir substrate results in a magnetic and structural transition as the thickness of the film is increased.

Prof. Swapan Pati's research group: The anisotropic nature of the electron hole mobilities found experimentally for 3-layer phosphorene has been analyzed and microscopic reasons have been found using Boltzman transport equation. It was demonstrated that Borocarbonitride can act as an Anode for Superior Performance in Sodium-ion rechargeable Battery and Capacitor.

Dr. Subir Das and his research group worked on problems related to equilibrium and nonequilibrium statistical mechanics. In this broad area, they worked on topics like (1) application of molecular dynamics methods to quantify critical singularities in transport properties like mutual diffusivity, shear viscosity and bulk viscosity; (2) hydrodynamic mechanism in fluid phase separations with disconnected morphology. Behavior of two-time order-parameter correlation function during phase separation in solid binary mixtures was studied via Monte Carlo simulations and finite-size scaling analysis.

Dr. Meher Prakash's research group was involved in interdisciplinary research collaborating with Chemists, Biochemists, and Biologists. Some of the research activities were for understanding the function and dynamics of proteins, and rational design of drugs specifically disrupting bacterial membranes.

Prof. Srikanth Sastry's research group researched on length scales relevant to slow relaxation, the relationship between structure and entropy in glass formers, analysis of thermodynamic and kinetic fragilities and the Stokes-Einstein relation in model glass formers, models of memory in glasses subjected to oscillatory deformation, approach to plasticity and yield in amorphous solids, analysis of shear jamming.

International Centre for Materials Science (ICMS)

Prof. C.N.R. Rao has initiated two major programmes on energy research: one related to artificial photosynthesis involving photocatalytic oxidation of water by nanoparticles of Mn and Co oxides and the other on photocatalytic H2 generation by hybrid nanostructures by using the Z-scheme, Synthesis, characterization and properties of anions substituted metal oxides where in oxygen is replaced by nitrogen and fluorine were investigated.

Prof. S.M. Shivaprasad continued to pursue the interesting observations made in the growth of Gallium and Indium Nitrides nanostructures. The research findings have shown the mechanism of bond formation in the gallium nanowall network.

Dr. Sridhar Rajaram developed a clear understanding of the charge transfer dynamics in twisted perylene solar cells. The nature of phase segregation in blends of polymer and twisted perylene was studied using a ferroelectric matrix.

Spintronics is a new upcoming area of research taken up by Dr. Ranjani Viswanatha which has various applications. The most preferred materials for these applications are semiconductors with a small percentage of magnetic dopants and are known as dilute magnetic semiconductors. However, these materials are extremely non-trivial to synthesize even in the bulk regime.

Dr. Rajesh Ganapathy's Soft Matter group primarily focused on elucidating the various aspects of the glass transition phenomena. In a work, that appeared in Phys. Rev. Lett, it was reported that the breakdown of the Stokes-Einstein relation in colloidal glasses coincides with the change in shape of cooperatively rearranging regions.

Academic Activities

During the August admissions of 2015-16, 63 students joined, and during the mid-year admissions of January

2015-16, 8 students joined JNCASR under different degree programmes. Fifty-three students have received their degrees this year under various academic degree programmes which include the award of 29 Ph.D. and 3 M.S. (Engg.) degrees. Under M.S. of Integrated Ph.D., out of a total 17 degrees awarded - 8 were in Biological Sciences, 5 in Chemical Sciences and 4 in Materials Science. In addition, 1 student was awarded Postgraduate Diploma in Science Education (PGDSE) and 3 students were awarded the Postgraduate Diploma in Materials Science (PGDMS).

Fellowship & Extension Programmes

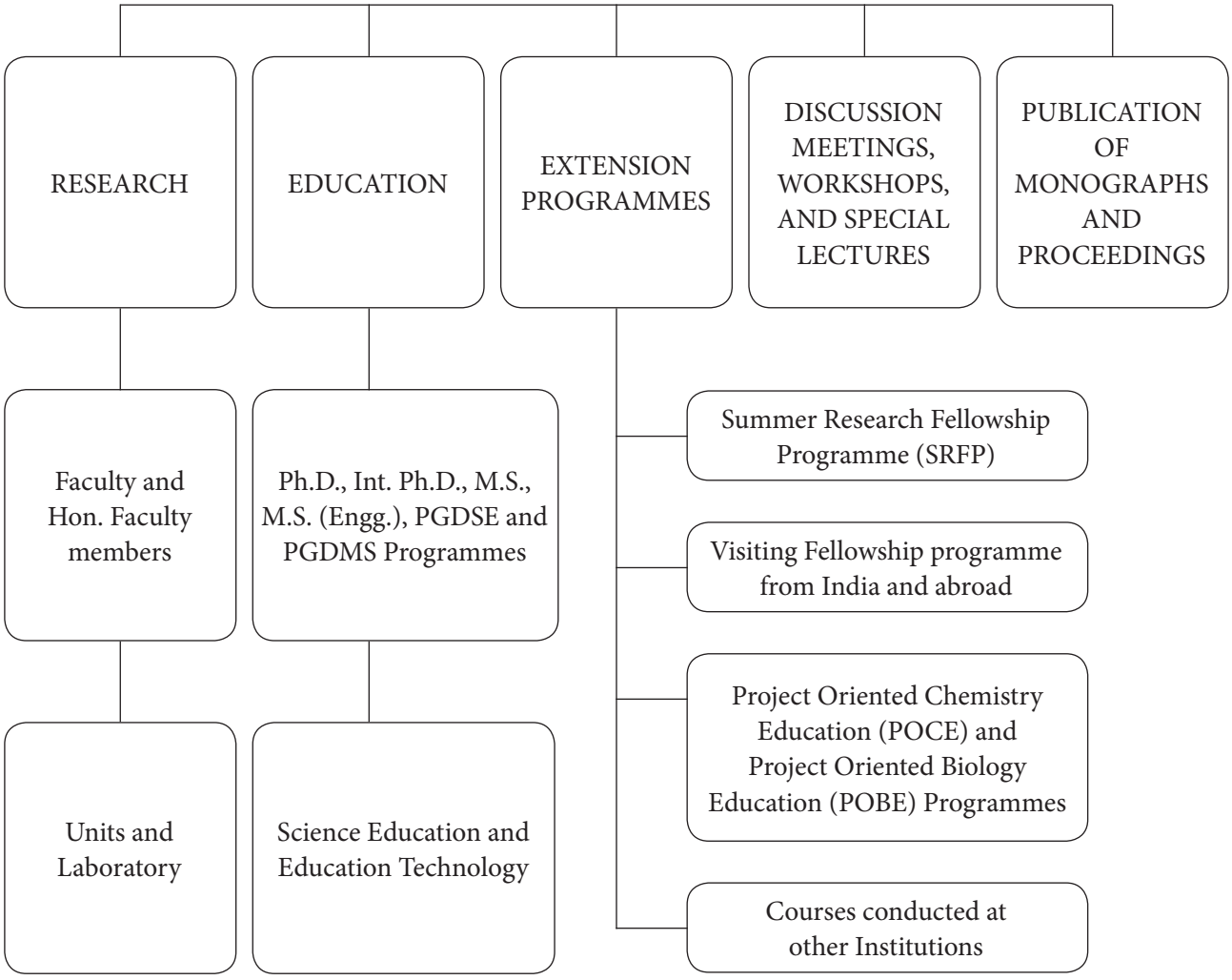
Thirteen scientists from research institutions across the country were selected for the Centre's Visiting Fellowships 2015-16. The selected scientists were hosted by the faculty of CPMU, EOBU, MBGU, NCU, NSU, and TSU. Sixty-nine students availed the scholarship for Summer Research Fellowship Programme 2015 and received research training in various areas of physics, chemistry, biology or engineering at research institutes in Bangalore, and elsewhere in the country. Thirteen students were awarded the Rajiv Gandhi Fellowship for the year 2015. For Project Oriented Biology Education (POBE), out of 171 applications received, 10 students have been selected and under Project Oriented Chemical Education (POCE), out of 263 applications received, 11 students were selected. Nine students of POCE 2013-15 had completed the programme successfully. Six scientists were shortlisted under the JNCASR-CICS Fellowship Programme 2015-16 from Nigeria, Uzbekistan, Ethiopia, Sri Lanka, Zambia and Cameroon.

Reservation, Official Language and Implementation of the judgments/orders of the CAT

The Centre follows the national policy on reservation and official language as per rules and orders issued by the Government of India with necessary guidelines from the Council of Management from time to time. During the current year, there were no cases pertaining to the Centre that appeared before the CAT.

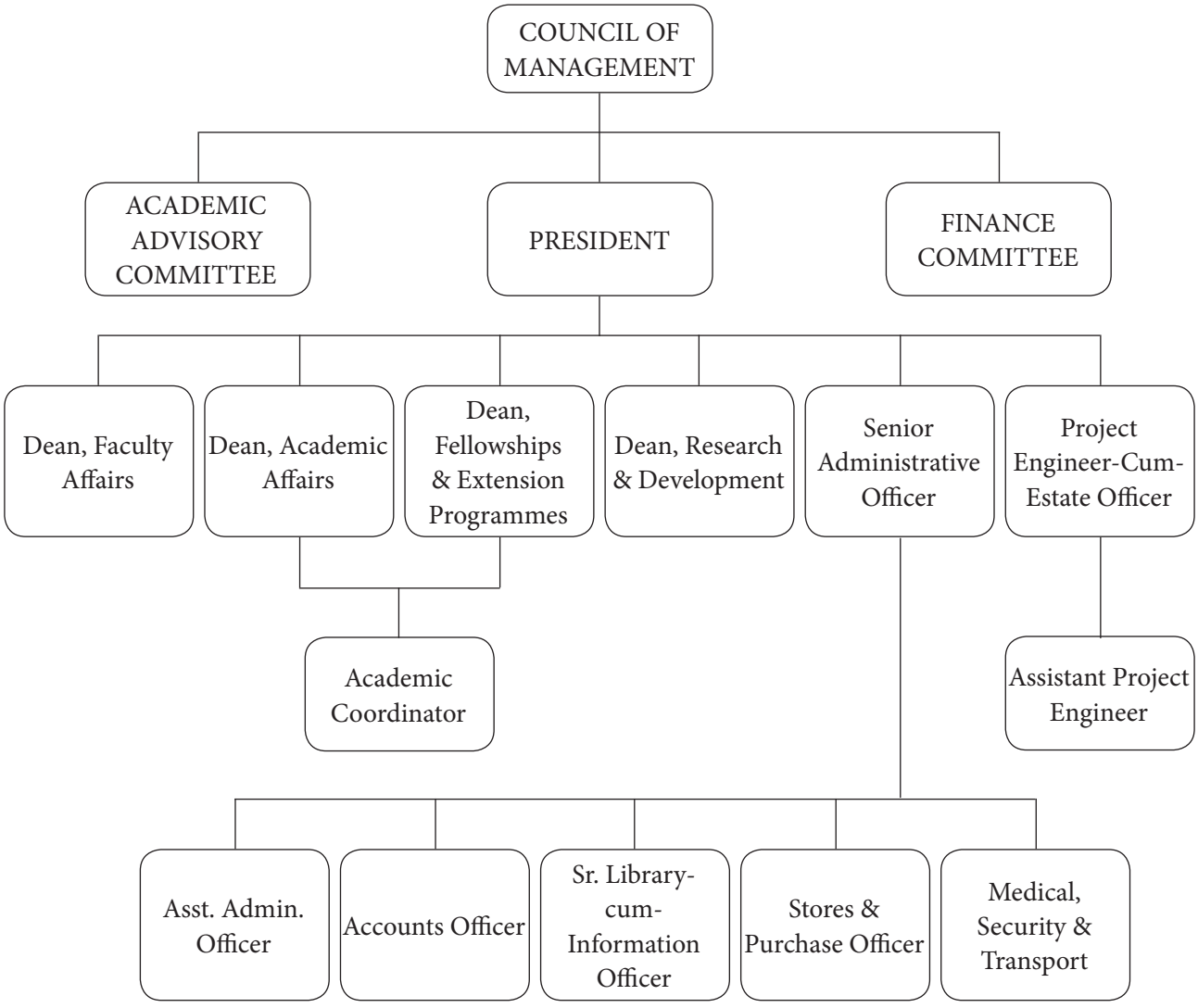
ACTIVITIES CHART

JAWAHARLAL NEHRU CENTRE
FOR ADVANCED SCIENTIFIC RESEARCH



ORGANISTION CHART

JAWAHARLAL NEHRU CENTRE
FOR ADVANCED SCIENTIFIC RESEARCH



COUNCIL OF MANAGEMENT

Administration and management of the affairs and finances of the Centre are conducted by the Council of Management. The Council of Management of the Centre meets twice a year.

The following are the members of the Council:

Dr. P. Rama Rao Hyderabad	Chairman
Prof. V. Nagaraja President, JNCASR	Member
Prof. C.N.R. Rao Hon. President, JNCASR	Member (JNC nominee)
Prof. Ashutosh Sharma Secretary, DST	Member
Shri J.B. Mohapatra JS & FA, DST	Member
Dr. Baldev Raj Director, NIAS	Member (DST nominee)
Prof. S.K. Joshi NPL, New Delhi	Member (UGC nominee)
Prof. Anurag Kumar Director, IISc	Member
Prof. Chandan Dasgupta IISc	Member (IISc nominee)
Mr. A.N. Jayachandra Sr. Administrative Officer, JNCASR	Secretary

FINANCE COMMITTEE

The Finance Committee of the Centre scrutinizes all financial proposals, and makes recommendations to the Council of Management.

The constitution of the Finance Committee is as follows:

Prof. V. Nagaraja President	Chairman (Ex-officio)
Prof. C.N.R. Rao National Research Professor	Member
Shri J.B. Mohapatra Joint Secretary and Financial Advisor, DST	Member
Mr. Sampad Patra Accounts Officer	Member (Ex-officio)
Prof. Chandan Dasgupta Dean, Undergraduate Studies, IISc	Member
Mr. A.N. Jayachandra Sr. Administrative Officer	Member (Ex-officio)

ACADEMIC ADVISORY COMMITTEE

The functions of the AAC include planning, execution and coordination of research and other academic activities of the Centre. It also regulates the courses of study, procedure for admission of students, examination, etc. It meets at least twice a year. The Committee makes its recommendations to the Council of Management on all academic matters.

The members of the Academic Advisory Committee are:

Prof. V. Nagaraja President, JNCASR	Chairman (Ex-officio)
Prof. Hemalatha Balaram Dean, Faculty Affairs, JNCASR	Member (Ex-officio)
Prof. Shobhana Narasimhan Dean, Academic Affairs, JNCASR	Member (Ex-officio)
Prof. Maneesha S Inamdar Dean, Fellowships and Extension Programmes, JNCASR	Member (Ex-officio)
Prof. K.S. Narayan Dean, R&D, JNCASR	Member (Ex-officio)
Prof. U. Ramamurty Mat. Engg., IISc	Member
Prof. George K Thomas IISER, Thiruvhapuram	Member
Prof. D.D. Sarma SSCU, IISc	Member
Prof. Devang V. Khakhar Director, IIT, Mumbai	Member (UGC Nominee)
Mr. A.N. Jayachandra Sr. Administrative Officer, JNCASR	Secretary (Ex-officio)

FACULTIES

All the faculty members are involved in various academic activities of the Centre and assist the Academic Advisory Committee in discharging its functions. The last Annual Faculty Meeting was held in November 2015 which included lectures by the faculty on the advances made in various research areas.

ADMINISTRATION

President	
V. Nagaraja	Ph.D., F.A.Sc., F.N.A.Sc.
Dean, Faculty Affairs	
Hemalatha Balaram	Ph.D.
Dean, Academic Affairs	
Shobhana Narasimhan	Ph.D.
Dean, Fellowships and Extension Programmes	
Maneesha Inamdar	Ph.D.
Dean, Research and Development	
K. S. Narayan	Ph.D.
Warden & Student Counsellor	
Tapas Kumar Maji	Ph.D.
Associate Warden	
Ranjani Vishwanatha	Ph.D.
Sr. Administrative Officer	
A. N. Jayachandra	B.Com., ICWA (Inter)
Assistant Administrative Officer	
C. S. Chitra	B.Com.
Academic Coordinator	
Princy Jaison Pereira	Ph.D.
Accounts Officer	
Sampad Patra	B.Com, PGDCA, MBA
Jr. Accounts Officer	
Venkatesulu B.	B.Sc.
Stores & Purchase Officer	
P. Cheeranjeevi	
Sr. Library-cum-Information Officer	
Nabonita Guha	MLIS
Sr. Secretary to President	
A. Srinivasan	B.A.

Project Engineer	
S. Chikkappa	BE
Project Engineer Gr.II (Civil)	
Nadiger Nagaraj	DCE
Junior Project Engineer (Civil)	
Veeresha N. R.	DCE
Assistant Project Engineer (Elec.)	
Sujeeth Kumar S.	DEE
Consulting Medical Officer	
G. R. Nagbhushan	MBBS
Consulting Lady Medical Officers	
Kavitha Sridhar	MBBS
Archana, M. L. V.	MBBS
H. V. Chandralekha	MBBS
Physiotherapist	
Y Yogesh	BPT
Honorary Medical Officers	
L. Sharada	MBBS
C. Satish Rao	MBBS
R. Nirmala	MBBS
Honorary Security Officer	
M.R. Chandrasekhar	B.Sc., LLB

UNITS, CENTRES, COMPUTER LABORATORY, LIBRARY AND ENDOWED RESEARCH PROFESSORS

CHEMISTRY AND PHYSICS OF MATERIALS UNIT (CPMU)

Research Progress and Achievements

The Molecular Modeling Group has made vital contributions in several areas, including gas storage, enzymatic catalysis, supramolecular assemblies and room temperature ionic liquids (RTIL). The vibrational and diffusional dynamics in the plastic crystalline phase of several RTILs have been studied using MD simulations. The effect of an external electric field on the liquid crystalline phase of supramolecular system showed a remarkable change in its handedness. Although such experiments were carried out as part of studies on organic (lead-free) ferroelectrics, researchers had not anticipated the change in helical handedness. Hence, this is a very novel result. The group has also intensively studied intermolecular interactions and dynamics of a tetramer of HG(X) PRTase, an enzyme involved in the biochemical pathway of the malarial parasite. Using biased MD simulations with multiple collective variables, the product release pathway in this enzyme has been delineated. Density functional theory, MD simulations and Grand Canonical Monte Carlo simulations were employed to study gas-solid interactions and gas adsorption isotherms in a variety of porous solids. A correlation between accessible surface area and mass density of amorphous porous polymer networks was established.

Bulk heterojunction (BHJ) polymer solar cells and organic electronics components such as field effect transistors (FETs) have reached a stage where the performance and cost effectiveness is considered quite feasible. Prof. K. S. Narayan's laboratory demonstrated the utility of electric field application during the fabrication process which enables higher performance characteristics. In case of BHJs, the application of electric field during the film drying and annealing process is observed to be beneficial in forming an active blend layer with noticeable increase in the solar cell parameters. While in the case of polymer FETs, the presence of lateral-surface electric field induced effects get further accentuated when the underlying substrates offer appropriate topology and the active layer represent molecular assembly which can respond to the cue offered by such external factors. This method of tailoring the microstructures translates to enhance device performance. They presented a host of examples to demonstrate this strategy.

In Prof. S.M. Shivaprasad's research group, studies were pursued on the epitaxial growth of thin films and nanostructures which has resulted in interesting observations made in the growth of Gallium and Indium Nitrides nanostructures. The research group discovered the mechanism of bond formation in the gallium nanowall network. By uniformly adsorbing Ag nanoparticles on these self-organized nanowalls with a large surface area, this morphology was used as a substrate for Surface Enhanced Raman Spectroscopy for bio-molecular detection with very high sensitivity and low detection limits. The unprecedentedly high mobility of electrons in the nanowall configuration was observed to be originating from a 2D electron gas formation at the wedge shaped tips of the nanowalls as determined by magnetoresistance and FET measurements. Some calculations were performed to see the morphological origin of the 2DEG that show this unprecedented mobility. Ultra-high resolution TEM studies have shown the defect free nature of the tops of the nanowalls and the inter-wall mis-orientation that has led to the mosaicity of the network. The research group has also been successful in spontaneously forming InGaN nanorods on Si(111) surface with varying band-gaps and chemical phase separations and have related them to the band-edge emission of these thin films.

Dr. M. Eswaramoorthy's research group has worked on sustainable and efficient metal-free, heteroatom doped, carbon based bi-functional electro-catalysts potential for hydrogen production using electrochemical water

splitting and oxygen reduction in fuel cells and metal-air batteries is developed with the focus to replace traditional Pt based catalysts. Rationally designed, nitrogen doped carbons with wider mesopores exhibiting very good mass transfer properties were obtained by pyrolysis and demineralisation of polydopamine coated clay nanotubes. The nitrogen doped carbon prepared showed excellent electrocatalytic activity for hydrogen evolution and oxygen reduction reactions.

Prof. A. Sundaresan's research group has discovered linear magnetoelectric effect in several A-site antiferromagnetic oxides, Co_3O_4 and MnB_2O_4 (B = Al, Ga), which belong to the family of AB_2O_4 oxides with spinel structure (Fd_3m). In these normal spinels, the magnetic ions (Co_{2+} and Mn_{2+}) located at the A-site, undergo collinear antiferromagnetic ordering at low temperatures where it exhibits magnetoelectric properties. The group has also investigated A-site ordered but B-site chromites spinels for magnetoelectric properties. The compounds $LiMCr_4O_8$ (M = Ga and In) exhibit interesting magnetostructural, magnetodielectric effects but do not show magnetoelectric effect. New series of multiferroic materials have been discovered based on Aeschynite type structure $RFeWO_6$ (R = Dy, Tb and Eu).

Dr. Sridhar Rajaram's research group has developed a clear understanding of the charge transfer dynamics in twisted perylene solar cells. The nature of phase segregation in blends of polymer and twisted perylene was studied using a ferroelectric matrix. Using these inputs, the research group has further pushed the efficiencies of perylene containing cells. In the area of catalysis, the Group has shown that sodium cations can be used to control the conformation of organo –catalysts. The structure of the sodium bound urea catalyst was studied using Raman spectroscopy. Additionally, the mechanism of the cyanide free synthesis of α-amino esters was also studied. Currently, the research group is working on developing novel catalysts based on our mechanistic studies.

The Molecular Materials Group has explored various porous materials over the year and has studied a wide range of properties starting from gas adsorption, catalysis and sensing to super-hydrophobicity. The Group has also started exploring the conductive properties of MOFs and CMPs. Many of these materials are electron rich in nature and owing to facile electron transfer, show good conductivity. The Group aims at fabricating devices with unique properties based on this. Also, during last year, work was undertaken extensively on electrochemistry and efforts were made to develop green metal-free materials for ORR, OER and HER. The group has published 22 papers in multiple peer-reviewed journals. Nivedita Sikdar presented her work in Euro-MOF 2015 held in Germany, while Papri Sutar presented her work in the esteemed Gordon Research Conference held in Italy. Both M. V. Suresh and Arpan Hazra received their Ph.D. degrees from the group in this academic year. M.V. Suresh has received the prestigious Humboldt fellowship for post-doctoral research.

The Light Scattering Laboratory has continued with the work of using SERS to study drug protein interactions in p300 for its histone acetyl transferase activity, understanding the importance of Mg_{2+} ion on transcription co-activator kpn1, developing a credible non-PCR based nucleic acid detection. The group has been working on understanding the selective gas adsorption studies on metal organic framework (MOF) using Raman and Brillouin Spectroscopy have come out with leads to help in making better MOFs. The group has been working on electronic topological insulators induced by pressure and have developed an indirect method of identifying these transitions using Raman spectroscopy, x-ray diffraction and resistivity studies. The group has come up with for the first time a second sound in any system at room temperature, namely, in carbon nanotube.

New programmes launched during the year:

High pressure and high temperature synthesis facility has been established and it will be used for making new materials with interesting physical properties. The High Power Computational facility has been operational with 0.2 petaflops capacity.

The following are the members of the Unit:

Chair

Chandrabhas Narayana	Ph.D., F.N.A.Sc.

Professors

C. N. R. Rao	Ph.D., D Sc, F A Sc, F N A, F R S, F T W A S, Hon. F R S C
S Balasubramanian	Ph.D., F.A.Sc.
K. S. Narayan	Ph.D., F.N.A.Sc., F.A.Sc., F.N.A.
G. U. Kulkarni	Ph.D.
S.M. Shivaprasad	Ph.D.
Chandrabhas Narayana	Ph.D., F.N.A.Sc.
A. Sundaresan	Ph.D.
M Eswaramoorthy	Ph.D.

Associate Professor

Tapas Kumar Maji	Ph.D.

Faculty Fellow (Jointly with NCU)

Sarit S Agasti	Ph.D.

Technical Officers

V Sreenath (BE), S Srinivas (BE), Usha G. Tumkurkar (M.Phil)

Research Students

Umesha Mogera, Amritroop Achari, Gopalakrishnan K., Venkata Suresh M., B. Satyanarayana, S. Kiruthika, B. Karteek Kumar, A.Z. Ashar, Tarak Karmakar, Nivedita Sikdar, Devendra Singh Negi, Arpan De, Somnath Ghara, Sunita Dey, Sreedhara M.B., Sanjay Kumar Nayak, Swathi, Papri Sutar, Dheeraj Kumar Singh, Dibyashree Chakraborti, Syamantak Roy, V. Rajaji, Bharath B., Chaitali Sow, Sudip Das, Abhijit Chatterjee, Badri Vishal, Korlepara Divya Bharathi, Apoorva Singh, Priyanka Jain, Meenkshi Pahwa, C.S. Deepak, Ganesh N., Shivaram B. Kubakaddi, Rajendra Kumar, Divya C., Monodeep Mondal, Yanda Premakumar, Ravi Shankar P. N., Usha Manjunath Bhat, Sharona Thomas Horta, M. S. Deena Dayalan, Nisha Mariam Mammen, Dileep Krishnan, M. Pandeeswar, Rana Saha, Sudeshna Sen, Varun Thakur, Dibyajyoti Ghosh, Anindita Chakraborty, Prashant Kumar, Ankush Kumar, Ram Kumar, Sisir Maity, Chandan Kumar, Chandan De, Anirban Mondal, Koushik Pal, Abhijit Sen, Rajib Sahu, Sonu K.P., Raaghesh A.V., Suchitra, Uttam Gupta, Sohini Bhattacharyya, Shantanu Aggarwal, Priyank Singh, Abhiroop Lahiri, Nikita Gupta, Srimayee Mukherji, Anirudha Mirmira, Pavitra Nityanand Shanbhag, Anaranya Ghorai, Narendra Kumar. Lakshay Dheer, Rajendra Singh, Niloyendu Roy, Janaky S., Sukanya Das

Research Scientist C

Dr. K.S. Subrahmanyam

Research Scientist B

Vijay Amirtharaj A., Ananda Raman, Sanjit Kumar Parida

Research Associates

Dr. Suman Banerjee, Dr. R. Vengadesh Kumara Mangalam, Dr. Venkata Suresh M., Dr. Sorb Y.A., Dr. Arpan Hazra, Dr. Piyush Kumar Chaturbedy, Dr. Satyanarayana Bonakala

DST Post-Doctoral Fellows

Dr. Deepa Narang, Dr. Murali Gedda

Research Associates (Provisional)
Manasa Nune, Dhanya R.

Senior Research Fellow
Umesha Mogera

Junior Research Fellow
Shivanna M.

SERB National Post-Doctoral Fellow
Dr. Shafeekh Kulathinte Meethal (Jointly with NCU)

Programme Assistant
K. Venkatesh

Technical Assistants
N. R. Selvi, Shivakumar, K.M.

R&D Assistants
Dr. Saibal Jana, Rajashekhar Pujar, Reshma Kakunje Raveendranatha, Rahul Kumar Sharma, Nisha Palanisamy Rajendran

Sr. Helper
M. Narayana Swamy

Helper
T. Basavaraj

Glass blower
Nanda Kishore

Secretarial Assistant Trainee
Pavana R.

EDUCATION TECHNOLOGY UNIT (ETU)

Activities and Achievements

The Unit was involved in the concept, development, and production of books and multimedia CD-ROMs dealing with various disciplines of science for school students and teachers. The Unit has developed and produced CD-ROMs and books in English and vernacular Indian languages.

The lectures/workshops for students and teachers were highly popular. These lectures and workshops were conducted on subjects like Physics, Chemistry, and Biology.

A meeting of the Resource Persons was organised on May 26, 2015, to decide the Teachers/students program schedule for the year 2015-2016. The meeting was chaired by Prof. C.N.R. Rao.

A multimedia presentation titled '*A brief history of chemistry (Great Pioneers)*' was developed and produced. The book was authored and narrated by Prof. C.N.R. Rao. The text, graphics and recording and editing of the voice-over were completed at the Unit. The presentation was made ready for replication. The inlay cover was designed at the Unit with relevant graphics and information. 1000 CD-ROMs were replicated for distribution to participants of the TWAS Meeting held at the Centre and to participants of the Workshop for Teachers, Lecturers, and Research Scholars. Also, the above multimedia presentation was presented at the Orientation Programme for new students and for NCU and CPMU students and faculty on August 3 and August 4 respectively.

The task of bringing out the print-ready copy of the Book '*Lives and Times of Great Pioneers in Chemistry (Lavoisier to Sanger)*' authored by Prof. CNR Rao and Dr. Indumati Rao was initiated. The text, graphics, references formatting and editing was completed at the Unit as per the authors specifications. The cover was designed and sent along with the completed manuscript to World Scientific for publishing. The Book has 21 chapters with each one describing the story of a chemist who made a mark on the subject and traces the development of chemistry through these stories. ETU collaborated with World Scientific Pvt. Ltd., Singapore for editing, proof-reading and completing the manuscript. The book was published and released in December 2015.

The task of producing the print-ready copy of the book titled 'New forms of Carbon (Nanocarbons)' by Prof. C.N. R. Rao was started. The layout was designed and the graphics were completed and the print-ready material was sent to the National Book Trust (NBT), New Delhi for printing and publishing. The book was released in January 2016. The book was distributed to participants of Bangalore-Nano 2016.

ETU and the CNR Rao Hall of Science created and printed several posters for Prof. C.N.R. Rao Archives. The Archives is being constantly updated and maintained. The CNR Rao Hall of Science webpage was maintained and updated with the events, activities and video recordings of the lecture programs conducted for students and teachers.

Organisation of Programmes

The Summer 2015 - Science Outreach Programme sponsored by the C.N.R. Rao Hall of Science, JNCASR was conducted in association with Himalayan Gram Vikas Samiti, Gangolihat by Prof. K.S. Valdiya during April 29-30, 2015. The Science Outreach Program was conducted at Dashaithal, Gangolihat, Pithoragarh, Uttarakhand where 122 students and teachers from various schools participated in the program. Prof. C.N.R. Rao gave the lecture titled 'A Celebration of Chemistry'. Also, faculty members from the Centre delivered lectures during the two-day programme. A Science Outreach Programme was conducted in the Garhwal region during November 3-9, 2015 where lectures were delivered by the faculty members of the Centre.

On May 28 & June 3, 2015, a one-hour multimedia presentation from the CD-ROM '*Nanoworld*' and excerpts from the CD-ROM '*Understanding Chemistry*' was presented to the students of Project Oriented Chemistry Education (POCE).

During 2015-2016, 11 lecture programmes were held for students and teachers. In addition to the planned programs, a three-day special lecture program for Chandan School students (Gadag, Karnataka) was conducted at the Madan Mohan Malviya Amphitheatre.

The Teachers-students workshop was conducted under the auspices of the Science Outreach Programme on June 30, 2015. In 2015, JNCASR in collaboration with the C.N.R. Rao Education Foundation presented the National Award of Chemical Education (Donated by AVRA Laboratories, Hyderabad) to Prof. Uday Maitra. The C.N.R. Rao Education Foundation sponsored 2014 prizes for Outstanding Science Teachers were awarded to Smt. Meenu Wadhwa and Shri. Prakash Ramachandra Garagatti. In the Lecture Programme following the award ceremony, one lecture in Chemistry and one in Biology were presented. The titles of the lectures were: "*Fun with chemistry*", delivered by Prof. Uday Maitra (IISc., Bangalore); and "*How shape & size are controlled in biology*", by Prof. Utpal Nath (IISc., Bangalore). Around 220 students and teachers attended the programme.

The list of other programmes/workshops organised were as follows:

- 30 June 2015 – Lecture Program (Science Teacher Award Function)
- 13-16 July 2015 – Science Orientation Workshop for Jawahar Navodaya Vidyalaya Students
- 6 August 2015 – Program in Physics for students
- 24 August 2015 – Program in Biology for students
- 21 September 2015 – Program in Chemistry for students
- 5 November 2015 – Program in Chemistry (Jointly organized with NCU)
- 19 November 2015 – Program in Physics for students
- 8 December 2015 – Program in Chemistry
- 29 January 2016 – Workshop for Teachers, Lecturers, and Research Scholars on `100 years of Chemical bond' (Jointly organized with NCU)
- 25 February 2016 – National Science Day Program
- 22-24 March 2016 – Special Lecture Program

In each of the above programmes, over 200 students and teachers participated and were consisted of lectures and demonstrations followed by an interactive Question and Answer session. The programmes were organized and conducted by CNR Rao Hall of Science and ETU under the auspices of the Science Outreach Programme.

A Science Orientation Workshop for Jawahar Navodaya Vidyalaya (JNV) students was organised for Class XI students from various JNV's across Karnataka. The programme had lectures in physics, chemistry, and biology delivered by faculty from the Centre followed by a laboratory tour. There were three lectures organized each day followed by a Q&A session at the end of each lecture.

A workshop on '*100 years of the chemical bond*' was specially organized on January 29, 2016, to commemorate the centenary of the discovery of the chemical bond. There were four lectures on different aspects of the chemical bond followed by a multimedia presentation of the CD-ROM '*A brief history of chemistry*'. The participants also visited the Chemistry of Materials Exposition and Prof. C.N.R. Rao Archives.

The National Science Day programme had a short talk on the wonders of science followed by a demonstration of experiments in physics and chemistry by faculty and students of the Centre. The participants visited several

laboratories and the Chemistry of Materials Exposition and Prof. C.N.R. Rao Archives. The programme participated by 150 students and teachers was held on February 25, 2016.

A programme was organised with New Chemistry Unit on November 5 for students of Class X. There were two lectures followed by a chemistry quiz. There was a demonstration of Chemistry Experiments by NCU students and faculty. In the concluding session, Mrs. Indumati Rao presented prizes to the winning team members of the Quiz competition. Around 175 students and teachers participated in the program.

A Programme in chemistry was organized on December 8, 2015, where Prof. C.N.R. Rao, Prof. Andy Cooper, Prof. Ashok Ganguli and Prof. S. Balasubramanian delivered lectures on the theme of the chemical bond. 200 students and teachers participated in the programme. The participating teachers were given the CD-ROM "*A brief history of Chemistry*" developed and produced by ETU.

The CNR Rao Hall of Science and ETU worked with Parikrama, (an NGO that educates street and slum children and runs 4 schools and a college for these children) in conducting a 'Festival of Science' on January 21-23, 2016 for 200 children from about 40 schools. The theme of the festival was `Energy'. Prof. C.N.R. Rao inaugurated the festival and addressed the students. Two of our faculty members delivered lectures to the students: 'Solid State Lighting' by Prof. S. M. Shivaprasad and Prof. Umesh V. Waghmare on `Materials for smart functions and energy conversions'. The teachers participating in this programme also visited the Chemistry of Materials Exposition and Prof. C.N.R. Rao Archives. The copies of *Learning Science Part 2* (English and Kannada) were presented to the participating students as this book covered concepts in Physics and Energy. Mrs. Indumati Rao addressed the students and teachers on January 23 and gave copies of *Learning Science* (Set of 4 Parts) to the teachers.

A Special Lecture Programme was organized for `School Chandan' students (from Gadag, Karnataka) of Classes IX and X during March 22-24, 2016. The three-day program had two lectures each in Physics, Chemistry and Biology followed by an interactive session. The participating students also conducted experiments on chemistry at the SOP-POCE Lab. A visit to the planetarium was scheduled for the participants.

Following are the members of the Unit:

Chair

Prof. V. Krishnan	Ph.D., F.A.Sc., F.N.A., F.T.W.A.S.

Coordinator (Hon.)

Indumati Rao	Ph.D. (Hon. Causa), M.A., M.S., C.E.

Sr. Technical Officer

Jatinder Kaur	M.Sc.

Assistant (Multimedia)

Sanjay S.R. Rao	B.Sc., Cert. Multimedia

ENGINEERING MECHANICS UNIT (EMU)

During the year 2015-16, activities in the Engineering Mechanics Unit include study of convection and instabilities in vibrated granular bed, fluid exchange between chambers having different density fluids through vertical and horizontal openings, shock-waves in dilute granular gases, development of an improved algorithm based on delayed difference scheme for large scale scientific simulations, implementation of lattice scheme for three dimensional multiphase simulations with high density ratios.

A close comparison between flow fields was obtained in experiments and LBM-based 3-D simulations of flapping flight. Experimental studies also showed the importance of accounting for three-dimensional nature of the flow and variation in lift produced for rigid and flexible wings during flapping. Experimental study on drag-reducing polymer (DRP) indicated the occurrence of a delayed transition, the shift of instability to longer wavelengths in the DRP solution compared to that for plain-water.

Particle-level simulations, with a rigorous accounting for hydrodynamic interactions, were used to examine the nature of correlations and fluctuations in microscopic swimmer suspensions.

Considerable progress has been made during the year on DNS studies of the flow past a low pressure turbine blade. A very high resolution (190 million grids) direct Navier Stokes computer simulation has provided for the first time pressure distributions on the blade that are very close to measured values. Many other interesting aspects of the flow, revealed by the simulation, are currently being analyzed in detail. The novel low drag wing planforms for turbo-prop aircraft, obtained by using optimization techniques, has now received patents from US, South Korea, and Japan.

Following are the members of the Unit:

Chair

K.R. Sreenivas	Ph.D.

Honorary Professor

Roddam Narasimha	Ph.D., F.A.Sc., F.N.A, F.T.W.A.S, F.R.S.

Professors

K.R. Sreenivas	Ph.D.
Meheboob Alam	Ph.D.

Associate Professors

Ganesh Subramanian	Ph.D.
Santosh Ansumali	Ph.D.

Research Students

Ujjayan Paul, Mohammed Istafaul Haque Ansari, K. Siddharth, Lakshminarayana Reddy M.H., Vybhav G. R., Shashank H. J., Sunil V Bharadwaj, Manjusha Namburi N L D B, Rajesh Ranjan, Navaneeth K M, Rama krishna Rongali, Saikat Saha, Sankalp Nambiar, Mahan Raj Banerjee, Mohammad Raifuddin, Praveen Kumar K., Prateek Anand, Arun Kumar Varanasi, Jumpal Shashikiran Reddy, Achal Mahajan, Nakul Pande, Ronak Gupta, Samarth Agrawal, Aghor Pratik Prashant, Mayank Toprani, Mohammad Atif, Biswadeep Roy, Piyush Garg

Research Associates

Tirthankar Sengupta, Samrat Rao, Dr. Rajesh Ranjan

Research Associate (P)
Maruthi N.H.

SERB National Post-Doctoral Fellow
Dr. Nandu Gopan

SERB Young Scientist Fellow
Dr. Shailendra Kumar Singh

Visiting Scientist
Prof. Garry Brown

R&D Assistants
Shaurya Kaushal, Achal Mahajan, Nakul Pande, Suhas Bannur, Pushpit Kant

Secretarial Assistant Trainees
H.V. Vijaylakshmi, Gayathri T.S.

EVOLUTIONARY AND ORGANISMAL BIOLOGY UNIT (EOBU)

Activities during 2015-2016

During the year 2015-2016, the faculty of EOBU continued to conduct research in the broad areas of animal behavior, phylogeography, chronobiology, evolutionary genetics, neurogenetics, neurodegenerative disorders, and population dynamics. Questions in the areas of (a) social organization in Asian elephants, (b) estimation of elephant population sizes through mark-recapture sampling, (c) biogeography of mammals in the Western Ghats, (d) communal roosting in common mynas, (e) foundational problems in evolutionary biology, (e) comparative neurobiology - across sympatric species on neuronal underpinnings for differences in rhythmic behaviours, (f) neurogenetics of sleep, (g) progression of neurodegenerative disorders using model organisms, (h) neuronal circuits underlying thermosensory modulation of rhythmic behaviours, (i) circadian rhythms in nature, (j) evolution of adaptations to crowding, especially the interplay of food deprivation and waste buildup, (k) fruit fly metapopulation dynamics and stability, and (l) philosophical clarifications of the usage of the terms fitness and inheritance, (m) life history evolution, (n) evolution of circadian rhythms, (o) adaptive significance of circadian rhythms, (p) neurogenetic basis of circadian egg-laying rhythm in fruit flies, (q) connection between circadian clocks and life history traits, (r) molecular-genetic regulation of morning and evening chronotypes, (s) role of social cues in circadian timing, (t) sleep-enrichment in fruit flies, and (u) circadian consequence of social organization in ants, are currently being addressed.

The Unit also continues to train personnel in the area of whole organismal biology through the Ph.D., Integrated Ph.D. and M.S. programmes, as well as through participation of the faculty in POBE and SRFP programmes of the JNCASR as well as similar outreach programmes run by the three Indian Science Academies and by DST and KVPY.

Research Progress

A theory to understand why not only density (eggs per unit volume of food) but also the total height of the food column in Drosophila culture vials affects the nature of selection in crowded cultures and potentially leads to the evolution of competitive ability via different sets of traits has been developed. Studies were undertaken on brain-body size allometry in fruitfly populations selected for rapid development. Studies carried out on behavioural and physiological plastic responses to food limitation in fruitfly larvae. The formal relationship between ecological (rate of reproduction) and evolutionary (rate of increase) fitness was investigated theoretically to develop a better conceptualization of evolutionary change. Studies were conducted on immune system function in fruitfly populations subjected to selection for rapid development at low versus high densities. Studies undertaken on the nature of unstable equilibria and post-perturbation dynamics in simple population growth models. Studies were carried out for investment in mating in fruitfly populations that have evolved differing degrees of sexually antagonistic male-female conflict.

Work on the social structure of female Asian elephants was continued in Nagarahole and Bandipur National Parks. Distinct clans within the population were detected. It was also found that clan membership did not change across years, that there were preferred associations within clans, and that there were significant correlations in pairwise association strengths across years, suggesting a fair degree of stability in this social structure.

Resource availability for elephants in Nagarahole National Park using vegetation plots in different forest types was estimated and found that, while elephants are often considered generalist bulk foragers, only a small proportion of all plant species were elephant foods. These food plant species showed patchiness in distribution within the forest type, which could facilitate between-clan dominance. The availability of the grass biomass was

also measured along the backwaters and found that grass biomass explained female habitat use to a moderate extent, and female habitat use explained the frequency of between-clan dominance interactions. The next step would be to examine grass quality as a predictor of habitat use.

Lateralization in trunk and forefoot movement during feeding in elephants was examined and a modified task complexity hypothesis was proposed, with increased lateralization shown during the performance of similar tasks by more complex organs. A strong trunk lateralization was found, with side bias that was independent of maternal preference, social associates, and feeding associates, and which developed much earlier than side preferences in other species studied, calling for a comparison of the ontogeny of side preferences in precocial and altricial species.

As per a simulation-based study of mark-recapture methods, it was found that social structure had only a minor effect on bias in elephant population size estimation. A new simulation study was set up, in which non-cycling and different kinds of seasonally cycling resources were included, along with movement rules and social organization. It was found that there was a main effect of social structure, and interactions of resource characteristics, such as patch size, with social structure that introduced bias in population size estimates.

Observations on common myna foraging showed that there was a high degree of ephemerality in food resources at the level of the grids examined, and resource depletion within a day. Therefore, it was unlikely that communal roosts served as information centres at this spatial scale of food patches. It was already shown that roosts did not serve as recruitment centres. It was found now that local enhancement was also not occurring. The next step would be to examine larger grid sizes to find out whether the level of ephemerality is lower, which could facilitate information transfer.

In collaboration with colleagues at IISER Mohali researchers at EOBU had established NMR-based metabolomics combined with multivariate statistical analysis as a useful method for future studies on the interactions between circadian clocks and metabolic processes. Studies were undertaken to understand the neuronal circuits that modulate rhythmic activity of *Drosophila melanogaster* in response to thermal cycles showed that the neurotransmitter serotonin and one of its receptor subtypes 5HTR1B is likely to be involved by signaling to mushroom body regions in the fly brain. Immunohistochemical analysis revealed that the differences in behavioural rhythms seen between two sympatric and closely related species of Drosophilids is reflected in differences in circadian clock protein PERIOD and neuropeptide PDF oscillations as well.

Studies of the interaction between circadian pacemakers and sleep homeostat show that PDF+ neurons promote daytime wakefulness by silencing sleep-promoting dorsal Fan shaped Body neurons. A small subset of circadian neurons (about 12 out of ~150 circadian neurons) can decrease sleep overall (both day and night) if activated constitutively. A time-of-day effect was found on extent of sleep deprivation, as measured by extent of sleep-rebound which is evidence for a circadian clock modulation of this aspect of sleep.

In a study it was found that *D. melanogaster* populations selected for evening adult emergence exhibit delayed pupation and development times, higher fecundity, and reduced adult lifespan. *D. melanogaster* populations selected for evening adult emergence evolve circadian clocks composed of weak oscillators, greater developmental plasticity and higher period plasticity. *D. melanogaster* populations selected for evening emergence evolve circadian clocks that facilitate stable entrainment across multiple environmental regimes involving light and temperature in both lab and nature. *D. melanogaster* populations selected for morning and evening emergence evolve divergent molecular clocks with the clock gene mRNA in their brain exhibiting advanced and delayed peaks of expression, exhibit higher levels of neuropeptide pigment dispersing factor that is known to mediate multiple rhythmic behaviors. It was also found in a study that locomotor activity rhythms of *D. melanogaster* populations selected for morning and evening adult emergence use the Circadian Integrated Response Characteristic (CIRC) to entrain to light/dark cycles. The net compression and expansion of internal cycles representing the circadian clocks driving locomotor activity rhythms of these morning and

evening emerging *D. melanogaster* populations is driven by a combination of time of day dependent phase and amplitude responses. Studies using the morning and evening emerging *D. melanogaster* populations revealed that period of a rhythm and phase of entrainment may be regulated by distinct parts of the circadian clock network. Selection for narrow gate of emergence results in correlated sex-specific changes in life history of *D. melanogaster*. Selection for narrow gate of emergence results in evolution of greater stability in free-running period across age and different temperatures. Populations selected for narrow gate of emergence evolve greater sensitivity to light, robust eclosion rhythms due to more stringent gating by the circadian clock.

The effects of polygamy were established on the activity/rest rhythm of male fruit flies Drosophila Pair-wise social interaction in males results in clock-independent sleep-enrichment in fruit flies *D. melanogaster*. Or47b olfactory sensory neurons regulate male-mating success in fruit flies *D. melanogaster*. Mechanosensory signals act via chordotonal organs to promote sleep in fruit flies *D. melanogaster. D. melanogaster* flies with clocks period close to that of the entraining regime show higher accuracy of entrainment. Short-period and wild type strains of *D. melanogaster* show temperature compensation whereas long-period strains show a reduction in period at lower temperatures. Pre-adult development time of *D. melanogaster* is clock regulated and seems to be dependent on the gating of adult-emergence rhythm. Circadian rhythm in activity/rest, adult emergence and oviposition persist in *D. melanogaster* populations reared in aperiodic environments for over 330 generations. *D. melanogaster* populations evolving in constant darkness display significantly higher light sensitivity compared to populations evolving in constant light populations. *D. melanogaster* populations evolving in nature under simultaneously changing multiple zeitgebers as opposed to controlled laboratory conditions) revealed a more robust circadian clock. Male presence effects phasing of egg laying rhythm under 12:12 h light/dark cycles, changing the phase of peak of egg laying or making the behavior arrhythmic, depending upon overlap of male evening activity peak with female egg laying peak, in fruit flies *D. melanogaster*. Male presence is unable to effect phasing of egg laying rhythm of females under short photoperiods 4:20 h light/dark cycles, in fruit flies *D. melanogaster*. Clock genes don't seem to play a role in persistence of egg laying rhythm in fruit flies *D. melanogaster*, though they effect phasing of the rhythm under 12:12 h light/dark cycles. Certain clock genes, such as perS which have a shorter free-running circadian period of ~18 h, effect egg laying rhythm in a similar phenotypic way reducing the free-running egg laying period under constant darkness. Egg maturation in clock mutants is disrupted for certain late stages of development while, phasing of immature egg stages is unaffected, under 12:12 h light/dark cycles in fruit flies *D. melanogaster*. Pan-neuronal expression of perS leads to a trend of decrease in free-running period in egg laying behaviour of female flies, indicating possible neural control of the circadian period of egg laying rhythm in fruit flies *D. melanogaster*. Olfactory and Gustatory neural circuits do not play a role in the persistence of egg laying rhythm in fruit flies *D. melanogaster*.

Following are the members of the Unit:

Chair

Vijay Kumar Sharma	Ph. D., F. A. Sc., F. N. A. Sc.

Professors

Amitabh Joshi	Ph.D., F.A.Sc., F.N.A.Sc., F.N.A.
Vijay Kumar Sharma	Ph.D., F.A.Sc., F.N.A.Sc.

Honorary Professor

Raghavendra Gadagkar	Ph.D., F.A.Sc., F.N.A., F.T.W.A.S.

Faculty Fellow

T.N.C. Vidya	Ph.D.

Associate Faculty from Neuroscience Unit

Sheeba Vasu	Ph.D.

Research Students

Pavitra Prakash, Nandini R Shetty, Antara Das, Nikhil K.L., Keerthipriya. P., Vishwanath Varma, Radhika Dilip Shindey, Hansraj Gautam, Anuj Menon, Manishi Srivastava, Singh Viveka Jagdish, Neha Pandey, Revathe T., Satyabrata Nayak, Sheetal Potdar, Avani Mital, Manaswini Sarangi, Abhilash Lakshman, Manan Gupta, Shambhavi Chidambaram, K. Ratna, Goirik Gupta, Srikant Venkitachalam, Kulkarni Rutvij Kaustubh, Pritha Kundu

Research Associate

Dr. Joy Bose

Research Associate (P)

Nikhil K.L.

R&D Assistants

Sajith V. S., Shruti Mallya, Venkateswaran

Helper

Rajanna

GEODYNAMICS UNIT

Broad areas of research:

1. Tectonics and earthquake mechanisms along the Himalaya
2. Tsunami hazards and post-seismic processes and plate deformation along the Andaman-Nicobar subduction zone.
3. Intra-continental tectonics and earthquakes.
4. Holocene climatic evolution in the Himalaya

Activities and achievements during the year 2015-2016

During the reporting period, the previously initiated studies on the plate deformation and the long-term tsunami recurrence in the Andaman region continued. The ongoing research was also focused on the neotectonics and earthquake generation in the central Himalaya in addition to the Holocene climate evolution. The activities also included initiatives in organizing science outreach programmes in various districts of Uttarakhand.

Earthquake/tsunami recurrence studies (Andaman Islands): Work was continued to develop a robust chronological database on the Indian Ocean tsunami history from deep coring the tidal inlets and wetlands of South Andaman. Around 10-m long cores were collected from several sites near Port Blair that preserve bands of tsunami depositions alternating with regular cycles of tidal sedimentation. The work on these cores to characterize the tsunami bands and chronological constraints is ongoing and the preliminary data from one of the cores suggest possible tsunamis at varying interval during the last 7000 years. The study when completed is expected to give a more definitive regional tsunami chronology with obvious implications for rupture characteristics and frequencies of the tsunami-generating earthquakes.

Crustal deformation studies (Andaman Islands): Research work on crustal deformation in the Andaman region involved the collection of GPS data from permanent sites established in the Andamans - a collaborative project with Centre for Earthquake Research and Information, University of Memphis, US. The work on the pre-earthquake campaign mode (before the great 2004 earthquake) acquisitions at Port Blair showed that the site started to subside between 2003 and 2004. In addition, during this period, the horizontal displacement of Port Blair with respect to India, deduced from 1996-2000 GPS data, changed its orientation from to that obtained during the 26th Dec 2004 co-seismic. Modeling this short-term subsidence indicated that it is equivalent to an earthquake with a moment magnitude of 6.3. Previously, the slow slip was believed to be occurring at intermediate depths roughly 35–55 km, but simple models of the deformation at this Port Blair site suggest slow slip at much shallower depth. This observation of subsidence obtained by GPS methods is in rough agreement with subsidence observed from tide gauge data. Campaign mode GPS data between 1996 and 2000 suggest uplift for Port Blair during the inter-seismic period and so does the reported field observations of inter-seismic micro-atoll emergence.

Earthquake recurrence in the central Himalaya: As part of the studies on the earthquake recurrence along the Himalaya, varying techniques were employed. Stalagmites were used within the caves of the central Himalaya as proxies to characterize earthquake induced damage and developed a chronology of deformations identified on them. Earthquake induced liquefaction features was also used within the flood plains of Bihar and eastern Uttar Pradesh and a time series of major earthquakes was generated that affected the Bihar region. The direct studies were focused on the fault offsets preserved in the shallow sedimentary sections across the frontal thrust in central Himalaya to understand the previous occurrences of earthquakes - their timing and magnitudes. For that purpose, the frontal thrust was excavated near Dhankadi in the far-western Nepal, a stretch within the

central seismic gap. Further work in the laboratory is ongoing.

The past climatic changes in Kashmir Himalaya: The south Asian Monsoon system is one of the most significant and prevailing of the Earth's major climatic system. The Himalaya displays complex climatic variability as the mountains act as a barrier to atmospheric circulation for both the summer monsoon and the winter westerlies. Continuing climate change is predicted to lead to major changes in the strength and timing of the Asian monsoon, inner Asian high pressure systems, and winter westerlies are the main systems affecting the climate of the Himalayan region. The high resolution long-term paleo-climatic data provides the background to model the future changes in monsoon dynamics. To understand the behavior of past monsoon dynamics, the Wular Lake in Kashmir Himalaya was cored up to a maximum depth of 18 meters, and the collected lake cores are now being subjected to multiple laboratory analyses.

Science Outreach Programme

With the financial support of C. N. R. Rao Hall of Science and C. N. R. Rao Education Foundation (JNCASR), the science outreach program was organized at Gangolihat on April 29-30, 2015 under the supervision of Prof. K. S. Valdiya along with Profs. Umesh Waghmare, Udaykumar Ranga and Chandrabhas Narayana. In this program, 99 students and 23 teachers were benefited from 25 inter-colleges from different districts of Uttarakhand including Rudrapryag, Chamoli, Bageswar, Champawat and Pithoragarh. During the month of November (November 02-08, 2016), another Outreach Programme was organized in Gouchar and Guptkashi (Rudraprayag District), Gopeshwar and Joshimath (Chamoli District) in which 1,370 students and 52 teachers from 17 inter-colleges were present.

Following are the members of this unit:

Chair

K S Valdiya	Ph.D., FASc, FNA, FNASc, FTWAS

Senior Associate

C P Rajendran	Ph D

Research Scientist

Dr. Jaishri Sanwal Bhatt	Ph D

Research Associate

Dr. K Anandasabari

MOLECULAR BIOLOGY AND GENETICS UNIT (MBGU)

Research Progress

Autophagy and autophagy related pathways in health and disease

Dr. Ravi Manjithaya

Current ongoing research looks at multiple aspects of autophagy biology using yeast, mammalian cells and mouse models. The laboratory has identified small molecules that regulate autophagy in both yeast and mammalian systems. To identify these small molecules, a high throughput screening of several libraries consisting of ~ 200,000 compounds was screened at University of California, Los Angeles (UCLA) using an in house developed real time autophagy assay. Follow-up work on some these compounds has identified compounds that up regulate autophagy and the recent results show that one of the compounds promotes autophagic elimination of Salmonella in an infection model. Another potent autophagy inducer helps clear neuronal protein aggregates via autophagy and has provided promising results in a mouse model of Parkinsonism. Three of the autophagy inhibitors identified in the laboratory have shown to affect the various stages of the autophagosome vesicle itinerary. Finally, detailed characterization of the roles of two novel protein complexes in autophagy is nearing completion.

Definition and epigenetic definition of centromeres

Dr. Kaustuv Sanyal

The focus of the Molecular Mycology Laboratory (MML) is to understand a) evolution of centromere sequence and composition of sequence elements b) genetic and epigenetic determinants of centromere identity, c) kinetochore assembly, and d) genome indexing by variant histones. The members of MML use two pathogenic fungal species complexes – Candida and Cryptococcus – to address these questions.

Research from MML lead to identification of centromeres in related Candida and Cryptococcus species complex and established rapid evolution of centromere sequence and organization of centromere DNA elements in closely related species. This group also showed that the physical chromosomal location, rather than the DNA sequence per se, plays a determining role in centromere identity in Candida. Across-talk between proximal DNA replication origins and DNA recombination-repair proteins helps in maintaining centromeric chromatin during cell division. The kinetochore, which forms on the centromere, is the chromosomal attachment site of spindle microtubules. MML members have shown that kinetochore formation is ordered with step-wise assembly of proteins in Cryptococcus but a coordinated interdependent circuitry proteins ensures integrity of the whole kinetochore in Candida. The research group also developed a computational model to simulate fungal mitosis. Recently, a variant histone H3 was identified that is exclusively evolved in the Candida clade species and plays a role in regulating gene expression that determines transition between biofilm and planktonic growth conditions.

Transcription regulation and chromatin dynamics

Prof. Tapas K Kundu

Focus of the Transcription and Disease Laboratory is to understand the different aspects of functional chromatin dynamics which are responsible for the gene regulation and its link to cellular physiology, differentiation and pathobiology. Apart from cell cycle regulation, muscle differentiation and neuroglial differentiation, two different diseases are being investigated in this context, namely cancer (oral cancer and breast cancer) and AIDS. The research group has discovered that highly abundant, multifunctional nuclear protein, PC4 is a

bonafide chromatin component involved in the chromatin compaction and thereby genome organization and transcription regulation. PC4 knockdown stable cell line was generated and it was found that PC4 is indeed involved in genome stability. Interestingly, in a large number of breast cancer samples, PC4 expression was found to be down regulated. Total knockout of PC4 is embryonic lethal. Presently, the group is working on organ-specific conditional knockout mice.

The group has worked on the human histone chaperone NPM1 and found that it is a regulator of RNA polymerase II-driven chromatin transcription in an acetylation-dependent manner. NPM1 was shown to be over-expressed and hyperacetylated in oral cancer. The group has also found that NPM1 is a positive regulator of p300 autoacetylation. Monoclonal antibodies were generated against modified and unmodified NPM1. These antibodies were commercialized by renowned companies. This laboratory has also been actively working on the small molecule modulators of chromatin modifying enzymes for more than a decade now. Apart from several small molecule inhibitors of lysine acetyltransferases and arginine methyltransferase, the research group also discovered the first known small molecule activator of p300/CBP lysine acetyltransferase, which could activate histone acetylation in mice brain and thereby enhance the neurogenesis process and spatial memory. Also, the first of its kind, a natural and specific inhibitor of the lysine acetyltransferase, PCAF was discovered and the role of PCAF was elucidated in the process of muscle differentiation. It was also found that the anti-hypertensive drug, felodipine is a specific inhibitor of Aurora Kinase A. Based on this finding, by employing Surface Enhanced Raman Spectroscopy (SERS) and molecular dynamics technique, a new method of molecular level drug-protein interaction identification method was established in collaboration with other units of the Centre.

Stem cell potency and cardiovascular development

Prof. Maneesha Inamdar

In a non-genetic approach for stem cell manipulation, the research group has integrated small molecule mediated and microparticle engineering approaches to modulate the mesenchymal stem cell (MSC) secretome. Through this, the pro-inflammatory components were inhibited, yet generally the beneficial anti-inflammatory and pro-angiogenic components were maintained. In vitro functional relevance was demonstrated by inhibiting key processes of cardiac fibrosis. It is anticipated that this non-genetic, transient cell engineering approach has broad therapeutic relevance.

The research group has genetically manipulated human embryonic stem cells (hESCs) to generate reporter lines expressing EGFP or TdTomato and overexpression lines for genes of interest. CRISPR/Cas9 mediated knockout hESC lines has also been generated. It was found that modulation of OCIAD1 levels is important for differentiation of early mesodermal precursors.

Additional conserved mechanisms have been identified that operate in Drosophila nephrocytes and kidney podocytes to maintain homeostasis. Perturbation of specific molecules that contribute to cell architecture causes loss of podocyte slit diaphragm morphology, leading to proteinuria in mouse models.

HIV-1 subtype-C strain: success story of the fittest viral subtype

Prof. Udaykumar Ranga

Over the past few years, the research group has been actively engaged in understanding how HIV-1 establishes and maintains viral latency. It appears that the same viral protein Tat can activate as well as suppress transcription from viral promoter although how is this trick accomplished at the molecular level is not known. There were some important leads in this direction. The research group found that the stronger the viral promoter, the faster the rate of latency establishment which appears to be paradoxical. However, the process of latency is controlled by Tat. The process of viral latency is more intriguing in the context of subtype C of HIV-1 as these viral

strains are acquiring a greater magnitude of variation in the viral promoter. Subtype-specific genetic variations provide a powerful tool to examine how these variations offer a replication advantage to specific viral subtypes if any. Only in subtype C of HIV-1, two genetically distinct transcription factor binding sites are positioned at the most critical location of the viral promoter. Since a single promoter regulates viral gene expression, the promoter variations can play a critical role in determining the replication fitness of the viral strains. The research group's work for the first time provides a scientific explanation for the presence of a unique NF-κB binding motif in subtype C, a major HIV-1 genetic family responsible for half of the global HIV-1 infections. The results offer compelling evidence that subtype C viral promoter is not only stronger but also is endowed with a qualitative-gain-of-function advantage. The genetically variant NF-κB, and the Sp1III motifs may be responsive to specific cell signal pathways differentially, and these mechanisms must be examined. The group is actively pursuing these leads to unravel the most puzzling aspects of HIV-1 transcriptional latency.

Molecular genetics of hereditary, prelingual, sensorineural hearing impairment

Prof. Anuranjan Anand

In the studies of over 500 families with at least two members with congenital, autosomal recessive, prelingual, non-syndromic, severe-to-profound deafness, a detailed examination of seven deafness-causing genes was carried out: Cx26 (connexin 26) Cx30 (connexin 30); TMPRSS3 (transmembrane serine protease 3), TMC1 (transmembrane cochlear-expressed gene 1), HAR (Harmonin), CDH23 (cadherin 23) and TMIE (Transmembrane inner ear expressed gene). This work has revealed a large spectrum of pathogenic mutations in these genes: 18 mutations in Cx26, 1 mutation in Cx30, 8 mutations in TMC1, 4 mutations in TMPRSS3, 6 mutations in HAR, 4 mutations in CDH23 and 4 in TMIE. The identification of a total of 45 pathogenic mutations has substantially extended our understanding of allelic heterogeneity at these genes and provided a large number of new mutant alleles for potential use in cell biological, biochemical and structure-function correlation studies.

About 25% of the hereditary deafness seen in the country is due to 18 mutations at a single gene, Cx26. Interestingly, the high prevalence of a particular Cx26 mutant allele, W24X is attributable to an approximately 8000-year old founder effect in our population. Knowledge of the relative contributions of these seven genes to the load of hereditary hearing loss has helped devise a 'genetic algorithm' that has important utility for early detection of the disorder and implementation of suitable intervention therapies.

An important milestone in the use of the genetic knowledge generated in this laboratory has been to decipher the cause of hereditary deafness in a tribal population of about 380 individuals in the state of Jammu and Kashmir. Of these, over 45 are affected by severe-to-profound hearing impairment. For over a decade, the exact cause of the disorder in this population had remained unknown. An extensive genetic work up involving whole genome-based gene identification approaches conducted by this laboratory found that deafness in this tribal population is due to mutations in CLAUDIN14 and OTOFERLIN. Currently, a team of ENT experts and human genetics experts is being set up to advice this population about possible remedial measures.

Protein engineering and molecular parasitology

Prof. Hemalatha Balaram

The Laboratory has continued its studies on mitochondrial metabolism in *Plasmodium falciparum* and on molecular enzymology with focus on enzymes involved in purine nucleotide metabolism in the parasite. Using biochemical and X-Ray crystallography tools, the group has established for the first time a molecular basis for ammonia channeling in GMPS. Further, a highly stable succinimide and its role in stability of HjGATase has been established. In collaboration with the groups of Prof. S. Balasubramanian and Dr. Meher Prakash, the molecular mechanism of the activation of parasite HGXPRTwas established using experimental approaches and MD simulation. The structural details of the substrates when bound to HGPRT have been elucidated using

ultraviolet resonance Raman spectroscopy (UVRR), in collaboration with Prof. Mrinalini Puranik (IISER, Pune). The structure of *P. falciparum* GMPS in substrate-bound state was obtained. It was found that this structure in conjunction with steady state and pre-steady state kinetics for the first time, provides a molecular basis for allostery, ammonia tunneling and a framework for understanding the catalytic mechanism in GMPS. Prof. Balaram's group has also been examining the crosstalk between purine nucleotide and tricarboxylic acid (TCA) cycles as the adenylate arm of purine nucleotide synthesis generates the TCA cycle intermediate fumarate. The group has now adopted a genetic strategy wherein AMP synthesis has been rewired to bypass the ADSS-ASL pathway and thereby, enabling the evaluation of the role of fumarate in parasite cellular processes.

Mechanisms underlying pathogenesis of human cerebral malaria

Prof. Namita Surolia

The Molecular Parasitology Laboratory focused its research activities last year on functional characterization of autophagy proteins in Plasmodium falciparum, which is relatively an unknown field. For the purpose, various GFP-autophagy fusion proteins were constructed and using proteomics approach, the interacting partners of some of the Plasmodium autophagy proteins were attempted to be deciphered. The group is also trying to characterize molecules which are highly up regulated in severe as well as cerebral malaria patients to explore the possibility of using these as biomarkers of the disease.

Chromatin biology and Genomics

Prof. M.R.S. Rao

Mrhl is a long non-coding RNA that was discovered in Prof. M.R.S. Rao's laboratory encoded within meiotic recombination hotspot locus. It is a 2.4 kb, unspliced, polyadenylated transcript, transcribed from the 15th intron of PHKB gene present in chromosome 8 of mouse. It is expressed in multiple tissues and negatively regulates Wnt signaling. Genome wide occupancy of mrhl RNA by ChOP sequencing showed that it physically associates at 37 gene loci. Sox8 is one such gene where mrhl occupies the promoter of this developmentally important transcription factor. Sox8 has an established role in Sertoli cell function and it has been shown through knockout studies that absence of this gene leads to defects in sex cord formation but there has been no report of its expression in germ cells. The research group has dissected out the role of mrhl in regulation of Sox8 with respect to Wnt pathway and have found that Sox8 is not only expressed in germ cells but is also important for meiotic commitment of spermatogonia. Sox8 is up regulated by the activation of Wnt signaling and the occupancy of mrhl RNA on the Sox8 promoter hinders the aforementioned phenomenon. The changes in the chromatin dynamics was analyzed that facilitated the transcriptional activation of Sox8 and found that the Tcf-4 binding site 800bp upstream of the transcriptional start site and the ChOP site 141 bp upstream of the TSS both play a role in modulating the chromatin to aid recruitment of transcriptional activators.

Long non-coding RNAs (lncRNAs) have emerged as important players in regulation of gene expression in higher eukaryotes. P68/ DDX5 helicase protein which is involved in splicing of precursor mRNAs also interacts with lncRNAs like, SRA and mrhl, to modulate gene expression in mammalian cells. RIP-seq to identify the complete repertoire of p68 interacting transcripts in HEK293T cells was carried out and was found that 389 lncRNAs are associated with the protein. The LOC284454 lncRNA based on its important and unique genomic architecture was characterized in detail. The RNA is located in the same primary transcript which harbours the miRNA cluster 23-a~27a~24-2. The gene is expressed in multiple tissues and is conserved only in primates. The nuclear localized RNA is also associated with p68 on chromatin. RNA-seq analysis of HEK293T cells over expressing this RNA revealed that the RNA modulates global gene expression and affects the expression of cancer pathway genes. The expression of this lncRNA is significantly altered in hormone responsive cancer tissues. The RNA is down-regulated in breast cancer tissue and cell lines and ectopic expression of the RNA in breast cancer cells reduced cell proliferation and migration suggesting a possible role of LOC284454 RNA in

breast cancer pathobiology.

The research group has identified various post-translational modifications on TH2B across the tetraploid and haploid stages of spermatogenesis. By computational analysis, it was also shown that the amino acid differences in the N-terminal tail, and the post-translational modifications acquired by some of the residues could cause the destabilisation of the nucleosomes. It is well established by now that meiotic recombination is triggered by DNA double strand breaks which require the chromatin reorganization but still the mechanism underlying this is not known. Currently, efforts are made to understand the role of serine-12 phosphorylation of TH2B (TH2BS12P) in meiotic prophase I. To address this, the phospho-specific TH2B (TH2BS12P) antibody was raised and characterized. Immunostaining revealed an enriched staining of TH2BS12P in the XY body compared to the result of the nucleus. This lead the research group to the hypothesis that TH2BS12P may be involved in a XY body specific function like recombination, heterochromatin formation etc. By colocalization studies, it was shown that TH2BS12P colocalizes with the major recombination proteins like DSB repair protein Spo11, strand invasion protein Rad51, H2A histone variant γH2AX and meiotic recombination kinase pATM in the XY body during the pachytene spermatocytes.

Following are the members of the Unit:

Chair

Anuranjan Anand	Ph.D., F.A.Sc.

Honorary Professor

Dipankar Chatterji	Ph.D., F.N.A.Sc., F.A.Sc., F.N.A., F.T.W.A.S.
V. Nagaraja	Ph.D., F.N.A.Sc., F.A.Sc., F.N.A., F.T.W.A.S.

Honorary Professor / SERB Distinguished Fellow

M.R.S. Rao	Ph.D., F.A.Sc., F.N.A., F.N.A.Sc., F.T.W.A.S.

Professors

Anuranjan Anand	Ph.D., F.A.Sc.
Hemalatha Balaram	Ph.D., F.A.Sc.
Namita Surolia	Ph.D., F.A.Sc., F.N.A.Sc.
Ranga Udaykumar	Ph.D.
Tapas Kumar Kundu	Ph.D., F.A.Sc., F.N.A.Sc., F.N.A.
Maneesha Inamdar	Ph.D.

Associate Professor

Kaustuv Sanyal	Ph.D.

Faculty Fellow

Ravi Manjithaya	Ph.D.

Associate Faculty from NSU

James P. Chelliah	Ph.D.

Sr. Technical Officer (Veterinary)

R. G. Prakash	B V Sc & A.H.

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Swaminathan, Shukla Arpit Prakashkumar, Shalini Roy Choudhury, Simi Muraleedharan, Prabhu S. A., Amit Kumar Behera, Neha Varshney, Stephanie Kaypee, Piyush Mishra, Santosh S., Sutanuka Chakraborty, Sweta Sikder, Divyesh Joshi, Arnab Bose, Debosree Pal, Palak Agrawal, Barve Gaurav Ramanand, Krishnendu Guin, Wulligundam Praveen, Rima Singha, Dongre Aparna Vilas Pushpalata, Suchismita Dey, Iyer Aditya Mahadevan, Arun Panchapakesan, Arindam Ray, Shrilaxmi V. Joshi, Asutosh B. R., Aditya Bhattacharya, Bhange Disha Ramesh, Sunanda Chakrabarti, Vandhana C., Ananya Ray, Sambhavi Puri, Moumita Basu, Nivedita Pandey, Shatarupa Sarkar, T. Lakshmi Prasoona, Vikas, Shveta Jaishankar, Lakshmi Sreekumar, R. Sunaina Singh, S. N. Suresh, Shreyas Sridhar, S Sundar Ram, Lakshmeesha K N, Pooja Barak, Saloni Sinha, Somya Bats, Arpitha A Suryavanshi, Siddharth Singh, Pallabi Mustafi, Shubhangini Kataruka, Priya Jaitly, Veena A., Bhavana Kayyar, Akash Kumar Singh, Aditi Batra, Sarika Chinchwadkar, Jigyasa Verma, Raktim Roy, Diwan Zeenat, Javid Lubna, C V Neha, Neelakshi Varma, Swati Keshri, Anindita Pal, Polisetty V S Satya Dev, Anjali Amrapali Vishwanath, Bornika Roy, Tirath Raj Dwivedi

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DBT-Research Associate-I

Dr. V Shalini

DBT Research Associate-III

Dr. Roshan Fatima Begum

Research Associate II

Dr. Arun Renganathan

Senior Research Fellow

Deeti K. Shetty

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Salauddin Sekh

Secretarial Assistant Trainees

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Lab Helpers

Munegowda, Lakkappa, Raju B.N., Krishnamurthy, Chandrashekar H.C., Ambarisha, Muniraju M.

NEUROSCIENCE UNIT (NSU)

Research Progress

Gain-of-function effects of the CASR gene mutations among patients with generalized epilepsy

Prof. Anuranjan Anand

Epilepsy is a relatively common brain disorder defined by recurrent and unprovoked seizures. Genetic generalized epilepsies (GGE) account for 50% of all epilepsies and have substantially complex genetic basis to their etiology. In an earlier work in this laboratory it was identified that a number of mutations in CASR present exclusively among genetic generalized epilepsy patients. CASR encodes a G-protein coupled receptor that senses extracellular calcium levels and is known to play a pivotal role in maintenance of systemic calcium homeostasis. It regulates several cell- and tissue-specific cellular processes by modulating different intracellular signaling pathways. The six mutations were identified which are rare, missense changes altering highly conserved CASR residues: p.Glu354Ala, p.Asp433His, p.Ser580Asn, p.Ile686Val, p.Arg898Gln and p.Ala988Val. A functional analysis was carried out comprising a (i) MAPK (mitogen-activated protein kinase) assay and (ii) Inositol monophosphate (IP1) accumulation assay, for the six CASR mutations identified in cultured mammalian cells.

In the MAPK assay carried out across different Ca^{2+}_{o} concentrations the signaling activity of CASR followed a sigmoidal dose-response curve, with exponentially increasing activity at 3-6 mM of Ca^{2+} and saturation at higher calcium levels. The wild-type CASR- transfected cells show a half-maximal response (EC_{50}) at 4.31 ± 0.13 mM. The signaling activities by all mutant receptors exhibited a leftward shift in the dose-response curves with EC_{50} values of p.Glu354Ala: 3.76±0.33 mM, p.Asp433His: 4.29±0.1 mM, p.Ser580Asn: 3.87±0.15 mM, p.Ile686Val: 3.52 ± 0.35 mM, p.Arg898Gln: 3.72 ± 0.27 mM, p.Ala988Val: 3.44±0.5 mM. The empty vector (pcDNA3.1) and a control vector (CASR-Asn583X pcDNA3.1) transfected cells exhibit basal level activity in response to increasing extracellular Ca^{2+} concentrations. The leftward shifts in the dose-response curves of the mutant CASR receptors suggest that these receptors have enhanced responsiveness to the $Ca^{2+}_{o.}$ Further, the effect of the CASR mutant receptors was studied on Phospholipase C (PLC) coupled Inositol 1,4,5-trisphosphate (IP3) pathway in response to extracellular Ca^{2+} by measuring intracellular IP1 accumulation by ELISA-based assays. As the lifetime of IP3 is less than 30 seconds in the cell, the levels of IP1 were quantified by competitive ELISA in presence of LiCl which prevents conversion of IP1 to Myo-inositol. In this functional assay, the wild-type CASR transiently expressed in HEK293T cells generated a dose-response curve for increasing Ca^{2+}_{o} concentrations with an EC_{50} of 4.05±0.13 mM. The dose-response curves of the mutant receptors exhibited EC_{50} values lower than that of wild-type receptor, indicative of their activating nature (p.Glu354Ala: 3.25±0.18mM, p.Asp433His: 3.78±0.16mM, p.Ser580Asn: 3.38±0.16 mM, p.Ile686Val: 3.79±0.2mM, p.Arg898Gln: 3.05±0.18mM, p.Ala988Val: 3.42±0.23 mM). The signaling response curves for p.Glu354Ala, p.Ser580Asn, p.Arg898Gln and p.Ala988Val showed distinct leftward shift and saturation at lower Ca^{2+} concentration as compared to WT-CASR. However, the cells transfected with control vectors (pcDNA3.1 and CASR-Asn583X pcDNA) had no change in intracellular IP1 levels due to increasing calcium concentration. The p.Arg898Gln mutation exhibited significantly high response at 3mM and 4mM Ca^{2+} concentrations than wild-type protein. The cells transfected with p.Ala988Val mutant receptor showed significantly reduced intracellular IP1 levels than wild-type at 5mM Ca^{2+}, exhibiting saturation at lower calcium levels. Quite similar to their effect on MAPK pathway, these mutant receptors show activation at Ca^{2+} concentrations lower than that of wild-type *CASR*, in the PLC-IP3- mediated signaling pathway.

Recently studies carried by other investigators have shown the role of CASR in axonal and dendritic growth. Hippocampal pyramidal neurons expressing CASR dominant negative mutations develop smaller dendrites in postnatal organotypic cultures. The activating *CASR* mutations affect the *CASR*-regulated neuronal functions

in a manner which remains to be deciphered. It is becoming increasingly clear that the function of CASR in the brain is crucial to maintain normal neuronal development and excitability, and that CASR could be a potential therapeutic target in epilepsies. The future line of research of Prof. Anand's group on CASR may include examining effect of mutant CASR on receptor trafficking to the plasma membrane, determining the calcium affinities and studying electrophysiological properties of the epilepsy-associated mutations in specialized neuronal cultures in collaboration with other scientists.

Neurogenetics and Behaviour

Dr. Sheeba Vasu

In collaboration with colleagues at IISER Mohali Dr. Sheeba Vasu's research group has established NMR-based metabolomics combined with multivariate statistical analysis as a useful method for future studies on the interactions between circadian clocks and metabolic processes. Their studies reveal that the oscillations in neuropeptide levels in the axonal arbors of critical circadian neurons are not causal agents of circadian activity/rest rhythms unlike previously believed. Studies to understand the neuronal circuits that modulate rhythmic activity of *Drosophila melanogaster* in response to thermal cycles showed that the neurotransmitter serotonin and one of its receptor subtypes 5HTR1B is likely to be involved by signaling to mushroom body regions in the fly brain. Immunohistochemical analysis revealed that the differences in behavioural rhythms seen between two sympatric and closely related species of Drosophilids is reflected in differences in circadian clock protein PERIOD and neuropeptide PDF oscillations as well studies of the interaction between circadian pacemakers and sleep homeostat show that PDF+ neurons promote daytime wakefulness by silencing sleep-promoting dorsal Fan shaped Body neurons. A small subset of circadian neurons (about 12 out of ~150 circadian neurons) can decrease sleep overall (both day and night) if activated constitutively. A time-of-day effect was found on extent of sleep deprivation, as measured by extent of sleep-rebound which is evidence for a circadian clock modulation of this aspect of sleep.

Cellular mechanisms of human mind disorders

Dr. James Chelliah

A cardinal feature of the human brain development is that sensory, cognitive and emotional experiences shape synapses, neural-circuit development, memory formation and recall of stored memories. Several studies have shown that these features are altered in intellectual disability (ID) and Autism Spectrum Disorder (ASD). *De novo* heterozygous mutations in the gene that encode for synaptic RasGAP, *Syngap1*, has been shown to cause ID and increase the risk for developing ASD in young children. In Dr. Chellaiah's lab, efforts were made to understanding the following functions of SYNGAP1 in brain development. One of the questions the Group has attempted to answer is how does *Syngap1* heterozygous mutation affects the function of GABA by modulating the switch of Cl^- transporters during development. Their preliminary results show that this mutation advances the switch of Cl^-transporters during development, thereby regulating the function of GABA during development. The second set of questions Dr. Chellaiah's group is trying to study whether SYNGAP1 can interact with the FMRP that are implicated in ID and ASD. Neuronal maturation in FMRP KO is opposite to *Syngap1* Heterozygous mutations i.e., delayed maturation in FMRP. This will help the Group to design therapeutic drugs targeting protein that regulate FMRP and reverse the behavioural and functional deficits observed in SYNGAP1. The third major question the Group studied is to understand the role of astrocytes in neuronal maturation and how *Syngap1* Heterozygous mutation alters the function of astrocytes. The preliminary data suggests that the astrocyte expression was reduced in *Syngap1* heterozygous mice, which can affect how the neurons (excitatory and inhibitory) neurons mature and function. The fourth major question studied in collaboration with Prof. Vidita in TIFR is to understand whether the rescue of the phenotypes observed in *Syngap1* Het mutations by targeting perineuronal nets that forms at the time of neuronal maturation (3 weeks in mice). The preliminary

results shows that the number of perineuronal nets are reduced in *syngap1* Hets. The Group has 3 collaborative projects with faculties from IISc, NCBS and RGCB with *Syngap1* not as the main theme and 1 collaborative project with a faculty in UK with *Syngap1* as a main theme.

Biomaterials for interfacing sensory organs

Prof. K.S. Narayan

Organic polymers serve as the active biomaterials for the bioelectronic interface in the field of neuroprosthesis based on their opto-electronic properties, mimicking the natural photosystems. In this study, a human neuronal in vitro model, SH-SY5Y was used & in vivo model, BALB/c, to access the viability and proliferation of cells towards different substrates and converting them into mature human neurons by differentiation process. A particular challenge faced using this approach is understanding the specific neuronal behavior and accurate measurement of functional neuronal output, which remains a hallmark of such assays. Limitations to the use of these scaffolds include the technical challenge associated with patch-clamp recordings and, to a lesser extent, immunocytochemistry. Efforts were made to overcome this issue by having high seeding density on MEA to provide cell's contact on the substrate, yielding more local potential activity upon photo-stimulation.

Bioactive conductive nanofibrous scaffolds for neural regeneration in order to achieve complete functional regeneration, an ideal nerve conduit must meet several requirements like mimicking the structure of native extracellular matrix, topography guiding the axons along their direction and provide essential bio-recognition signals for the cells to attach, proliferate and perform their normal functions. Electrospun nanofibrous scaffolds are attractive candidates for neural regeneration due to similarity to the native extracellular matrix. Aligned nanofibres provide necessary guidance and topographical cues required for directing the axonal and neurite outgrowth during regeneration. Proper conduction of nerve impulses is a mandatory feature of a typical nerve. The neuro-conductive property can be imparted by blending the biodegradable, bioactive polymers with conductive polymers. This will provide additional features, i.e., electrical cues to the already existing topographical and bioactive cues in order to make it a more multifaceted neuroregenerative approach. Hence, in the present study, electrospun nanofibrous composite scaffolds made up of biocompatible, bioactive and conductive polymers will be fabricated and their effect on neuronal cell cultures are being evaluated.

Understanding the Role of Long Non-coding RNA Mrhl in Neuronal Development

Prof. M.R.S. Rao

Being located in the 15th intron of *phkb* gene of mouse chromsome8, *Mrhl* gene exhibits tissue-specific expression in the adult mouse. It is processed into a 80 nt transcript by the nuclear Drosha machinery and the 2.4 kb primary transcript as well as the 80 nt processed transcript are nuclear restricted. In the context of spermatogenesis, mrhl RNA has been shown to negatively regulate Wnt signaling in mouse spermatogonial cells, through its interaction partner p68. During mammalian embryonic development, the Wnt signaling pathway presents itself as a regulator in a highly context dependant manner. Long non-coding RNAs (lncRNAs) have alongside emerged to be key players in regulating various aspects of mammalian development. In this study, focus was on the role of mrhl lncRNA in embryonic neuronal development, a phenomenon in which both lncRNAs and pathways like Wnt signaling contribute significantly. Interestingly, ~40% of mammalian lncRNAs are expressed in the brain. The lncRNA of the research group's interest, *Mrhl* is found to be differentially expressed in various stages of mouse embryonic brain development and also in a temporal manner in an *in vitro* model system where mouse embryonic stem cells have been specifically directed towards neuronal differentiation. Interestingly, *mrhl* expression is up regulated during the formation of neuronal precursors but rapidly down regulated during subsequent stages of neuronal differentiation.

The mechanisms underlying the aforesaid phenomena are under study. The interplay of transcription factors in the regulation of a gene is well established. Preliminary bioinformatic analysis has revealed the presence of binding sites for Ascl1 and Pax6 in the promoter of *Mrhl*, both of which are important for neuronal progenitor maintenance and/or differentiation. Studies are being undertaken to address the regulation of *Mrhl* by these transcription factors. Furthermore, CRISPR-Cas9 mediated knockdown of *Mrhl* will be performed to generate a knockout mouse embryonic stem cell line to reinforce the role of mrhl RNA in neuronal differentiation and development.

Patent Granted

US Patent 9,037,251 granted for 'Artificial retina device'
Inventors: K.S. Narayan, V. Gautam, M. Bag

Following are the member of this Unit:

Honorary Professor and Chair (SERB Distinguished Fellow)

M. R. S. Rao	Ph.D., F.A.Sc., F.N.A., F.N.A.Sc., F.T.W.A.S.

Faculty Fellows

James P. Chelliah	Ph.D.
Sheeba Vasu	Ph.D.

Associate Faculty

Anuranjan Anand	Ph.D., F.A.Sc.
K S Narayan	Ph.D., F.A.Sc., F.N.A., F.N.A.Sc.
Tapas Kumar Kundu	Ph.D., F.A.Sc., F.N.A., F.N.A.Sc.
Ravi Manjithaya	Ph.D.

Research Students

Vijaya Verma, Iyer Aishwarya Ramakrishnan, Abhik Paul, Iyengar Aishwariya Prasan

NEW CHEMISTRY UNIT (NCU)

The New Chemistry unit was created by the Jawaharlal Nehru Centre for Advanced Scientific Research as part of the 11th Five Year Plan. The unit was inaugurated in the presence of Prof. A.K. Cheetam, Prof. M. L. Klein, Prof. W. Jones and Prof. E. W. Meijer in December 2010 and works on interdisciplinary aspects of chemical science. The most important areas that are actively pursued are at the interface of chemical biology, chemical Science and materials science. Some of the specific areas of research are solid state and materials chemistry, chemistry of metal chalcogenides, organic synthesis, biomaterials, organic and supramolecular chemistry, antimicrobial therapeutics, drug delivery systems, patternable polymers, conducting polymers, semiconducting nanomaterials, renewable energy, liquid interfaces, multifunctional metal-organic hybrids, medicinal chemistry, theoretical chemistry, carbon and oxide based materials and catalysis.

The Unit currently includes core faculty members with Prof. C.N.R Rao as its Chairman and several associated faculty members from other Units of the Centre. The Unit admits students for the Ph.D. degree programme as well as integrated Ph.D. in Chemical Sciences. The Unit also admits students for integrated M.S.-Ph.D. programme in Chemical Sciences through Project-Oriented Chemistry Education (POCE). The students admitted for these programmes undergo extensive course work and research training before continuing for dissertation work.

Research Progress

Prof. C. N. R. Rao

Several aspects of the chemistry of materials were pursued by Prof. C.N.R. Rao. For more than five decades, C.N.R. Rao has been working on transition metal oxides. He continues to work on some recent aspects of metal oxides. Specifically, his group has initiated two major programmes on energy research: one related to artificial photosynthesis involving photocatalytic oxidation of water by nanoparticles of Mn and Co oxides and the other on photocatalytic H_2 generation by hybrid nanostructures by using the Z-scheme. In particular, he is interested in anion substituted oxides and sulfides wherein the oxygen is substituted by nitrogen and fluorine. Such substitution results in drastic changes in electronic structure and properties. He is continuing to conduct research on graphene and graphene mimics. Graphene mimics include a few layer or single layer materials formed by layered inorganic compounds such as MoS_2 and TaS_2. This has resulted in a wealth of new materials with possible applications. Novel synthesis of materials, as well as an exploration of new phenomena and properties exhibited by them, are of primary interest to Prof. Rao.

Dr. T. Govindaraju

Dr. Govindaraju's research interest in general is at the interface of chemistry, biology and (bio)materials science, and in particular, organic chemistry, peptide chemistry (peptidomimetics), functional and disease amyloids, molecular probes, nucleic acids and bioinspired (nano)architectonics. During the reporting period, major research efforts were in the development of diagnostics and therapeutics for currently incurable neurodegenerative diseases such as Alzheimer's (AD) and Parkinson diseases (PD). Several solutions were explored to address issues related to these diseases by elegantly combining the multidisciplinary-chemical biology approaches. Specifically, working on targeting multiple pathways involved in the pathogenesis of these diseases to develop peptide and small molecule-based therapeutic agents. Hybrid peptoids and small molecule-based molecular tools were developed in his laboratory, which are capable of clearing the toxic plaques through the natural cellular process. The research group is in the process of developing molecular probes detecting AD-biomarkers in cerebrospinal fluids, blood and brain tissue samples, to be used as viable tools for early diagnosis of AD. Another important area where work was undertaken extensively was the development of synthetic

technology to produce biomimetics of functional amyloids (e.g., silk) and their applications as biomaterials.

Dr. Jayanta Haldar

A recent press release from Washington Post reported that a bacteria has been isolated from a patient that is resistant to colistin (the drug of last resort against Gram-negative infections). The report sheds some light on the impending danger that is looming on world health. Efforts have been made by the research group to design various strategies to prevent and treat pathogenic infections, especially towards pathogens that have developed resistance to the already marketed drugs. One such strategy utilizes lipidated vancomycins and their sugar conjugates, which is the most active drug against vancomycin resistant Enterobacter sp. reported so far (categorized as a "*Hot paper*" in *Angewandte Chemie*, *GYTI-BIRAC award, 2015*). In another approach, dipicolyl moieties were introduced into the vancomycin backbone, which endowed the molecule with the ability to bind to pyrophosphate groups of cell-wall lipids while maintaining the inherent binding affinity for pentapeptide termini of cell-wall precursors (categorized as a "*Very important paper*" in *Angewandte Chemie, 2016*). Both of these were more active than the parent compound in animal models and are being taken forward for clinical development. The research group has also developed polymeric membrane active agents which were able to act against resistant Gram-negative bacteria both alone and in combination with other antibiotics (*GYTI-BIRAC award, 2016*). These molecules were also able to prevent bacterial endotoxin mediated sepsis. Further, the researchers of this Laboratory have validated the efficacy of several membrane active small molecules against clinical isolates of drug resistant pathogens and their biofilms in murine models of infections (*Highly cited paper* in *J. Med Chem, GYTI-BIRAC award, 2015*). Investigations were also carried out against the efficacy of these molecules against fungi and their biofilms. Catheters coated with organo-soluble antimicrobial polymers developed by the group, were found to prevent the formation of biofilms in sub-cutaneous models of infection in mice (*GYTI-BIRAC award, 2016*). An injectable hydrogel with superior antimicrobial properties has also been designed that could act as an adhesive or sealant. Some of the results from these studies have already published and others are in the process of submission.

Dr. Kanishka Biswas

With about 65% of utilized energy being lost as waste heat. Thermoelectric materials can directly and reversibly convert waste heat into electricity, and will play a significant role in the future energy management. Kanishka Biswas's research group has discovered several new classes of inorganic metal chalcogenides, which exhibit high thermoelectric performance owing to ultralow thermal conductivity (*Angew. Chem. Int. Ed., 2016, DOI: 10.1002/anie.201511737; Angew. Chem. Int. Ed., 2015, 54, 15241* and *Energy Environ. Sci., 2016, 9, 20122*). The research group has also investigated the intergrowth layered structures which are natural heterostructure which resembles van der Waals heterostructure. Two-dimensional few-layer nanosheet intergrowth $Pb_mBi_{2n}Te_{3n+m}$, by solution phase synthesis (*Angew. Chem. Int. Ed., 2015, 54, 5623*) have been synthesized. These few-layered materials exhibit a semiconducting band gap, with exotic electronic transport properties.

Dr. Ranjani Viswanatha

Dr. Ranjani Viswanatha worked extensively on doping transition metals into quantum dots and using them as nanosensors to probe the electronic structure of the host quantum dots. Spintronics is a new upcoming area of research for various applications. The most preferred material for these applications are semiconductors with a small percentage of magnetic dopants and are known as dilute magnetic semiconductors. However, these materials are extremely non-trivial to synthesize even in the bulk regime. In addition, uniformly doping magnetic impurities in semiconductor quantum dots has been the bottleneck for their implementation in devices even though they have been shown to have distinct advantages for applications compared to their undoped

counterparts. Diffusion of dopants or impurities in host nanocrystals out of the host has posed a serious threat to the efficient synthesis of doped nanocrystals. Uniform doping, specifically for magnetic impurities is crucial and is predicted to show room temperature ferromagnetism. The research group has worked on the synthesis of uniformly doped semiconductor nanocrystals with the constructive use of diffusion of dopants out of the nanocrystal with a wide range of dopants like Mn, Fe, Co, and Ni. Consecutively, some extremely important and promising magnetic, optical and magneto-optical responses compared to earlier materials have been studied.

Dr. Sebastian C. Peter

The broad research interests of the research group led by Dr. Sebastian C. Peter are focused on the synthesis and properties of novel solid-state inorganic materials such as intermetallics, chalcogenides, and polyoxometalates. In intermetallics, a special attention is given towards the compounds containing rare earths especially Ce, Eu and Yb because of the presence of an unstable electronic 4f-shell. Every new compound discovered displayed a novel situation in the physical properties such as magnetism, Kondo effect, heavy-Fermion, and superconductivity. In another project, the low cost nanomaterials in the form of alloys, intermetallics, bimetallics, core-shell etc. developed as the replacement for Pt and other expensive current state-of-the-art materials for the production of green energy in fuel cell and CO_2 reduction. The other area is the design of novel inorganic-organic hybrids based on polyoxometalates for their potential applications in energy and catalysis. The group also focused on the application of these materials as supercapacitors, topological insulator, catalysts of various important industrial chemical reactions, battery, thermoelectric and so on.

Dr. Subi Jacob George

The underlying theme of Dr. Subi George's research lies at the interface between synthetic efforts on π-conjugated systems and the organization of these molecules using supramolecular self-assembly principles, with the ultimate aim of developing novel functional materials. This group target the electronic, optical and self-assembling properties of the π-conjugated backbone for the design of materials. During the last year, the research group has made significant contributions in the field of supramolecular optoelectronics and on the fundamental understanding of supramolecular polymerization. This group has introduced a novel concept of chirality driven self-sorting for controlling the organization of donor and acceptor molecules. Also, the group has proposed a dipole-moment driven supramolecular polymerization which is an important step towards the realization of multi-block and mono-disperse supramolecular systems. In addition, from a technological point of view, Dr. George's group have initiated the synthesis of metal-free, room temperature triplet phosphors.

Dr. Sarit Agasti

In the field of bioimaging, it has been a challenging task to visualize biomolecules at nanoscopic resolution (~10-20 nm) as well as to track them while they function inside the cells. Over the last one year, Dr. Sarit Agasti's research group has worked towards developing new techniques along with generating compatible molecular probes so that the group can overcome the diffraction limit (~200-300 nm) of light microscopy and localize molecules inside cells in nanometer precession. In addition, an important feature has been integrated with this imaging technique, the ability to simultaneously image and quantitate 100s of target molecules from a single cell. The goal of the research group is to ultimately utilize these potentially transformative features, nanoscopic, quantitative and ultramultiplexed imaging, to address various biological questions. For example, going forward the researchers tried to understand the system level changes in synaptic protein compositions and their distribution during aging of neuronal system.

Prof. H. Ila

The research activities of Prof. H. Ila's research group revolve mainly around design and development of new general, highly efficient synthetic methods for biologically important five and six membered heterocyclic compounds using novel organosulphur building blocks/synthons derived from a broad range of active methylene compounds. The various methodologies involve design and development of new domino and multi component reactions, transition metal (especially palladium and copper) catalyzed C-C and C-N bond formation reactions, regio- and chemoselective C-C and C-heteroatom bond formations with various carbon and heteronucleophile on these synthons, heteroaromatic annulations with bifunctional heteronucleophiles and cycloadditions with activated isocyano methylene compounds on these substrates.

Recently, the research group has also initiated a new project on newer routes for benzoheterocycles involving transition metal catalyzed intramolecular C-H activation-C-heteroatom bond formation.

Dr. Sridhar Rajaram

A clear understanding was developed of the charge transfer dynamics in twisted perylene solar cells. The nature of phase segregation in blends of polymer and twisted perylene was studied using a ferroelectric matrix. Using these input the research group has further pushed the efficiencies of perylene containing cells. In the area of catalysis, Dr. Rajaram's group has shown that sodium cations can be used to control the conformation of organo–catalysts. The structure of the sodium bound urea catalyst using Raman spectroscopy has also been studied. Additionally, the mechanism of the cyanide free synthesis of α-amino esters was explored. Currently, the group is working on developing novel catalysts based on our mechanistic studies.

Departmental Activities

1. The Sixth Annual Chemistry Lecture was delivered by Prof. Santanu Bhattacharya, Indian Institute of Cultivation of Science (IACS), Kolkata, India on "Molecular Design of Cellular Transporters".
2. Dr. Sarit Agasti was appointed as Faculty Fellow jointly with the New Chemistry Unit and Chemistry and Physics of Materials Unit.

Following are the members of this Unit:

Linus Pauling Research Professor and Chair

C. N. R. Rao	Ph.D., D.Sc, F.A.Sc., F.N.A., F.R.S., F.T.W.A.S., Hon. F.R.S.C.

Associate Professors

T Govindaraju	Ph.D.
Subi Jacob George	Ph.D.
Jayanta Haldar	Ph.D.

Faculty Fellows

Sebastian C. Peter	Ph.D.
Kanishka Biswas	Ph.D.
Ranjani Viswanatha	Ph.D.
Sarit Agasti (Jointly with CPMU)	Ph.D.

Associate Faculty Members

Swapan K Pati (Professor)
A Sundaresan (Professor)
M Eswaramoorthy (Professor)

Tapas Kumar Maji (Associate Professor)
Sridhar Rajaram (Associate Professor)

Honorary Professor / Hindustan Lever Research Professor

H Ila

Research Students

G. Ramana Reddy, Divakara SS Murthy Uppu, S. Vijay Kumar, Chandradhish Ghosh, Shivaprasad Manchineella, Pallavi Bothra, Arjun Kumar Chittoory, S. Yugandar, Udumula Subba Rao, Pramoda K., Ankit Jain, Swastika Banerjee, Lingampalli Srinivasa Rao, G. Krishnamurthy Grandhi, Anand Acharya, Avijit Saha, Jiaul Hoque, Satya Narayan Guin, Manoj Kumar Jana, Soumyabrata Roy, Manjeet Chhetri, Shubhajit Das, Anand Kumar Roy, Subhajit Roychowdhury, Suman Kuila, Ramesh M S, Aritra Sarkar, Swagatam Barman, Sourav Samanta, Ranjan Sasmal, Manisha Samanta, Shreya Sarkar, Anusha Avadhani, Pradeep K R, Arkamita Bandyopadhyay, K. Rajasekhar, Mohini Mohan Konai, Krishnendu Jalani, Pallabi Haldar, Yelisetty Venkata Suseela, Ananya Mishra, Rajkumar Jana, Ananya Banik, Kushagra Gahlot, Saurav Chandra Sarma, Amit Bhattacharya, Paramita Sarkar, Mahima Makkar, Suchi Smita Biswas, Shikha Dhiman, Ekashmi Rathore, Madhulika Mazumder, Sreyan Ghosh, Satyajit Pal, Manswee Barua, Santu Sinha

Research Associates

Dr. Vijaykumar S Marakatti, Dr. Sandip Samaddar, Dr. I. Pakrudheen, Dr. Vijay Singh Parihar, Dr. Abhaya Dutta, Dr. M Pandeeswar, Dr. S Vijay Kumar, Dr. Udumula Subbarao, Dr. Saidulu Konda, Dr. Provas Pal, Dr. Chilakapati Madhu

DST Post-Doctoral Fellow

Dr. Pratap Vishnoi

SERB National Post-Doctoral Fellow (Jointly with CPMU)

Dr. Shafeekh Kulathinte Meethal

Project Investigator

Dr. Vibha Gautam

Senior Research Fellow

B. Saraiah

R&D Assistants

Pooja Bhagel, Sujoy Saha, Vardhaman Babagond, Vamseedhara Vemuri, Dundappa Mumbaraddi

Visiting Students

Giulia Belladelli, Beatrice Cogliati

Secretarial Assistant Trainee

Pavan K R

THEORETICAL SCIENCE UNIT (TSU)

Research Accomplishments

Members of the Materials Theory group of Prof. Umesh V Waghmare demonstrated (a) controlled confinment of electrons to 2-D in oxide based polar superlattices; (b) how electronic topology influences thermopower of thermoelectrics; (c) atomistic processes inside electrodes during charging and discharging of a battery. They also developed phonon eigenspectrum-based formulation of the atomistic Green'd function method for thermal transport across interfaces; and developed derivation of a model hamiltonian for Neel transition and associated magnetoelastic effect in multiferroic $YMnO_3$. They explained that the electron-hole asymmetry evident in phosphorene-based field effect transistors. It was discovered that high electrochemical activity of N-rich BCN in hydrogen evolution reaction. Structural nuances and associated properties of 2-dimensional transition metal chalcogenides was explored. The group also investigated how deformation mechanism of nano-scale hcp metals involves multi-scale hyper-elasticity. The origin of ultra-low thermal conductivity of InTe was discovered. The thermoelectric performance of a topological insulator was improved by chemical doping. The research group predicted that (a) 2-D form of NbN that has the potential for application in conversion of solar energy into electrical and chemical (Hydrogen) forms; (b) 2-dimensional half-metallic magnet based on vanadium porphyrin; (c) use of 2-D GaS for solar splitting of water; (d) a solid state electrolyte for room temperature operation of Na-batteries; and (e) effects of anion substitution on electronic properties of functional materials (ZnO, CdS).

Dr. N. S. Vidhyadhiraja's research group focused on three issues: quantum criticality, combined effect of disorder and interactions and phonon localisation due to disorder. A variety of model Hamiltonians like the Anderson-Hubbard model, a Kondo insulator-metal bilayer model, and a gapped Anderson impurity model were investigated. Dr. Nagamalleswararao Dasari, Ph.D. student of this group has successfully submitted and defended his thesis. Ms. Sudeshna Sen Ph.D. student has submitted her thesis.

Dr. Kavita Jain's research group studied an autocorrelation function in a class of non-equilibrium processes. Research work was initiated to understand the properties of eigenvalues in a class of random matrices. The group obtained an exact solution of a population genetics model with beneficial mutations.

The research group of Prof. Shobhana Narasimhan continued to use ab initio density functional theory to study nano systems computationally. Among several new results obtained in the past year, some major findings are: it was shown that doping graphene with boron nitride significantly increases the binding of methanol; a new way to make a topological insulator was found; it was shown that growing Fe films on an Ir substrate results in a magnetic and structural transition as the thickness of the film is increased; the tendency of different nano particles to sinter was compared when deposited on oxide substrates; the etching properties of different halogens on semiconductor surfaces were compared; and the properties of water on graphene oxide was studied. The research group has also studied host-guest systems on surfaces, and has shown that the host-guest interaction energy can induce the formation of a cavity that can accommodate the guest only in the presence of the guest.

Prof. Swapan Pati's research group: The anisotropic nature of the electron hole mobilities found experimentally for 3-layer phosphorene has been analyzed and microscopic reasons have been found using Boltzman transport equation. It was demonstrated that Borocarbonitride can act as an Anode for Superior Performance in Sodium-ion rechargeable Battery and Capacitor. Manganese Porphyrin systems were analysed and found that these systems can be made to be quite efficient spin-state switching devices, if conformational modification is introduced by a STM tip. Various line defects in Silicene have been shown to be stable and their effective applications for device fabrications were suggested. It was considered that the Bisphenol A, a plastic material found commonly in environment including in water, and have shown that it can be effectively extracted

onto 2D surfaces and also its structural motif can be modulated using light. The group studied optical lattice consisting of hardcore bosons in two coupled chains and have shown that the system show any exotic quantum phases. It was found that a spin Crossover Molecule, which when put between two electrodes can act as efficient thermoelectric Junction. The photophysical properties of a set of charge transfer pairs were analysed when it is encapsulated inside a macrocycle cage.

Dr. Subir Das and his research group worked on problems related to equilibrium and nonequilibrium statistical mechanics. In this broad area, they worked on topics like (1) application of molecular dynamics methods to quantify critical singularities in transport properties like mutual diffusivity, shear viscosity and bulk viscosity; (2) hydrodynamic mechanism in fluid phase separations with disconnected morphology. Behavior of two-time order-parameter correlation function during phase separation in solid binary mixtures was studied via Monte Carlo simulations and finite-size scaling analysis. Influence of self-propelling particles on the phase behavior of de-mixing systems were studied and obtained insight on how to map such non-equilibrium problems to equilibrium ones. The dynamics of ordering and persistence of spins were studied via Monte Carlo simulations of Ising model during paramagnetic to ferromagnetic phase transitions. Exotic structure formation and growth dynamics during vapor-solid phase transitions were understood.

Dr. Meher Prakash's research group was involved in interdisciplinary research collaborating with Chemists, Biochemists, and Biologists. Some of the research activities were for understanding the function and dynamics of proteins, and rational design of drugs specifically disrupting bacterial membranes.

Prof. Srikanth Sastry's research group researched on length scales relevant to slow relaxation, the relationship between structure and entropy in glass formers, analysis of thermodynamic and kinetic fragilities and the Stokes-Einstein relation in model glass formers, models of memory in glasses subjected to oscillatory deformation, approach to plasticity and yield in amorphous solids, analysis of shear jamming.

Following are the members of the Unit:

Chair

Umesh V. Waghmare	Ph.D., F.A.Sc., F.N.A.Sc.

Honorary Professor / SERB Distinguished Fellow

Kalyan B. Sinha	Ph.D. (Univ. of Rochester), F.A.Sc., F.N.A.Sc., FTWAS

Professors

Shobhana Narasimhan	Ph.D., F.N.A.Sc.
Srikanth Sastry	Ph.D.
Swapan K Pati	Ph.D., F.A.Sc., F.N.A.Sc.
Umesh V. Waghmare	Ph.D., F.A.Sc., F.N.A.Sc.

Associate Professors

Kavita Jain	Ph.D.
Subir Kumar Das	Ph.D.
N.S. Vidhyadhiraja	Ph.D.

Faculty Fellow

Meher K. Prakash	Ph.D.

Research students

Nagamalleswara Rao Dasari, Kaushlendra Kumar, Alok Kumar Dixit, Wasim Raja Mondal, Priyanka, Rukhsan Ul Haq, Sona John, Vasudevan M.V., Ananthu James, Jiarul Midya, Subhajit Paul, Anjali Singh, Saikat Chakraborty, Bradraj Pandey, Arpita Paul, Sukanya Ghosh, Debdipto Acharya, Rajdeep Banerjee, Pawan Kumar, Monoj Adhikari, Sruthi C.K., L. Jayathi, Meha Bhogra,

Sourav Mondal, Dheeraj Kumar, Malay Ranjan Biswal, Pallabi Das, Neha Bothra, Jyoti Dalal, Yagyik Goswami, Nalina V., Koyel Das

Project Investigator

Dr. Siamkhanthang Neihsial

Research Associates

Dr. Somesh K. Bhattacharya, Dr. Amrit Sarmah, Dr. Madhuri Mukhopadhyay, Dr. Swetarekha Ram, Dr. Sandhya Shenoy U., Dr. Sebastiano Bernini, Dr. Leishangthem Premkumar, Dr. Soumalya Joardar, Dr. Sandhya Rai

Research Associates (Provisional)

Saikat Debnath, Dr. Tanmoy Pal, Pallavi Bothra, Sudeshna Sen

R&D Assistants

Kaley Nisheal Michael, Ashvini Ray

Visiting Students

Bel Haj Salah Selim, Amreen Bano, Jorge Ontaneda

Secretarial Assistant Trainee

Anitha G.

THE INTERNATIONAL CENTRE FOR MATERIALS SCIENCE (ICMS)

The International Centre for Materials Science (ICMS) at the Centre, is devoted to carrying out high impact interdisciplinary research, promote collaborations, personnel exchange, organize discussions and meetings and promote education in advanced materials science. ICMS was dedicated to the nation by Prime Minister of India Dr. Manmohan Singh on December 03, 2008. The Centre is financially supported by the Department of Science and Technology (DST), Government of India and directed by Prof. C.N.R. Rao, F.R.S.

The ongoing research programmes are the chemistry of materials, surface physics, soft condensed matter and low-dimension materials and other aspects of materials science. The Centre now houses several sophisticated research facilities such as a molecular beam, epitaxy and another growth system, ultra high resolution TEM and state-of-the-art optical, electrical and magnetic characterization probes.

The International Centre had established several collaborations and had signed Memorandum of Understanding with leading international research institutions such as Weizmann Institute of Science, Israel, Scuola Internazionale Superiore di Studi Avanzati (SISSA), Italy, RMIT University, Australia, University of Waterloo, Canada, under which there were constant exchanges of students and researchers along with frequent technical meetings and workshops. ICMS is also a member of several International fora like Euro-Indo Forum on Energy (EICOON), World Materials Research Institutes Forum (WMRIF) and the Indo-US Science and Technology Forum (IUSSTF).

The research facilities housed in ICMS is to serve research both in-house researchers and from other institutions. Infrastructure of the International Centre was expanded further with facilities like Atomic Layer Deposition, Physical Property Measurement System (PPMS), Nanofabrication lab, Analytical Facility, Sonicators, Bridgman Furnace, Powder XRD System, Maskless Lithography System, FESEM, Reactive-ion etching (RIE), Physical vapor deposition (PVD), Superconducting Quantum Interference Device (SQUID), Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES), UV Spectrometer, Photoluminescence Spectrometer (PL), etc. The "Thematic Unit of Excellence on Computational Materials Science" is being set up in the new CCMS building as an extension of the Centre for Computational Materials Science (CCMS) of ICMS.

ICMS has supported Ph.D. and M.S. degree programmes, short-term visits of students and scientists and offered Post-graduate Diploma in Materials Science (PGDMS). Senior and Junior Fellowships were offered under RAK-CAM Programme and also Short-term Visiting programmes. The students admitted by JNCASR under Ph.D. and M.S. programmes were facilitated to use the state-of-the-art research facilities, were supported to attend national/international conferences, meetings and visits to other universities under various collaborative and exchange programmes. Six students graduated during the two semesters (one year) Post Graduate Diploma in Materials Science programme. Three students are currently enrolled in this programme.

The following is the list of special annual seminars series

The Annual Materials Lecture initiated in 2011, is an annual lecture series delivered by eminent scientists from all over India. The Fifth Annual Materials Lecture was delivered by Prof. A. K. Sood, F.R.S., Indian Institute of Science, Bangalore on June 12, 2015.

The International Materials Lecture is another annual lecture series by eminent scientists from all over the world. This series has also been well appreciated and successful. The Eighth International Materials Lecture was delivered by Prof. Prof. Anthony K. Cheetham, FRS, the University of Cambridge on December 3, 2015.

The Sheikh Saqr Materials Lecture series: The fifth lecture of this series was delivered by Prof. Andrew I. Cooper, F.R.S., the University of Liverpool on December 7, 2015.

ICMS also organized seminars, schools, workshops and conferences in collaboration with colleagues in JNCASR and elsewhere. ICMS has also sponsored various schools and workshops conducted by other organizations.

1. International Workshop on Advanced Materials (IWAM 2016)
   Organized jointly with Ras-Al Khaimah Centre for Advanced Materials
   Venue: Ras-Al Khaimah
   Dates: February 21-23, 2016

2. Winter School on Frontiers in Material Science
   Supported by SSL and University of Cambridge
   Venue: JNCASR, Bangalore
   Dates: December 7-11, 2015

3. JNCASR-Temple University Joint Symposium on "Chemistry and Physics of Advanced Materials"
   Venue: JNCASR, Bangalore
   Dates: December 3, 2015

4. Research Conference on Chemical Frontiers, CF-2015
   Organized jointly with IIT-Mumbai
   Venue: Hotel Majorda, Goa
   Dates: August 15-18, 2015

5. Frontiers in Advanced Materials, FAM-2015
   Organized jointly with IISc
   Venue: IISc, Bangalore
   Dates: June 15-18, 2015

6. International Workshop on Advanced Materials (IWAM 2015)
   Organized jointly with Ras-Al Khaimah Centre for Advanced Materials
   Venue: Ras-Al Khaimah
   Dates: February 22-24, 2015

7. A School on Materials and Processes for Applications in Energy and Environment
   Organized jointly by University College London and KIST
   Venue: JNCASR, Bangalore
   Dates: January 15-18, 2015

Sheikh Saqr Laboratory

The International Centre for Materials Science had established a close collaboration with the Ras Al Khaima Centre for Advanced Scientific Research (RAK-CAM) in 2007. The ties were further strengthened by the signing of a Memorandum of Understanding in December 2011, to establish the Sheikh Saqr Laboratory at the ICMS of JNCASR, Bangalore. The Sheikh Saqr Laboratory in the New CCMS building was inaugurated by His Highness Sheikh Saud Bin Saqr Al Qasimi in 2013.

SSL infrastructure and research facility have grown steadily since 2013. The SSL and ICMS research facilities have jointly fulfilled the objectives as the country's leading research-initative. The New CCMS building and the SSL laboratories won the NDTV - Design and Architecture Award under the Institutional Architecture Design of the Year for Education-2014.

The Sheikh Saqr Laboratory is headed by Prof. C. N. R. Rao, Director, ICMS. Professor Anthony K. Cheetham, Chairman of RAK-CAM's Scientific Advisory Board, will hold the title Sheikh Saqr Distinguished Visiting Professor and the Faculty of ICMS and others working in materials science at JNCASR are associated with SSL. This grant also supports Research Associates, Technical Assistants and R&D Assistants.

Fellowships awarded to faculty and students:

- Prof. Srikant Sastry and Prof. Chandrabhas Narayana were awarded Sheikh Saqr RAK CAM Senior Fellowships
- Dr. Rajesh Ganapathy and Dr. Ranjani Viswanatha were awarded Sheik Saqr Career Award Fellowships
- Sheikh Saqr Student Fellowships were given to Mr. K. Gopalakrishnan, Mr. S. R. Lingampalli, Ms. Sunita Dey, and Mr. Uttam Gupta.

Research Progress

Prof. C.N.R. Rao has initiated two major programmes on energy research: one related to artificial photosynthesis involving photocatalytic oxidation of water by nanoparticles of Mn and Co oxides and the other on photocatalytic H_2 generation by hybrid nanostructures by using the Z-scheme, Synthesis, characterization and properties of anions substituted metal oxides where in oxygen is replaced by nitrogen and fluorine were investigated.

Prof. S.M. Shivaprasad continued to pursue the interesting observations made in the growth of Gallium and Indium Nitrides nanostructures. The research findings have shown the mechanism of bond formation in the gallium nanowall network. By uniformly adsorbing Ag nanoparticles on these self-organized nanowalls with a large surface area this morphology was used as a substrate for Surface Enhanced Raman Spectroscopy for bio-molecular detection with very high sensitivity and low detection limits. The unprecedentedly high mobility of electrons in the nanowall configuration is observed to be originating from a 2D electron gas formation at the wedge shaped tips of the nanowalls as determined by magnetoresistance and FET measurements. Calculations were performed to see the morphological origin of the 2DEG that shows this unprecedented mobility. Ultra-high resolution TEM studies have shown the defect free nature of the tops of the nanowalls and the inter-wall mis-orientation that has led to the mosaicity of the network. The research group was successful in spontaneously forming InGaN nanorods on Si(111) surface with varying band-gaps and chemical phase separations and have related them to the band-edge emission of these thin films.

Dr. Sridhar Rajaram developed a clear understanding of the charge transfer dynamics in twisted perylene solar cells. The nature of phase segregation in blends of polymer and twisted perylene was studied using a ferroelectric matrix. Using these input the efficiencies of perylene containing cells were further pushed. In the area of catalysis, research findings have shown that sodium cations can be used to control the conformation of organo –catalysts. The structure of the sodium bound urea catalyst was studied using Raman spectroscopy. Additionally, the mechanism of the cyanide free synthesis of α-amino esters was studied. Currently, work is in progress on developing novel catalysts based on mechanistic studies.

Dr. Ranjani Viswanatha has worked on doping of magnetic ions into CdS nanocrystals. Spintronics is a new upcoming area of research taken up by Dr. Viswanatha which has various applications. The most preferred material for these applications are semiconductors with a small percentage of magnetic dopants and are known as dilute magnetic semiconductors. However, these materials are extremely non-trivial to synthesize even in the bulk regime. In addition, uniformly doping magnetic impurities in semiconductor quantum dots has been the bottleneck for their implementation in devices even though they have been shown to have distinct advantages for applications compared to their undoped counterparts. Diffusion of dopants or impurities in host nanocrystals out of the host has posed a serious threat to the efficient synthesis of doped nanocrystals. Uniform doping, specifically for magnetic impurities is crucial and is predicted to show room temperature ferromagnetism. The research was undertaken toward the synthesis of uniformly doped semiconductor nanocrystals with the constructive use of diffusion of dopants out of the nanocrystal with a wide range of dopants like Mn, Fe, Co, and Ni. Some of the extremely important and promising magnetic, optical and magneto-optical responses were compared to earlier materials in her further research.

Dr. Rajesh Ganapathy's Soft Matter group primarily focused on elucidating the various aspects of the glass transition phenomena. In a work that appeared in Phys. Rev. Lett, it was reported that the breakdown of the Stokes-Einstein relation in colloidal glasses coincides with the change in shape of cooperatively rearranging regions. In a study that appeared in Nature Physics, the first experiments reported shown conclusively of a growing static length scale on approaching the colloidal glass transition. This study also allowed the research group to discern between competing mechanisms of glass formation.

Research in this group is currently focusing on controlling colloidal self-assembly using templated surfaces. Building on their previous results the group also looked into various aspects of the glass transition phenomenology. Experiments were initiated in the direction that address memory effects in amorphous solids subjected to oscillatory shear.

Following are the members of ICMS:

Director

C.N.R. Rao	F.R.S., Hon. F.R.S.C., Hon. F. Inst. P.,

Professor

S. M. Shivaprasad (jointly with CPMU)	Ph.D.

Associate Professors

Ranjan Datta	Ph.D.
Rajesh Ganapathy	Ph.D.
Sridhar Rajaram	Ph.D.

Faculty Fellow

Ranjani Viswanatha	Ph.D.

Honorary Faculty

A. K. Sood, IISc.	F. A. Sc., F. N. A., F. T. W. A. S.
U. Ramamurty, IISc	Ph.D. (Brown Univ.),

Sr. Research Officer

Jay Ghatak

ICMS Incharge Co-ordinator

Aruna V. Mahendarkar

Research Associates

Dr. A Muthuvinayagam, Dr. Loukya Chowdary, Dr. Magesh G.

Research Associate (Provisional)

K. Manjunath

Technical Assistant (Inst)

Mahesh J.I.

Diploma Students (PGDMS)

Danish Shamoon, Rajesh S., Vidyanshu Mishra

R&D Assistants

Sachin B M, Gururaj Hosamani

Junior Lab Assistant

Mune Gowda H.

Visiting Scientists

Dr. Ritu Kataky, Dr. Kurshed A. Shah

Visiting Student

Manjodh Kaur

Technical Assistants

Shivakumar K. M., Prajwal D. J.

Technical Assistant Trainee

Jagadish T.

THEMATIC UNIT OF EXCELLENCE ON COMPUTATIONAL MATERIALS SCIENCE (TUE-CMS)

Research Activities

Much progress has been achieved in the modelling of gas adsorption in porous solids. These have been studied using a variety of electronic structure and classical methods. Similarly considerable progress has been made in modelling supramolecular assemblies in non-polar solvents. Coarse grain models have been developed. The effect of electric field on the nature of the helical handedness has been investigated using atomistic MD simulations.

The conditions under which small metal nanoclusters oxidize or get reduced has been studied. A new way of making topological insulators was found. The properties of water on graphene oxide have studied. Host-guest interactions was shown that can cause cavities to be formed in the host only in the presence of the guest.

Simulations and analysis of fragility in glass forming liquids and the role of the temperature (or density) variation of configurational entropy and the high temperature activation energy model potentials have been carried out extensively. A new demonstration of the relationship between the breakdown of the Stokes Einstein relation and a growing dynamical length in liquids. An interplay of structure and friction in jamming is proposed and studied. Yielding transition is found to be closely related to a sharp transition occurring between the non-diffusive and diffusive states under oscillatory deformation. Memory effects in glasses have been investigated.

A superconducting ring with putting electric field flux was studied and found that beyond a certain flux, the superconducting state breaks down and the system becomes a normal metal.

The catalytic processes was investigated by which HCOOH can be changed to water and carbon dioxide.

The microscopic origin of transport anisotropy in black phosphorene systems was studied.

Calculations on various donor acceptor macro cycles was carried out, which can do sequence specific tripeptide recognitions.

A detailed mechanism of catalytic hydrogenation of Carbonyl compounds using Frustrated Lewis Pair was derived.

Explanations were presented on (a) the electron-hole asymmetry evident in phosphorene-based field effect transistors, (b) high electrochemical activity of N-rich BCN in hydrogen evolution reaction, (c) structural nuances and associated properties of 2-dimensional transition metal chalcogenides and (d) how deformation mechanism of nano-scale hcp metals involves multi-scale hyper-elasticity.

Prediction were made of (a) 2-D form of NbN that has the potential for application in conversion of solar energy into electrical and chemical (Hydrogen) forms, (b) 2-dimensional half-metallic magnet based on vanadium porphyrin, and (c) use of 2-D GaS for solar splitting of water.

Using Myoglobin as a prototypical system for protein-solvent interactions, studies were undertaken to know how the solvent influences the protein. Research observations were: water drives the collapse of myoglobin, and the functional contacts which affect the release of CO from myoglobin.

Meetings

- Discussion meeting on water and aqueous solutions. Organizer: Prof. Srikanth Sastry. January 9-10, 2015.

- School on 'Materials and Processes for Applications in Energy and Environment'. Organizers: **Prof. Umesh V. Waghmare along with** Prof. Richard Catlow (UC, London) and Prof. S-C Lee (IKST). January 15-17, 2015.

Seminars/Workshops

1) Seminar titled "The Role of Frustration in Electron Transfer Reactions Confined within Layered Manganese Dioxides" by Dr. Richard Charles Remsing on April 6, 2016. He is a visitor to TUE-CMS. During his stay at JNC he has planned to work with research groups in TUE-CMS, deliver lectures and conduct hands-on tutorials.

2) Discussion meeting on glass formers and glasses, April 29-30, 2016, organized by Prof. Srikanth Sastry.

Equipment and Lab facility

A new 110 TFlops cluster, named 'Mallige' was installed on May 2015, it has been listed at the 11th position, in the top Super computers in India List December 2015. In addition to this new cluster, users of TUE-CMS are running jobs on the following three older clusters:

- 4 Tera Flops (7 years old) High Performance Cluster (HPC) named "Sampige"
- 6.5 Tera Flops (4 years old) HPC named 'Booruga'.
- 10.6 Tera Flops (1.5 years old) HPC named 'Taavare' procured and set up under the current TUE-CMS project.

TUE-CMS Visitors Programme

1. Ms. Atreyee Banerjee, Ph. D. Student, NCL, Pune, Visiting Student, with Prof. Sastry, from March 26, 2015 to April 10, 2015. Area of research interest: Dynamics of supercooled liquids.
2. Dr. Madhavendra Tripathi, Guru Ghasidas Vishwavidyalaya, Bilaspur, Visiting Scientist with Prof. Waghmare, June 4 – 26, 2015. Area of research interest: Computational Materials Science.
3. Dr. Maben Rabi, Indian Institute of Technology Mandi, Visiting Scientist with Prof. Waghmare, December 14 - 24, 2015. Area of research interest: Control theory, Geometric phases.
4. Ms. Sinthika Selvaraj, Junior Research Fellow, SRM Research Institute, SRM University, Chennai, February 7 – 16, 2016, Area of research interest: Simulations of Catalyst Materials.
5. Dr. Henu Sharma, University of Liege (Belgium), Visiting Scientist with Prof. Umesh V. Waghmare, March 1- May 31, 2016. Area of research interest: First-principles calculations, Biophysics, Material science, Oxides.
6. Dr. Richard Charles Remsing, Institute for Computational Molecular Science, Temple University, Philadelphia, USA. He received the APS-IUSSTF Travel Fellowship to spend a month in India. He is visiting JNCASR (primarily), IMSc-Chennai & IIT-D. Stays at JNCASR during March 31 – April 10 and April 14 – April 30, 2016.

Following are the members of TUE-CMS:

Coordinator

Prof. Balasubramanian Sundaram FASc

Members

Prof Shobhana Narasimhan	FNASc
Prof Srikanth Sastry	FNASc, FASc
Prof Swapan Pati	FNASc, FASc
Prof Umesh Waghmare	FNASc, FASc FNA
Dr Meher K Prakash	

Associate Members

Prof. Amalendu Chandra, IIT Kanpur
Prof. Sanjoy Bandyopadhyay, IIT Kharagpur
Prof. Prabal K. Maiti IISc, Bangalore
Prof. S. Yashonath IISc, Bangalore
Prof. Tanusri Saha-Dasgupta, S.N. Bose National Centre for Basic Sciences, Kolkata
Prof. Lavanya M. Ramaniah, Bhabha Atomic Research Centre, Mumbai
Prof. P.B. Sunil Kumar, IIT Madras, Chennai
Prof. K.P.N. Murthy, Indira Gandhi Centre for Atomic Research, Kalpakkam
Prof. Surajit Sengupta, S.N. Bose National Centre for Basic Sciences, Kolkata
Prof. Gautam Menon, Institute of Mathematical Sciences, Chennai
Prof. B. Jayaram, IIT Delhi
Prof. Rajendra Prasad, IIT Kanpur
Prof. Dilip G. Kanhere, University of Pune
Prof. G.P. Das, Indian Association for the Cultivation of Science, Kolkata
Prof. Ganapathy Ayappa, IISc, Bangalore
Prof. T.A. Abinandanan, IISc, Bangalore
Prof. Indra Dasgupta, Indian Association for the Cultivation of Science, Kolkata
Prof. Dilip Angom, Physics Research Laboratory, Ahmedabad
Prof. Satyavani Vemparala, Institute of Mathematical Sciences, Chennai
Prof. Indira Ghosh, University of Pune

Visiting Scientists

Dr. Rick C Remsing, Dr. Maben Rabi, Dr. Henu Sharma

Visiting Student

Sinthika Selvaraj

Programme Assistant

Venkatesh K.

Staff

Basavaraj T., Vijay Amirtharaj A., Ananda Raman A.

THEMATIC UNIT OF EXCELLENCE IN NANOCHEMISTRY (TUE-NANO)

Research Progress

New synthetic strategies for nanomaterials and investigating properties leading to applications are the two important aspects, currently pursued in the Unit. The synthesized nanomaterials include size and shape controlled metal and semiconductor nanocrystals, functionalized carbon nanotubes, graphene, and its derivatives as well as 2D analogues, metal and semiconductor nanowires, nanocomposites, semiconductor wall-like structures, organic as well as biomaterials.

Various wet chemical routes were employed for the synthesis of pristine and doped semiconductor Nanocrystals. Their size-dependent electronic and optical behavior were investigated in detail. Nanoparticles of several oxides, chalcogenides, nitrides and carbides have also been synthesized. Porous nanomaterials and metal/metal oxide nanoparticles have been synthesized which are being used in catalytic reactions such as NO_x removal, methane conversion and selective oxidation of hydrocarbons. A new class of porous metal-organic framework solids is being examined for their potential applications in gas storage, separation, and catalysis; they also possess interesting optical and magnetic properties. Other unique materials being investigated were graphene and functionalised graphene. Inorganic graphene analogues such as metal sulfides and BCN have also been synthesized and well characterized. Properties of some of these materials were investigated in devices, such as supercapacitor, field emitter, and radiation detectors. Various photocatalytic nanocomposites have been made and demonstrated to have high activity in water splitting.

Surface physics at sub-monolayer coverage and molecular beam epitaxy of thicker films have been combined to produce epitaxial 2D films and nanostructures of III-nitrides. The formed nanostructures were well characterized using sophisticated characterization tools such as RHEED, Ellipsometry, XPS, LEED, Photoluminescence, High Resolution XRD, etc. A highlight of this study was GaN based nanowall network structure, which exhibited photoluminescence confined to voids between the walls. Many careful measurements were carried out including cathode-luminescence and high resolution electron microscopy. Solution processable organic semiconductors provide a cost effective alternative mainly due to the reduction in processing costs. In order to realize the promise of low cost electronics, the performance of organic materials in electronic devices has to be improved. In this direction, the morphology of the materials was controlled using synthetic and processing strategies. For example, such optimization has provided a pathway for producing perylene based solar cells with good efficiencies. In addition, there have been activities related to nanomaterials for intracellular drug delivery suporamolecular nanofibres and soft materials.

Transparent conductors are ubiquitous among optoelectronic devices. As alternate to ITO, new generation transparent conductor in the form of highly interconnected metal (Au, Ag, Cu etc.) wire networks was developed, invisible to the naked eye, on common substrates such as glass. Unlike the conventional method of dropping nanowires on a substrate, these conducting electrodes (TCEs) are produced employing a newly developed recipe termed as "crackle lithography". The TCEs thus formed exhibit optoelectronic properties that are superior in many ways, to those of conventional ITO films and other alternate materials. The performance characteristics of the TCEs as well as of devices- solar cells and touchscreens, electrochromic devices fabricated using the TCEs, have been measured. Many non-optoelectronic devices related to transparent electronics such as transparent capacitors, transparent heaters, and strain sensors have also been fabricated.

Following are the members of TUE-Nanochemistry:

Faculty

Prof. C.N.R. Rao
Prof. G.U. Kulkarni
Prof. A. Sundaresan
Prof. K.S. Narayan
Prof. S.M. Shivaprasad
Prof. M. Eswaramoorthy
Dr. Rajesh Ganapathy
Dr. Subi Jacob George
Dr. T. Govindaraju
Dr. Jayanta Haldar
Dr. Tapas Kumar Maji
Dr. Sridhar Rajaram
Dr. Ranjan Datta
Dr. Ranjani Viswanatha
Dr. Sebastian C. Peter

Technical Assistants

N. R. Selvi, Govindan Kutty

CSIR CENTRE OF EXCELLENCE IN CHEMISTRY (CSIR-COE)

In January 1991, the CSIR established this person-based Centre of Excellence in Chemistry. The Centre works on various aspects of solid state and materials chemistry. The main activities of this CSIR-Centre deal with the following aspects:

Graphene is one of the main areas of research in this laboratory. Synthesis of two to four-layer graphene was carried out by arc-discharge of graphite in a hydrogen atmosphere as well as with other conditions. Besides providing clean graphene surfaces, this method allows for doping with boron and nitrogen.

Inorganic analogues of graphene constitute an important area of research. Various chemical methods have been developed for the synthesis of layered transition metal dichalcogendes which includes MoS_2, WS_2, $MoSe_2$, WSe_2, NbS_2 and $NbSe_2$. Their applications in IR detectors, gas sensors, composites with polymers for mechanical properties and electrical properties, magnetic properties, and hydro-desulphurization (HDS) catalysis have been studied. Micromechanical cleavage method has been used for obtaining the single-layers of MoS_2, GaS and GaSe and studied their applications in transistors, detectors and sensors. Fictionalization of MoS_2 nanosheets and MoS_2 covalently bonded to nanosheets of other materials are being pursued.

High Surface area borocarboniitrides were synthesized from low cost starting materials like urea, boric acid and activated charcoal. Graphene-like BxCyNz samples exhibit surface area in the range 1500-1900 m2/g, with large uptakes values of CO_2 and shows good performance characteristics as supercapacitor electrodes and as ORR catalysts. Several other aspects of borocarbonitrides are being examined.

Photocatalytic water splitting using powder catalyst dispersed in water by simply shining light is one of the most energy effective and easiest ways to obtain H_2 and O_2. Spinel based photocatalysts have been used which contained ''Mn4O4 cubane" like structure similar to that found in chlorophyll for oxidation water. It was found that nanoparticles of Co, oxides like the spinel $Li_2Co_2O_4$ and the perovskite $LaCoO_3$ shows oxygen evolution in solution containing Ru(bpy)32+. Amongst the manganese oxides studies, Mn2O3 with the bixbyite structure and $LaMnO_3$ with the perovskite structure containing Mn3+(t2g3 eg1) ions show high catalytic activity. Generation of hydrogen by using semiconductor heterostructures and dyes is being investigated. Thermochemical decomposition of H_2O by perovskite oxide is another area of active exploration.

Aliovalent anion substitution in metal oxides and sulfides causes major changes in electronic properties and structure. Several oxides including ZnO and TiO_2 substituted by N and F have been investigated. P, Cl substituted CdS and ZnS are being examined. Analogues of ZnO and Cds such as Zn_2NF and $Cd_4P_2Cl_3$ are been investigated.

Following are the members of this Centre:

Linus Pauling Research Professor and Chair

C N R Rao, *FRS, FASc, FNA, FTWAS, Hon FRSC, Hon F Inst P*

Glass Blower (Temporary)

Nandha Kishore

Office Staff

Victor Sathish D.G. (Lab Helper)

COMPUTER LABORATORY (CompLab)

Network upgradation: The existing network in JNCASR campus is upgraded to high speed Gigabit switches along with optical fiber cables which give high speed Local Area Network (LAN) i.e., up to 10 Gbps Intranet connectivity. Internet bandwidth is increased from 300 Mbps to 330 Mbps with a combination of service providers, i.e., 100 Mbps from National Knowledge Network (NKN), 170 Mbps from Aircel and 80 Mbps of Radio Frequency with enhanced Internet bandwidth, each network user is given 2.5 Mbps Internet connectivity throughout the campus.

Central Storage facility: A new storage device was added with 10 TB of storage capacity and Veeam de-duplication software was installed to meet additional storage requirement.

Webmail migration: The network edition of commercial ZIMBRA mail server was migrated to the open source version of the same.

Secured and Enhanced Wi-Fi: The high speed wireless network was installed with 802.11 b/g/n/ac on the Campus. Along with this, 70 instant wireless access points were made available across the campus to provide wide-spread network accessibility. Each access point is made capable of giving 350 Mbps to 500 Mbps network connectivity with 802.11 b/g/n/ac. Campus Wi-Fi is also configured with high-end security modules. Wi-Fi users and visitors are authenticated via the centralized LDAP and CPPM Server.

Enhanced Network Management system: The network management system was set up to ensure security and redundancy of servers and other interconnecting devices like core switch, firewall etc. All critical network components were placed on active-active redundancy mode. This will enhance the network performance and will provide continuous network connectivity on the campus.

Following are the members of CompLab:

Head, CompLab

Dr. Santosh Ansumali, Ph D

Consultant

Avinash, Udhya Kumar

Trainee

Atul Kumar

Onsite Engineers

Vikas Mohan Bajpai, Rajeev Ranjan, Sudheer Kumar

LIBRARY

The Library has a collection of over 9117 books and access to over 5000 scientific journals. Journal articles were procured on request under document delivery service from CSIR and DST Institutions across the country and also from other neighbouring libraries within the city. It is equipped with network scanners and copiers, Wi-Fi and Desktop PCs for browsing online journals and library catalogue.

Overview of Collection

Books	
Books procured during 2015-16	91
Total books in collection	9,117
Journals	
Online journals subscribed	166
Print journals subscribed	6
Total Journals subscribed (Online + Print)	172
Abstracting and Indexing database (Web of Science) – from National Knowledge Resource Consortium (NKRC)	Web of Science, SciFinder
Total online journals in collection (subscription + consortium resources)	5000+

Books Acquisition

In the financial year 2015-16, 91 books worth Rs. 3,42,770.00 were procured based on the recommendations of faculty members.

Journal Subscription and Consortium Resources

Total amount spent for the renewal of print and online journals for the year 2015-16 is Rs. 66,56,938.00.

Document Delivery Service (DDS)

Journal articles on request from faculty and students were procured from libraries across the country and abroad under Document Delivery Service. Total 173 article requests were fulfilled through inter-library cooperation.

Following are the library staff members:

Sr Library-cum-Information Officer
Nabonita Guha

Sr Library cum Information Assistants (Gr.I)
Nandakumari E., Nagesh Hadimani

Library cum Information Assistant
Senthil Kumar N.

Library Trainee
Poornima Hosamani

Helper
Rajeeva J.

ENDOWED RESEARCH PROFESSORS

Linus Pauling Research Professor

Prof. C.N.R. Rao — F R S, D Sc, F A Sc, F N A, F R S, F T W A S, Hon F R S C
Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore
(Term: Life time)

D S Kothari Chair

Prof. M.M. Sharma — F R S, F A Sc, F N A
Emeritus Professor of Eminence, Mumbai University, Mumbai
(Term: 30/11/2014 to 30/11/2017)

Hindustan Lever Research Professor

Prof. H. Ila
Honorary Professor, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore
(Term: 01/01/2015 to 31/12/2016)

ACADEMIC PROGRAMMES

ACADEMIC ACTIVITIES

At JNCASR, research is carried out in seven Units: Chemistry and Physics of Materials Unit (CPMU), Evolutionary and Organismal Biology Unit (EOBU), Engineering Mechanics Unit (EMU), Molecular Biology and Genetics Unit (MBGU), New Chemistry Unit (NCU), Neuroscience Unit (NSU) and Theoretical Sciences Unit (TSU). The research undertaken is inter-disciplinary in nature.

The Centre offers Ph. D., Integrated Ph. D., M.S. (Research) and M.S. Engg. degree programmes in Science and Engineering. Students are admitted to the Units mentioned above. The minimum academic qualification required to apply for the M.S./Ph.D. programmes of the Centre is M.Sc./B.E./B.Tech./M.E./M.Tech./MBBS degree/s. Candidates applying for M.S./Ph.D. programmes should have at least 50% in their highest University examination, and should also have qualified in GATE/UGC-CSIR-JRF/ICMR-JRF/DBT-JRF/JEST/equivalent examinations. Candidates applying for Integrated Ph.D. Programme of the Centre should have at least 55% marks in their Bachelor's degree in any area of Science or Statistics.

The Centre selects candidates on the basis of their academic record, performance in GATE/UGC-CSIR-JRF/ ICMR-JRF/DBT-JRF/JEST/equivalent examination(s), recommendations from referees and performance in the interview. The selected candidates are offered course work, provided with research facilities for research and on successful completion offered with the degree.

(a) Research Admissions

During the August admissions of 2015-16, 63 students joined, and during the mid-year admissions of January 2015-16, 8 students joined JNCASR under different degree programmes. The current student strength at JNCASR is 305. The advertisement for the regular admission to the Integrated Ph.D., Ph.D. and M.S. programmes 2016-17 session was released in all the prominent national and regional newspapers and announced on our web site.

(b) Degrees Awarded

The Centre is a Deemed University, and awards Ph.D. and M.S. degrees. Following are the students were awarded degrees under various degree programmes during April 2015- March 2016:

Ph.D. Degree

Sl. No.	Name of the research scholar	Sl. No.	Name of the research scholar
1.	Priya M P	2.	Laxmi Shankar Rai
3.	Satish Shetty	4.	Sourav Roy
5.	Garima Verma	6.	Senapati Parijat Ramesh
7.	Satyaprasad Premswarup Senanayak	8.	Sanjeev Kumar
9.	Khadilkar Rohan Jayant	10.	Anjali Verma
11.	B V V S Pawan Kumar	12.	Akhade Vijay Suresh
13.	Nikhil Gupta	14.	Piyush Kumar Chaturbedy
15.	Kirthana M V	16.	Ravichandran S

Sl. No.	Name of the research scholar	Sl. No.	Name of the research scholar
17.	Rajdeep Singh Payal	18.	Gayatri Kumari
19.	Malleswara Rao Tangi	20.	Shiwani Singh
21.	K D Mallikarjuna Rao	22.	Bhawani N
23.	Ulman Kanchan Ajit	24.	Sarada S
25.	Ritesh Haldar	26.	P K Raju Pedabaliyarasimhuni
27.	Sananda Biswas	28.	Saikishan Suryanarayanan
29.	Gautam Chatterjee		

M.S.(Engg.) Degree

Sl. No.	Name of the research scholar
1	Kanwar Nain Singh
2	Vicky Kumar Verma
3	Anand Kumar Roy

Master of Science degrees in Integrated Ph.D. Programme

Master of Science (M.S.) in Materials Science		Master of Science (M.S.) in Biological Science	Master of Science (M.S.) in Chemical Science
Sl. No.	Name of the research scholar	Name of the research scholar	Name of the research scholar
1	Shantanu Aggarwal	Abhilash Lakshman	Ananya Banik
2	Shivakumar D T	Manan Gupta	Ananya Mishra
3	Sohini Bhattacharyya	Payel Ganguly	Kushagra Gahlot
4	Vikas Garg	Meenakshi P	Promit Ray
5		Saloni Sinha	Rajkumar Jana
6		Somya Bats	
7		Debanjan Mukherjee	
8		Arpita A Suryavanshi	

Postgraduate Diploma in Materials Science		Postgraduate Diploma in Science Education
Sl. No.	Name	Name
1	Harish Kumar Singh	Rashmi Vinayak Savant
2	Anjali Devi Das	
3	Shashwat Anand	

(c) Student Awards

- Dr. B.V.V.S Pavan Kumar was the recipient of the Best thesis award under Physical Sciences category for the year 2014-15.
- Dr. Khadilkar Rohan Jayant was the recipient of the Best thesis award under Biological Sciences category for the year 2014-15.
- Dr. Saikishan Suryanarayanan received the Roddam Family Award for the Best Ph D thesis in Engineering Mechanics
- Mr. Kanwar Nain Singh received the Roddam Family Award for the Best M.S. (Engg.) thesis in Engineering Mechanics.

(d) Short-term Academic Programmes

The following students have joined the Centre's Postgraduate Diploma programme in Materials Science (PGDMS):

Danish Shamoon – under Prof S M Shivaprasad
Rajesh S – under Prof. C N R Rao and Dr Kanishka Biswas
Vidyanshu Mishra – under Dr Sebastian C Peter

The students are presently undergoing course work and will be completing their course requirements by July 2016. On successful completion of their course requirements, they will be awarded a Postgraduate Diploma of the Centre.

The advertisement for the Postgraduate Diploma in Materials Science and Postgraduate Diploma in Science Education will be released during May 2016.

DISCUSSION MEETINGS

1. 19th DST Programme Advisory Committee (PAC) Meeting, May 20, 2015.
2. Frontiers in Materials Science, JNCASR & SSCU (IISC), June 15-18, 2015.
3. Chemical Frontiers 2015, co-ordinated by Prof R Murugavel, IIT-Bombay, August 15-18, 2015.
4. Programme on Mathematical Biology, co-ordinated by Dr Kavita Jain, September 7-11, 2015.
5. Indian Peptide Society Symposium (IPS-2015), co-ordinated by Dr T Govindaraju, September 24-25, 2015.
6. Chemistry of Materials, co-ordinated by Prof. Subi J George, October 2-4, 2015.
7. JNCASR-FCBS Workshop for Chemistry Students and Teachers, co-ordinated by Prof M V George, NIIST, Trivandrum, October 15-17, 2015.
8. MCB75: From Molecules to Organisms, co-ordinated by Prof Umesh Varshney, IISc, December 11-14, 2015.
9. Emergent Phenomena in Soft and Active Matter: Variations on the Coffee Ring Effect: Shape Dependent Capillary Interactions, co-ordinated by Prof. Arjun Yodh, University of Pennsylvania, USA, January 05, 2016.
10. Two days meeting on Organismal Biology, co-ordinated by Prof. Vijay Kumar Sharma, Evolutionary and Organismal Biology Unit, February 4-5, 2016.

ENDOWMENT LECTURES

A V Rama Rao Foundation Lectures in Chemistry: What can be learnt from the fluorescence behaviour of molecular systems in room temperature ionic liquids?, Prof. Anunay Samanta, School of Chemistry, University of Hyderabad, Hyderabad; **Prize Lecture**: Functional organic molecules for biological application, Dr. D. Ramaiah, Director, CSIR-North East Institute of Science & Technology, Jorhat, Assam, May 25, 2015.

Fifth Annual Materials Lecture: Prof. A. K. Sood, Department of Physics, IISc Bangalore, June 12, 2015.

Prof V Ramalingaswami Lecture: A new fabric for the Biological Sciences in the 21st Century: The shifting geography and language of biology, Prof. Satyajit Mayor, Director, National Centre for Biological Sciences and inSTEM, Bangalore, July 27, 2015.

Prof C N R Rao Oration Award Lecture: Theoretical Prediction of Novel Structures and Phenomena in Solids: Basic Science behind Modern Technologies, Prof. Umesh Waghmare, TSU, JNCASR, August 04, 2015.

Darwin Lecture 2015: How predictable is evolution?, Prof. Joachim Krug, Institute of Theoretical Physics University of Cologne, September 15, 2015.

DAE-Raja Ramanna Lectures in Physics: Symmetries and the birth of the universe, Prof. Sandip Trivedi, Director, TIFR Mumbai. **Prize Lecture**: Materials modelling from first-principles electronic structure calculations, Prof. Tanusri Saha-Dasgupta, Dep of Condensed Matter Physics and Materials, Sciences, S N Bose National Centre for Basic Sciences, Kolkata, 24 September 2015.

ISRO Satish Dhawan Lecture: Indian Agriculture: Harvest of Hope, Dr. S. Ayyappan, Director General,

Indian Council of Agricultural Research, November 2, 2015.

The fifth Annual Sheik Saqr Materials Lecture: Prof. Andrew I. Cooper, University of Liverpool, UK, December 5, 2015.

The Eighth International Materials Lecture: Prof. Anthony K. Cheetham, FRS, University of Cambridge, December 10, 2015.

Darwin Lecture (5th in the Series)**:** Why is there so much genetic variation?, Prof. Nick Barton, Institute of Science and Technology Austria, January 25, 2016.

Prof. M. K. Chandrashekaran Memorial Lecture: M.K. Chandrasekharan: development of his legacy as time goes by, Prof. David Lloyd, Cardiff School of Biosciences, University of Cardiff, UK, February 05, 2016.

6thAnnual Chemistry Lecture: Molecular Design of Cellular Transporters, Prof. Santanu Bhattacharya, Indian Association for the Cultivation of Science (IACS), Kolkata, February 12, 2016.

ISRO Satish Dhawan Lecture (Fifteenth in the series): Lessons from Information Technology Industry and a Research Agenda, Shri. Kris Gopalakrishnan, Co-founder, and former CEO, MD of Infosys, February 24, 2016.

SPECIAL LECTURE

Surface Nanobubbles and Nanodroplets, Prof. Detlef Lohse, Department of Applied Physics, University of Twente, the Netherlands, December 04, 2015.

SYMPOSIA / WORKSHOPS / CONFERENCES / WINTER SCHOOL

1. ComSol Workshop, organised by COMSOL Inc, May 12, 2015.
2. Satellite meeting on 'BioInspiration' organised in London by Royal Society London in celebration of 350th anniversary of first scientific journal "Philosophical Transactions", co-chaired by Dr. T. Govindaraju, NCU, JNCASR, May 27, 2015.
3. BD-JNCASR Flow Cytometry Workshop, BD Biosciences, June 08-10, 2015.
4. Workshop on Basic Flow Cytometry, convened by Prof Ranga Udaykumar, MBGU, JNCASR, June 17-18, 2015.
5. Wellness Workshop on International Yoga Day, in co-ordination with Isha Foundation, Bangalore, June 19, 2015.
6. JNCASR-IKST Joint Workshop for promoting collaborative research, convened by Prof. Umesh V. Waghmare, TSU, JNCASR and Dr. Seung Cheol Lee, R&D Director, IKST (Indo-Korea Science and Technology Center), July 21, 2015.
7. One-day symposium cum laboratory visits organised for the students of National College, Basawangudi, convened by Prof. Chandrabhas Narayana, CPMU, JNCASR, August 25, 2015.

8. Analyzing Indian monsoon rainfall: a time series statistical approach, Dr. Sarita Azad, IIT Mandi, October 08, 2015.

9. Conference on Growing Length Scale Phenomena in condensed matter physics, convened by Dr. Subir K. Das, TSU, JNCASR October 8-10, 2015.

10. Winter School 2015, December 07-11, 2015.

11. TWAS Regional Conference of Young Scientists on Frontier in Scientific Research, December 21 – 22, 2015.

12. Workshop for Teachers, Lecturers and Research Scholars on "100 Years of Chemical Bond", January 29, 2016.

FLUID DYNAMICS COLLOQUIA

1. Mesoscopic Methods in Physics & Biology, Dr. Anuj Chaudhri, Applied Math Department Computational Research Division, Lawrence Berkeley National Lab, Berkeley, USA, April 15, 2015.

2. Investigation of some aspects of the structure of turbulent shear flows and flow stability, Dr. Sourabh Suhas Diwan, Flow Control Research Group, Department of Aeronautics, Imperial College London, UK, November 06, 2015.

3. Rapid growth of large aggregates by correlated coalescences in turbulent flow, Dr. Jeremie Bec, Laboratoire Lagrange Observatoire de la Côte d'Azur, France, January 11, 2016.

4. Nanomechanics of Soft Interfacial Materials, Dr. Prathima Nalam, Department of Civil and Environmental Engineering, University of Illinois, Urbana – Champaign, January 12, 2016.

5. Many-body hydrodynamic forces and torques between active colloids, Prof. Ronojoy Adhikari, Institute for mathematical sciences, Chennai, January 19, 2016.

6. Plastic Events in Soft Glasses, Prof. Roberto Benzi, University of Rome "Tor Vergata", Italy, January 21, 2016.

7. Axially homogeneous turbulent convection at high Rayleigh numbers: scaling laws for flux and spectra, Mr. Shashikant Pawar, Department of Mechanical Engineering, Indian Institute of Science (IISc), Bangalore, February 17, 2016.

8. Spherical Squirmers - models for swimming micro-organisms, Prof. T.J. Pedley, Department of Applied Mathematics and Theoretical Physics, University of Cambridge, UK, February 18, 2016.

SEMINARS

1. Experimental investigations on instability in suspension flow, Prof. Anurag Singh, Department of Chemical Engineering, Indian Institute of Technology, Guwahati, April 6, 2015.

2. Properties simulation and results of perovskite materials at finite temperatures, Dr. Brajesh Kumar Mani, Postdoctoral Research Associate at the University of South Florida (USF), Tampa, USA, April 13,2015.

3. The role of regulatory and accessory proteins of HIV-1 in pathogenesis, Dr Akhil Banerjea, National Institute of Immunology, New Delhi, May 7, 2015.

4. Strong Hybridization Effects on the "Hubbard U" and "Hund's Rule" in Strongly Correlated Electron Systems, Dr Subhra Sen Gupta, June 19, 2015.

5. Quantum Phases and Phase Transitions in Two-Dimensional Diffusive Metals at Oxide Interfaces, Prof. R. C. Budhani, IIT Kanpur, June 24, 2015.

6. Whole Mouse Brain Imaging Using Oblique Plane Tomography, Dr. Arun Narasimhan, Cold Spring Harbor Laboratory, New York, June 29, 2015.

7. Modulation of lncRNAs as an anti-cancer therapeutic: MALAT1 as a paradigm, Dr Gayatri Arun, Cold Spring Harbor Laboratory, New York, June 30, 2015.

8. Studies of hydrogen generation by semiconductor heterostructures and P, Cl substituted CdS, Mr. Anand Kumar Roy, JNCASR at Sheikh Saud Hall (ICMS Building), July 02, 2015.

9. Sizing up worm growth: from organelle to populations, Dr. Sravanti Uppaluri, Princeton University, July 09, 2015.

10. LhX2 controls position, specification and maintenance of optic identity, Dr Achira Roy, Centre for integrative brain research, Seattle Children's Research institute, Seattle, Washington, USA, July 23, 2015

11. Dynamics of inertial particles in a turbulent flow: Settling and Coalescences, Prof. Smariddhi Sankar Ray, International Center for Theoretical Sciences, Tata Institute of Fundamental Research, TIFR Centre Building, Indian Institute of Science, Bangalore, September 08, 2015.

12. Emergent states of quantum matter, Prof. Ross McKenzie, University of Queensland, Brisbane, Australia, October 06, 2015.

13. Some surprises and open questions in soft matter, Pof. Steve Granick, Ulsan National Institute of Science and Technology, Ulsan, South Korea, October 07, 2015.

14. UV/IR mixing in non-Fermi liquids, Dr Ipsita Mandal, Condensed Matter Theory, Perimeter Institute, Canada, October 15, 2015.

15. Disease resistance and tolerance in a natural host-parasite system: Eco-evolutionary drivers and epidemiological implications, Dr Guha Dharmarajan, IISER Kolkata, October 20, 2015.

16. Control of Neural Protein Synthesis in Health and Disease, Dr Aditi Bhattacharya, Centre for Brain Development and Repair, inStem, Bangalore, October 29, 2015.

17. Dynamic Nuclear polarisation and the paradox of Quantum thermalization, Prof Alberto Rosso, Université Paris-Sud, Orsay, France, November 03, 2015.

18. Investigation of some aspects of the structure of turbulent shear flows and flow stability, Dr Sourabh Suhas Diwan, Imperial College London, U K, November 06, 2015.

CPMU Seminars

1. Light- Matter Strong Coupling: A Molecular Perspective, Dr. Jino George, Laboratoire des Nanostructures ISIS, Universite de Strasbourg France, January 07, 2016.

2. Penta-graphene - New Carbon Allotropes Predicted by Ab-initio Simulations, Prof. Yoshiyuki Kawazoe, New Industry Creation Hatchery Center, Tohoku University, Sendai, Japan, January 11, 2016.

3. Nanomagnetism: From materials to medicine and information, Prof. Kannan M. Krishnan, University of Washington, USA, January 11, 2016.

4. Probing the 3D (P-T-H) phase diagram of heavy fermion systems, Prof. Daniel Braithwaite, IMAPEC,

Institute for Nanosciences and Cryogenics, France, January 13, 2016.

MBGU Seminars

1. The Viral determinants of HIV pathogenesis, Dr. Vinayaka R. Prasad, Department of Microbiology and Immunology, AECOM, Yeshiva University, USA, November 06, 2015.
2. Mathematical Immunology: an introduction, Dr. Carmen Molina-Paris,School of Mathematics, University of Leeds, UK, November 20, 2015.
3. How impaired nucleocytoplasmic glycosylation leads to an arm for a leg, Dr. Daniel Mariyappa, College of Life Sciences, University of Dundee, UK, December 22, 2015.
4. Mechanically activated Piezo1 ion channels: characterization of the pore domain, and their link to hereditary xerocytosis, Dr. Swetha Murthy, Patapoutian Lab, Department of Molecular & Cellular Neuroscience, The Scripps Research Institute, Howard Hughes Medical Institute, USA, January 08, 2016.
5. General cell-cycle lessons from single-cell profiling of mouse embryonic stem cells, Dr. Kedar Natarajan, European Bioinformatics Institute Hinxton, UK, March 10, 2016.
6. Understanding CFTR: From Macromolecular Complexes to Personalized Medicine, Dr. A. P. Naren, Cincinnati Children's Hospital Medical Center, Cincinnati, USA, March 15, 2016.
7. Dissecting the mechanisms of spindle positioning in animal cell, Dr. Sachin Kotak, Department of Microbiology and Cell Biology (MCB), Indian Institute of Science (IISc), Bangalore, March 31, 2016.

NSU Seminars

1. Gene network based drug discovery for neurological disorders, Dr. Prashant Kumar Srivastava, Division of Brain Sciences, Department of Medicine, Imperial College London, UK, December 04, 2015.
2. Synaptic tagging mechanism and the role of Synaptotagmin 3 on learning and memory, Dr. RamachandranBinu, Trans Synaptic Signaling European Neuroscience Institute(ENI), Germany, December18, 2015.
3. Mitochondrial (dys)function in neuromaintenance and neurodegeneration, Dr. Manish Jaiswal, Howard Hughes Medical Institute, Department of Molecular and Human Genetics, Baylor College of Medicine, USA, January04, 2016.
4. Novel genetic approaches to explore neural stem cell homeostasis, Dr. Sonal Nagarkar-Jaiswal, Howard Hughes Medical Institute, Department of Molecular and Human Genetics, Baylor College of Medicine, USA, January 05, 2016.
5. Glial Cells as Architects of Neural Circuit Assembly and Function in the CNS, Dr. Sandeep Singh, Department of Cell Biology, Duke University Medical Center Durham, the USA, February 18, 2016
6. Maturation and electrophysiological properties of human pluripotent stem cell-derived neurons and oligodendrocytes, Dr. DavidWyllie, Centre for Integrative Physiology, University of Edinburgh, UK, March 11, 2016.
7. Tales of feigned death and multilevel feedback, Dr. Joby Joseph, Center for Neural and Cognitive Sciences, University of Hyderabad, March 11, 2016.

TSU Seminars

1. Topology and Transport in Periodically Driven Systems, Dr. Arijit Kundu, Technion, Haifa, Israel,

November 17, 2015.

2. Probing condensed phase dynamics using plasma-driven ultrashort pulses, Dr. Krupa Ramasesha, Combustion Research Facility, Sandia National Laboratories Livermore, USA, December 23, 2015.

3. Dots for Everyone, Prof. R. Shankar, Yale University, USA, January 06, 2016.

4. Hamiltonian Theory of Fractional Chern Bands, Prof. R. Shankar, Yale University, USA, January 07, 2016.

5. From quantum transport to non-equilibrium dynamics: quantum simulations with ultracold atoms, Dr. Bodhaditya Santra, Fachbereich Physik, TU Kaiserslautern, Germany, January 12, 2016.

6. Mutations, Immune Checkpoint Therapy and Personalized Medicine, Dr. Gyan Bhanot, Rutgers University, January 13, 2016.

7. Solids and fluids at interfaces: Novel simulation techniques, Prof. Jargen Horbach, Institute for Theoretical Physics II, University of Dasseldorf, Germany, January 19, 2016.

8. First-principles study of V_2O_5 polymorphs as cathode materials for Mg (and multi-valent) batteries, Mr. Sai Gautam Gopalakrishnan, Department of Materials Science and Engineering, Massachusetts Institute of Technology, February 19, 2016.

9. Shear-reversal simulation of dense supercooled melt: rheology, microstructure and puzzles, Dr. A.K. Bhattacharjee, Department of Physics, Indian Institute of Science (IISc), Bangalore, March 29, 2016.

Other Seminars

1. Predicting Self-assembly in NanoMaterials, Prof. Jordi Faraudo, Institut de Ciencia de Materials de Barcelona (ICMAB-CSIC), Spain, February 10, 2016.

2. Coping with stress in academia, Prof. Nalini Dwarakanath, CCS, Indian Institute of Science (IISc), Bangalore, February 25, 2016.

OTHER PROGRAMMES

Hindi Week

Hindi Week was organised from September 14-23, 2015 in which staff and students have participated enthusiastically on various programmes. A Hindi Workshop on the title "Hindi at International level" by Shri M. G. Savadatti, Dy Director (Retd), Hindi Teaching Scheme, Govt. of India; Hindi Entertainment Programme by RJ Red FM 93.5; Hindi Quiz conducted by Dr. S. M. Mahesh, Sr. Hindi Translator, CAIR, DRDO, Bengaluru; and a scientific Talk in Hindi by Dr. D. D. Oza, Jaipur were the programmes organized. Prof. K. S. Narayan, President In-charge, JNCASR, Dr S N Sinha, Jt Director, Central Translation Bureau, and Mr. A. N. Jayachandra, Sr. A. O., distributed the prizes to the winners and certificates of Prabodh, Praveen and Pragya to the qualifying employees.

Hindi Workshop

Two workshops in Hindi were organized on December 18 and March 28, 2016 respectively. The workshops aimed to teach fundamentals while writing and speaking the Hindi language.

Vigilance Awareness Week

This was organised from October 26 – 31, 2015. A pledge on vigilance was taken by all Faculty, Students and Staff

of the Centre October 27, 2015. A lecture was delivered by Mr. K. N. Narayanaswamy, Assistant Commissioner of Police, City Special Branch, Bangalore on Preventive Vigilance on October 29, 2015, at 3.30 P.M.

LECTURES DELIVERED AT THE ANNUAL FACULTY MEETING

Annual Faculty Meeting was held on November 13 and an In-House Symposium on November 14, 2015. Following lectures were delivered by eminent scientists from the Centre and IISc:

1. Botnets and the Fast Graph Based Identification of Structured P2P bots, speaker: Prof. N. Balakrishnan, IISc
2. Rational Materials Design: A Futuristic Paradigm Gets Real, speaker: Prof. Shobhana Narasimhan, JNCASR
3. Strategies to enhance cell permeation of Peptide Nucleic Acids (PNA) and Polypeptides, speaker: Prof. K. N. Ganesh, IISER, Pune
4. The future antibiotics: From the 'Magic bullet' to 'Smart bullet', speaker: Dr. Jayanta Haldar
5. Perturbation of genome topology, speaker: Prof. V. Nagaraja, JNCASR

FELLOWSHIPS AND EXTENSION PROGRAMMES

EVENTS AND PROGRAMMES HELD DURING 2015-16

Orientation Programme for POBE-POCE 2015 students

An orientation programme was conducted for the 2015 batch of POBE and POCE programme students on 13 May 2015 and was also attended by SRFP students.

Inaugural Address by Prof. C.N.R. Rao for students of POBE-POCE and SRFP programmes 2015 was held on Tuesday, June 2, 2015.

Student Buddy Programme

The aim of this programme is to expose class XI/XII students to a day in the life of a research scholar, through individual interactions. Under this programme, so far 76 students from Jawahar Navodaya Vidyalaya and Kendriya Vidyalaya have benefitted. Detailed feedback was collected from participating students, buddies and teachers. The response was very positive and enthusiastic. JNC faculty and students wholeheartedly participated and the programme was immensely appreciated by the school students and their teachers.

Lecture programme for Jagadish Bose Talent Search (JBTS) awardees: Several faculty of the Centre gave research overview lectures to about 25 awardees of the JBTS programme who visited the Centre on 23 June 2015. Speakers were: Prof. K. B. Sinha (TSU), Prof. K.R. Sreenivas (EMU), Prof. Chandrabhas Narayana (CPMU), Dr. James Chelliah (NSI), Prof. Kavita Jain (TSU) and Dr. Sheeba Vasu (NSU).

Award of Diploma Certificates Ceremony for the award of diploma certificates to POBE-POCE 2013 batch of students was held on 01 July 2015.

Visit of College students to the Centre: B.Sc. and M.Sc. students from the following colleges in the country visited the Centre during the last six months: Mar Athanasios College for Advanced Studies (MACFAST), Tiruvalla, Kerala - Visited on 20.05.2015, Jagadis Bose National Science Talent Search (JBNTS), Kolkata - Visited on 23.06.2015., Six college students from Tibet visited JNCASR on June 30, 2015. They interacted with faculty and students and visited laboratories. The group that visited the Centre on June 30, 2015, also attended lectures organized by the C.N.R. Rao Hall of Science. \

Ongoing programmes

Visiting Fellowship Programme

Thirteen scientists from research institutions across the country were selected for the JNCASR Visiting Fellowships 2015-16. They will be hosted by the faculty of CPMU, EOBU, MBGU, NCU, NSU, and TSU. The following is the status of their fellowship:

Sl. No.	Name & Present Position/ Employment	Proposed to work with (Name of the Faculty)	Status
1	Dr. R. M. Melavanki Assistant Professor, MSRIT Bangalore, Karnataka	Prof. Chandrabhas Narayana	First spell – Joined

2	Dr. M. Umadevi Associate Professor, Mother Teresa Women's Univ. Kodaikanal, TN	Prof. M. Eswaramoorthy	First Spell Completed
3	Dr. Saket Asthana Associate Professor, IIT, Hyderabad Telangana	Prof. Chandrabhas Narayana	Yet to Join
4	Dr. Mahesh Kumar Scientist, National Physical Laboratory New Delhi	Prof. S.M. Shivaprasad	Yet to Join
5	Dr. R. Parimaladevi Assistant Professor, Mother Teresa Women's Univ. Kodaikanal, TN	Dr. Sebastian C. Peter	First Spell Completed Second spell- joined
6	Dr. Udaykumar Vasantrao Khadke Associate Professor, Bheemanna Khandre Institute of Technology, Bidar, Karnataka	Prof. Umesh V. Waghmare	First Spell Completed
7	Dr. V. Sathish Assistant Professor, Bannari Amman Institute of Technology, Sathymanglam, TN	Prof. Subi J. Geroge	Yet to Join
8	Dr. Meenakshi Ghosh Assistant Professor, Vidyasagar College for Women, Kolkata, W.B	Prof. Tapas K. Maji	First spell - Joined
9	Dr. Devipriya Nagarajan Research Scientist, SASTRA University Thanjavur, TN	Prof. Tapas K. Kundu	First spell - Joined
10	Dr. Pankaj Yadav Research Scientist, SASTRA University Thanjavur, TN	Dr. Sheeba Vasu	First spell - Joined
11	Dr. Guruvayoorappan. C Assistant Professor, Karunya University, Coimbatore, TN	Prof. Vijay Kumar Sharma	Yet to Join
12	Dr. M. Abdul Kareem Assistant Professor IGNOU, New Delhi	Prof. Maneesha S. Inamdar	Yet to Join
13	Dr. S. Banudevi Research Scientist, SASTRA University Thanjavur, TN	Dr. Ravi Manjithaya	First spell - Joined

Summer Research Fellowship Programme (SRFP)

69 students availed the scholarship for SRFP 2015 and received research training in various areas of Physics, Chemistry, Biology or Engineering at research institutes in Bangalore, and elsewhere in the country. 13 students were awarded the Rajiv Gandhi Fellowship for the year 2015.

The advertisement for SRFP 2016 was announced on the JNCASR website and emailed to around 150 college principals in the country. 1681 applications were received.

Category	No. of applications received for 2016	No. of fellowships offered in 2016	No. of applications received for 2015	No. of fellowships utilized in 2015
Life Sciences	753	24	540	16
Engineering Sciences	183	06	154	09
Physical Sciences	410	17	297	11
Chemical Sciences	160	27	128	27
Mathematics	115	02	090	02
Materials Science	60	00	059	00
Atmospheric Science	-	-	032	00
Total	**1681**	**76**	**1300**	**65**

Project Oriented Chemistry Education (POCE)

Advertisement for POCE-2016 was released in 07 newspapers and announced on our web site. In addition, a copy of the form and information sheet was sent to over 200 college principals of small towns to expand the reach of POCE and encourage students to apply for the programme. Out of 263 applications received, 11 students have been selected.

Nine students of POCE-2013-15, who had completed the programme successfully, are doing M.Sc. in different institutions in the country.

Project Oriented Biology Education (POBE)

Advertisement for POBE-2016 was released in 07 newspapers and announced on our website. In addition, a copy of the form and information sheet was sent to over 200 college principals of small towns to expand the reach of POCE and encourage the students to apply for the programme. Out of 171 applications received, 10 students have been selected.

JNCASR-CICS (Centre for International Cooperation in Science) Fellowship Programme

This Fellowship programme aims to encourage mobility of scientists from developing countries and to promote co–operation among developing regions. Six scientists from the following countries were shortlisted under the JNCASR-CICS Fellowship programme for the year 2015-16:

S.No	Name	Country	Guide	Status
1.	Dr.Kana Jean Raphael	Cameroon	Dr. S.P. Muthukumar Head, Animal House Facility CSIR-CFTRI, Mysore- 570 020	Yet to join

2.	Dr. Alexander Shula Kefi	Zambia	Guide yet to be identified	
3.	Dr. Apsara Umayangani Wijenayake	Sri Lanka	Co Guides: Dr. Sanjeev Krishnan, Assistant Professor, Centre for Earth Sciences, IISc, Bangalore Prof. C.P. Rajendran, Senior Associate, Geodynamics Unit, JNCASR, Bangalore	Yet to join
4.	Ms. Eneni Mercy Inara Roberts	Nigeria	Joined and presently working with Dr. Ram Kumar Sharma, Senior Scientist Biotechnology Division, CSIR-Institute of Himalayan Bioresource Technology Palampur - 176 061, H.P	Joined on 13.01.2016
5.	Dr. Dilafruz Rashidovna Kulmatova	Uzbekistan	Prof. K.R. Sreenivas, EMU, JNCASR, Bangalore	Yet to join
6.	Mr.Wondwesen Shiferaw Detamo	Ethiopia	Guide yet to be identified	

INTELLECTUAL PROPERTY

IP assets (IPAs) are collections of intellectual properties – patents, trademarks, copyrighted works, industrial designs, geographical indications, trade secrets, etc. IP assets have economic value because of their ability to enhance the value and financial return from technologies, products and services.

Realising the importance of IPAs created by research personnel and to foster Academia-Industry partnership, the Centre constituted an IP Management Committee [IPMC] in 2004. The IPMC developed IPR guidelines to encourage and facilitate the creation, development, protection and management of commercially exploitable IP and its enforcement. The Dean, R&D oversees the activities of the IP Management Cell, which implements the recommendations/suggestions of the IPMC.

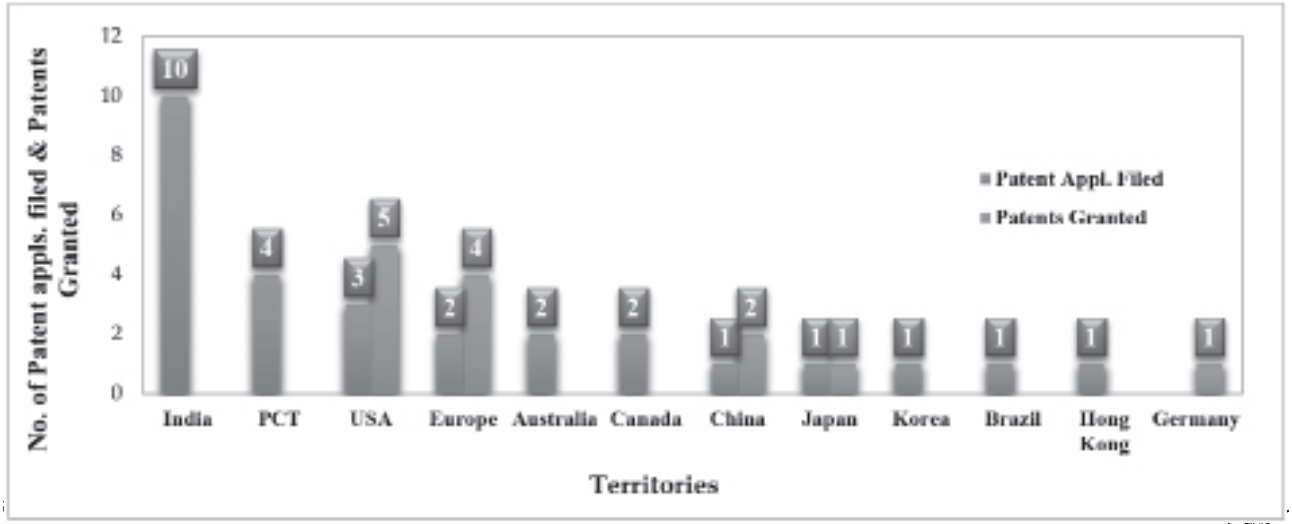
The Centre has so far filed 219 (India-73, PCT-45, USA-46, Europe-20, Japan-7, China-6, Korea-5, Australia-5, Brazil-3, Canada-3, S.Africa-2, Vietnam-1, Israel-1, Germany-1, Hong Kong-1) patent applications and obtained 53 (USA-25, India-8, Europe-8, Japan-4, China-3, S.Africa-2, Australia-1, Korea-1, Germany-1) patent grants, in addition to registering one Industrial Design and One Trade Mark.

During the reporting year, the researchers at the Centre developed several new inventions. The IPMC reviewed strategically and recommended the filing of **28 patent applications** (India-10, International Patent Application under PCT-4, USA-3, Europe-2, Australia-2, Canada-2, China-1, Japan-1, Korea-1, Brazil-1, Hong Kong-1) for commercialisable inventions meeting the patentability criteria. The Centre has also obtained **13 patent grants** (USA-5, Europe-4, China-2, Japan-1, Germany-1)**.**

Technology Transfer

Two inventions of Prof. Jayanta Haldar viz. *Antimicrobial Compounds, Their Synthesis and Applications Thereof* (Int. Patent Application under PCT: No. PCT/IB2013/061090) and *Antimicrobial Conjugates, Method for Production and Uses Thereof* (Int. Patent Application under PCT: No. PCT/GB2015/050750) has been partially assigned to M/s. Public Health England (PHE), an executive agency of the U.K. Department of Health for testing, evaluation and potential commercialisation of their pharmaceutical applications including anti-microbial properties.

Graphical representation of the patent applications filed and patents granted (2015-2016)



Patent Applications Filed

I. Indian Provisional Patent Applications

- Jayanta Haldar et al, Appl. No. 4011/CHENP/2015, filed on 7/07/2015.
- Tapas Kumar Maji et al, Appl. No. 1871/CHE/2015, filed on 9/04/2015.
- Giridhar Udapi Rao Kulkarni et al, Appl. Nos. 2967/CHE/2015, filed on 12/06/2015, and 5285/CHE/2015, filed on 1/10/2015
- Govindaraju Thimmaiah et al, Appl. Nos. 4493/CHE/2015, filed on 26/08/2015 4494/CHE/2015, filed on 26/08/2015 and 201641004770, filed on 10/02/2016.
- Ravi Manjithaya et al, Appl. No. 6596/CHE/2015, filed on 9/12/2015.
- Eswaramoorthy Muthusamy et al, Appl. No. 6711/CHE/2015, filed on 15/12/2015.
- Kaustuv Sanyal, Appl. No. 201641002369, filed on 21/01/2016.

II. International Patent Applications under PCT

Title of the invention	Inventors	Application No	Date of filing
Small Molecular Probes, Processes and Use Thereof	Govindaraju Thimmaiah, Nagarjun Narayanaswamy, Kolla Rajasekhar	PCT/IB2015/052463	3-Apr-2015
Glycopeptides and Uses Thereof	Jayanta Haldar, Yarlagadda Venkateswarlu	PCT/IN2015/050216	24-Dec-15
Glycopeptides Conjugates And Uses Thereof	Jayanta Haldar, Yarlagadda Venkateswarlu	PCT/IN2016/050047	6-Feb-16
Luminescent Conjugates Microporous Polymer With Lewis Acidic 'Boron' Sites on the Pore Surface: Ratiometric Sensing and Capture of F^- Ions	Tapas Kumar Maji, Venkata Suresh M, Swapan K. Pati, Arkamita Bandyopadhyay	PCT/IB2016/051961	7-Apr-16

III. National Phase Applications

Title of the invention	Inventors	Territory	Application No	Date of filing
Antimicrobial Compounds, Their Synthesis and Applications Thereof	Jayanta Haldar, Chandradhish Ghosh, Gautham Belagula Manjunath, Padma Akkapeddi	Australia	2013365769	12-Jun-2015
		USA	14/652,714	16-Jun-2015
		Brazil	BR112015014391-1	17-Jun-2015
		Europe	13865950.3	17-Jul-2015
		Canada	2894202	19-Jun-2015
		China	201380070984.40	21-Jul-2015
		Hong Kong	15111327.4	17-Nov-2015
		Japan	Yet to assign	

Title of the invention	Inventors	Territory	Application No	Date of filing
Composition, Substrates and Methods Thereof	Giridhar Udapi Rao Kulkarni, Kunala Durga Mallikarjuna Rao, Ritu Gupta , Boya Radha, Shanmugam Kiruthika	USA	14/773,040	4-Sep-2015
Vancomycin-Sugar Conjugates and Uses Thereof	Jayanta Haldar, Yarlagadda Venkateswarlu, Goutham Belagula Manjunath, Mohini Mohan Konai	USA	15/024,242	23-Mar-2016
		Canada	2925005	22-Mar-2016
		Europe	14796240.1	
		Australia	Yet to assign	
		South Korea	10-2016-7009601	

Patents Granted

Title of the Invention	Inventors	Territory	Patent No.	Grant No.
Artificial Retina Device	Kavassery Narayan Sureswaran, Vini Gautam, Monojit Bag	USA	9037251	19-May-15
		Europe	2585015	3-Jun-15
		China	ZL201080067806.2	20-May-15
		Germany	2585015	3-Jun-15
Manufacturing Strain Sensitive Sensors and/ or Strain Resistant Conduits From a Metal and Carbon Matrix	Kulkarni Giridhar Udapi Rao, BoyaRadha, Abhay A Sagade	Japan	5752852	29-May-15
Optimal Wing Planforms For Reducing the Induced or Total Drag of the Wing of an Aircraft Driven by Wing-Mounted Tractor Propellers/Rotors	Roddam Narasimha, Suresh Madhusudan Deshpande, Praveen Chandrashekarappa, Rakshith Belur Raghavan	China	CN 102470931 B	25-Nov-15
Self Assembly of Naphthalene Diimide Derivatives And Process Thereof	Govindaraju Thimmaiah, Manjula Basavanna Avinash, Makam Pandeeswar	USA	9230708 B2	5-Jan-16
Cationic Antibacterial Composition	Jayanta Haldar, Yarlagadda Venkateswarlu, Akkapeddi Padma	Europe	2780359 A1	8-Jan-2016

Title of the Invention	Inventors	Territory	Patent No.	Grant No.
Artificial Retina Device (Bulk Heterojunction/ Electrolyte Polymers as Novel Biocompatible Photoactive Multi Color-Sensing Technology)	Kavassery Sureswaran Narayan, Vini Gautam, Monijit bag	USA	Received Notice of Allowance	
A Nanosphere-Histone Acethyltransferase (HAT) Activator Composition And Process Thereof	Tapas Kumar Kundu, Anne-Laurence Boutillier, Snehajyoti Chatterjee, Muthusamy Eswaramoorthy, Puspak Mizar, Chantal Mathis, Jean-Christophe Cassel, Romain Neidl, Mohankrishna Dalvoy Vasudevarao, Vedamurthy Bhusainahalli Maheswarappa	USA Europe	Received Notice of Allowance	
Inhibition of Histone Acetyltransferases by CTK7A and Methods Thereof	Tapas Kumar Kundu, Mohammed Arif, Kempegowda Mantelingu, Gopinath Kodaganur Srinivasachar	Europe	Received Notice of Allowance	
Polynucleotide Sequences of Candida dubliniensis and probes for Detection	Kaustuv Sanyal, Sreedevi Padmanabhan, Jitendra Thakur	USA (Continuation Appl.)	Received Notice of Allowance	

RESEARCH PROGRAMMES

RESEARCH AREAS

1. Chemistry and Physics of Materials Unit (CPMU)

- Computational molecular science
- Programmable molecular materials in imaging and diagnostics
- Raman, brillouin spectroscopy and high pressure research
- Nanomaterials and catalysis
- Nanomaterials, nanofabrication and devices
- Functional organic/organic-inorganic hybrid materials
- Organic electronics, photovoltaics, device physics and bio-electronics
- Chemistry of materials
- Novel low-dimentional properties of GaN thin films
- Magnetism, superconductivity and multiferroicity
- Engineering Mechanics Unit (EMU)
- Fluid mechanics and heat transfer
- Mechanics of granular matter and nonlinear dynamics
- Computational physics
- Aerospace and atmospheric fluid mechanics
- Complex fluids and flows

2. Evolutionary and Organismal Biology Unit (EOBU)

- Circadian rhythms in fruit flies and ants
- Evolutionary genetics, life-history evolution and population dynamics
- Animal behavior and sociogenetics

3. Geodynamics Unit

- Neotectonics and environmental geology
- Fault zone studies, active tectonics and seismic hazard

4. Molecular Biology and Genetics Unit (MBGU)

- Molecular and cellular mechanisms of human genetic disorders
- Molecular parasitology and molecular enzymology
- Stem cell potency and cardiovascular development
- Transcription regulation and chromatin dynamics
- Autophagy and autophagy related pathways
- Chromatin biology and genomics
- Genetic and epigenetic definition of centromeres

- Mechanisms underlying pathogenesis of human cerebral malaria
- The HIV-1 subtype-C strain

5. Neuroscience Unit (NSU)

- Molecular pathways in gliomagenesis
- SynGAP1 in neuronal function and in Intellectual disability
- Neuronal circuits in fruit flies

6. New Chemistry Unit (NCU)

- Engineering molecular systems for biological applications
- Thermoelectrics and metal chalcogenides
- Supramolecular functional (organic and hybrid) materials
- Bioorganic chemistry
- Chemical biology and medicinal chemistry
- Designing new ways to small molecule heterocyclic scaffolds
- Solid state inorganic chemistry
- Semiconductor nanocrystals

7. Theoretical Science Unit (TSU)

- Theory and simulations of materials
- Statistical physics of systems at and away from equilibrium
- Nonequilibrium phenomena in physics and biology
- Computational nanoscience
- Advanced quantum theory: from molecules to materials
- Computational studies of protein-protein interactions
- Phase transformations and dynamics of soft matter
- Non-commutative probability and geometry: mathematics of quantum mechanics
- Coorelated electron systems and organic electronics

8. International Centre for Materials Science (ICMS)

- HRTEM, HREELS, semiconductors, thin film growth
- Experimental soft condensed matter research
- Organic semiconductors and asymmetric catalysis
- Obtaining high mobility indium nitride and InGaN thin films
- Semiconductor nanocrystals: electronic structure study

RESEARCH FACILITIES

(Added during 2015-16)

1. 350 ton high pressure pressing machine and consumption goods
2. Agilent gas chromatograph 7890B
3. Leica DMi8 modular research microscope
4. Master cycler nexus, PCR cooler
5. Lieca DMi 1 inverted phase contrast microscope with HD camera
6. Super resolution microscope system
7. Mossbauer spectrometer with accessories
8. ALS-IR-5-SF Laser system
9. Leica DM2700 metallurgical microscope
10. Ferro electric and multiferric test system
11. YAG laser for PIV / PLIF applications
12. Cyclic voltammetry with electro chemical workstation
13. Leica S6D stereomicroscope
14. MAGTEX materials microscope
15. Typhoon FLA 7000 IPA
16. High resolution and sensitive spectral confocal workstation with super resolution imaging and high sensitive spectral confocal with long term live cell imaging, correlation spectroscopy and anisotropy application

EXISTING RESEARCH FACILITIES AT JNCASR

1. Animal Lab. Facility
2. Electrophysiology patch clamp facility
3. Time-Resolved Photoluminescence (TRPL)
4. Physical Property Measurement System (PPMS)
5. Field Emission Scanning Electron Microscope (FE-SEM)
6. Clean Room
7. Titan Transmission Electron Microscope

SPONSORED ONGOING RESEARCH PROJECTS

Sl. No.	Project titles	Funded by	Principal Investigator	Duration
1	J.C. Bose Fellowship	SERB	Prof. Amitabh Joshi	5 years
2	Congenital deafness in Dhadkai village, Doda District, Jammu & Kashmir	ICMR	Prof. Anuranjan Anand	3 years
3	Thematic Unit of Excellence on Computational Materials Science at JNCASR	DST	Prof. Balasubramanian S.	5 years
4	Memorandum of Understanding between RAK-CAM and JNCASR	SSL	Prof. C.N.R. Rao	6 years
5	Memorandum of Understanding between DRDO and JNCASR	DRDO	Prof. C.N.R. Rao	5 years
6	CSIR Center for Excellence in Chemistry	CSIR-COE	Prof. C.N.R. Rao	5 years
7	Evaluating earthquake tsunami recurrence along the Andaman Arc from the study of shallow cores	INCOIS	Prof. C.P. Rajendran	4 years
8	Controlled release dispensers for delivery of semiochemicals	DBT	Prof. Eswaramoorthy M.	3 years
9	Postdoctoral Fellowship in Nanoscience & Technology	DST	Prof. G.U. Kulkarni	12 years
10	JNC - BRUCKER Sophisticated X-Ray Diffraction facilities	BRUCKER AX	Prof. G.U. Kulkarni	10 years
11	Thematic Unit of Excellence on Nanochemistry, JNCASR	DST	Prof. G.U. Kulkarni	5 years
12	SERB Distinguished Fellow	SERB	Prof. K.B. Sinha	3 years
13	Improving organic solar cell performance in large area architecture by use of active encapsulation and aging studies	DST	Prof. K.S. Narayan	3 years
14	J.C. Bose Fellowship	DST	Prof. M.R.S. Rao	10 years
15	SERB Distinguished Fellow	SERB	Prof. M.R.S. Rao	3 years
16	Chromatin Biology Research - Phase II	DBT	Prof. M.R.S. Rao	5 years
17	Reprogramming somatic cells to model cardiovascular differentiation for research and therapeutic potential	DBT	Prof. Maneesha S. Inamdar	3 years

Sl. No.	Project titles	Funded by	Principal Investigator	Duration
18	Indo - Denmark project titled "Genetics towards future genetics towards future cell therapy in diabetes & cardiovascular disease understanding embryonic genetics towards future cell therapy in diabetes & cardiovascular disease understanding embryonic stem pancreatic beta cells & cardiomyoc"	DBT	Prof. Maneesha S. Inamdar	3 years
19	Analysis of human development EMT *in vitro* and establishment of *in vivo* models of embryogenesis	DBT	Prof. Maneesha S. Inamdar	2 years
20	Analysis of factors regulating self-renewal and differentiation to aid generation of lineage restricted stem cells/progenitors for cell replacement therapy	DBT	Prof. Maneesha S. Inamdar & Prof. Hemalatha Balaram	4 years
21	DAE-SRC Outstanding Research Investigator Award Project titled "Dynamics and patterns in granular fluid: theory and experiment"	DAE	Prof. Meheboob Alam	5 years
22	Experiments using salt water / fresh water test facility for buoyancy induced flow studies	BARC	Prof. Meheboob Alam	3 years
23	Analysis of *in vivo* transcription of plasmodium falciparum from Indian patents suffering from cerebral malaria and its comparison with (MOD) symptoms	ICMR	Prof. Namita Surolia	3 years
24	The biological significance of unique NF-KB binding site in the viral promoter of HIV -1 sub-type C	SERB	Prof. Ranga Udaykumar	3 years
25	Numerical simulation of cloud flow and mixing layers	INTEL	Prof. Roddam Narasimha	5 years
26	DNS of turbo-machinery blading	GTRE	Prof. Roddam Narasimha	3 years
27	The Year of Science Professorship	DST	Prof. Roddam Narasimha	5 years
28	J.C. Bose Fellowship	DST-JCB	Prof. Swapan K Pati	5 years
29	Indo-Italian project titled "From small molecules to advanced molecular materials: transport and transfer properties"	DST	Prof. Swapan K. Pati	3 years
30	J.C. Bose Fellowship	DST-JCB	Prof. Tapas Kumar Kundu	10 years
31	Programme support on chromatin and disease (chromatin dynamics and transcription regulations: implications in disease and therapeutics)	DBT	Prof. Tapas Kumar Kundu	5 years

Sl. No.	Project titles	Funded by	Principal Investigator	Duration
32	Regulation of chromatin associated proteins by MIRNAS: implications in breast cancer	DBT	Prof. Tapas Kumar Kundu	4 years
33	Mechanisms of lysine acetyltransferase (KAT/ HAT) activation by small molecule activators and use thereof in memory	IFCPAR	Prof. Tapas Kumar Kundu	2 years
34	Mechanism of chromatin repair: role of chromatin role of chromatin associated protein pc4 acetylation by TIP60	DST	Prof. Tapas Kumar Kundu	2 years
35	Investigating the role of BLM helicase as a global tumor suppressor: understanding its regulatory loops and using the knowledge for therapeutic & clinical applications in cancer biology	DBT	Prof. Tapas Kumar Kundu	3 years
36	J.C. Bose Fellowship	DST-JCB	Prof. Umesh V. Waghmare	4 years
37	Plasticity of covalent nanoparticles	CEFIPRA	Prof. Umesh V. Waghmare	3 years
38	Startup grant for young scientist entitled "Holocene climate change and tracking the impact of anthropogenic activity in Wular or Mansar lake in Kashmir Himalaya : appraisal of human influence"	SERB	Dr. Jaishri Bhatt	2 years
39	Impact of SYANGAP 1 heterozygous mutations on the maturation & function of Gabaergic inter-neurons during development	SERB	Dr. James Chelliah	3 years
40	Ramanujan Fellowship	DST	Dr. Jayanta Haldar	5 years
41	Development of novel organic-inorganic antimicrobial with hydroxyaptite and antimicrobial polymer	DST	Dr. Jayanta Haldar	3 years
42	Ramanujan Fellowship	SERB	Dr. Kanishka Biswas	5 years
43	Structure-function analysis of centromeres of a pathogenic budding yeast *Candida Tropicali*	DBT	Dr. Kaustuv Sanyal	4 years
44	Identification of centromeres of the budding yeast *Saccharomyces Castellii*	DBT	Dr. Kaustuv Sanyal	3 years
45	Role of histone H3 variants in genome indexing in *Candida Albicans*	SERB	Dr. Kaustuv Sanyal	3 years
46	Characterization of the fungal specific DAM1 complex as an attractive target for safer and more potent antifungal drug to treat candidiasis	DBT	Dr. Kaustuv Sanyal	3 years

Sl. No.	Project titles	Funded by	Principal Investigator	Duration
47	Pulsed Laser Deposition (PLD) growth of ZnO, BCn and Rare Earth Manganite and study their properties from atomic scale imaging and spectroscopic techniques	SERB	Dr. Ranjan Datta	3 years
48	Synthesis and study of the optical magnetic and electrical properties of co-doped II-IV semiconductor nanocrystals	DST	Dr. Ranjani Viswanatha	3 years
49	Small molecule modulators of autophagy and autophagy related pathways	WT-DBT	Dr. Ravi Manjithaya	5 years
50	Memorandum of Understanding between JNCASR & HPCL development of microbial catalysts (biocatalysts) for fermentative Butanol production	HPCL	Dr. Ravi Manjithaya	4 years
51	Numerical investigations of unsteady aerodynamics in insect flight	ADE	Dr. Santosh Ansumali	3 years
52	Structure-property relations in the RE2TSI3(RE=Rare Earths: T= Transition Metals) compounds	CSIR	Dr. Sebastian C. Peter	2 years
53	Ramanujan Fellowship	DST	Dr. Sebastian C. Peter	5 years
54	Structure-property relations in Re2TGe3 (Re=RARE EARTHS; T=Transition Metals) Compounds	UGC-DAE	Dr. Sebastian C. Peter	3 years
55	Rare earth doped chalcogenide glasses for optical and photonic applications	SERB	Dr. Sebastian C. Peter	3 years
56	A study of the interactions between the circadian clock & homeostatic mechanisms regulating sleep & arousal in *Drosophila Melanogaster*	SERB	Dr. Sheeba Vasu	3 years
57	Computational modeling on fuels cells for clean and efficient energy storage	SERB	Dr. Siamkhanthang Neihsial	3 years
58	Ramanujan Fellowship	DST	Dr. Subir Kumar Das	5 years
59	IYBA Award - 2010 to Dr. T. Govindaraju "Development of biomimetic materials as substitutes for natural fibers using designed modular peptides"	DBT	Dr. T. Govindaraju	5 years
60	Developing novel chemosensors of metal ions in aqueous media for environmental & biological applications	CSIR	Dr. T. Govindaraju	3 years

Sl. No.	Project titles	Funded by	Principal Investigator	Duration
61	Theranostic approach for mechanistic understanding & discovery of novel inhibitors of neurodegenerative diseases	SERB	Dr. T. Govindaraju	3 years
62	Development of nucleic acid hybrid nanosystems and materials for drug targeting delivery and biosensing applications	DBT	Dr. T. Govindaraju	3 years
63	Between - group encounters & its correlates in female Asian elephants	NGS	Dr. T.N.C. Vidya	2 years
64	Between - group encounters and its correlation in female Asian elephants	CSIR	Dr. T.N.C. Vidya	3 years
65	Ramanujan Fellowship	DST	Dr. Ujjal K. Gautam	5 years

NEW SPONSORED RESEARCH PROJECTS

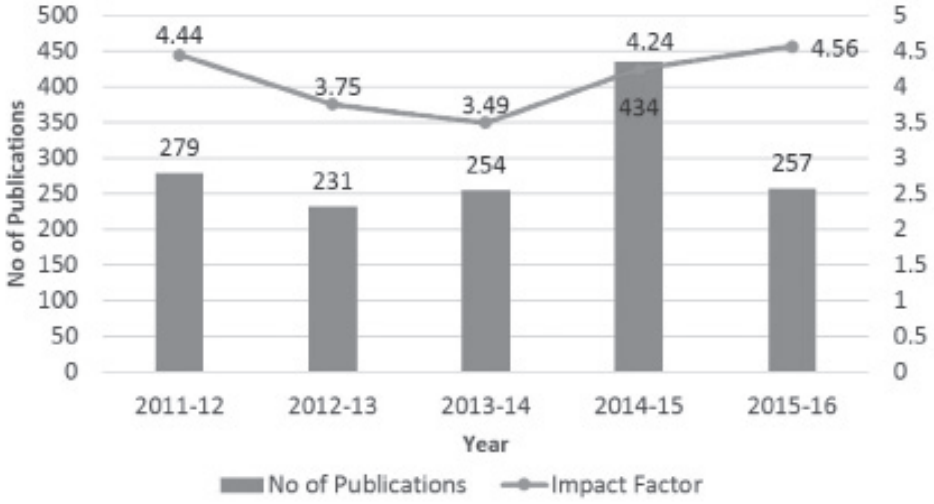
(Started during 2015-16)

Sl. No.	Project Title	Funded by	Principle/Project Investigator	Duration
1	Implementation of phase II of Indian Beamline at Photon Factory, Kek, Tskuba, Japan	DST-BEAMLI	-	-
2	Post-Doctoral Fellowship Programme entitled "Nano Science and Technology (NS&T) Overseas Visiting Fellowships" under the guidance of Prof. C.N.R. Rao	DST-OVF	Prof. C.N.R. Rao	-
3	Geological & geomorphic characterization of the frontal thrust fault at central & northeast Himalaya	MOES	Prof. C.P. Rajendran	3 years
4	Development of a beam line at PETRA III & assured access to all PETRA III beam lines & flash facility at DESY, Hamburg, Germany	DST-PETRA	Prof. Chandrabhas Narayana	1 year 6 months
5	Deciphering the role of purine nucleotide cycle in plasmodium by metabolic rewiring using genetic strategies	DBT	Prof. Hemalatha Balaram	3 years
6	Significance of fumarate metabolism in plasmodium examination of the growth phenotype of FH MQO & AAT knockout parasites	SERB	Prof. Hemalatha Balaram	3 years
7	Malarial parasite biology: an avenue to discover new drug targets (Phase II) under the Category II Outstanding Scientist Research Programme in Biotechnology of Centre of Excellence and Innovation	DBT	Prof. Hemalatha Balaram	5 years one month
8	Development of laboratory setup to evaluate the performance of drag reducers for refinery streams pipeline transportation	HPCL	Prof. K.R. Sreenivas	1 year
9	Advancing the efficiency & production potential of excitonic solar cells (Apex Phase II)	DST	Prof. K.S. Narayan	2 years
10	J.C. Bose Fellowship	SERB-JCB	Prof. K.S. Narayan	5 years one month
11	Setting up of Technical Research Center at the Jawaharlal Nehru Center for Advanced Scientific Research, Bengaluru	DST-TRC	Prof. K.S. Narayan	5 years one month
12	HPC simulations with ANUROOP: code acceleration, optimization and benchmarking	DRDO	Prof. R. Narasimha	-
13	Research work in HIV Lab	MDPL	Prof. Ranga Udaykumar	-
14	A multi- centric observational study to examine replicative fitness & pathogenic proper ties of the emerging new viral strains of HIV-1 in India	DBT	Prof. Ranga Udaykumar	3 years
15	Magnetism of self - organized structures at surfaces	CEFIPRA	Prof. Shobhana Narasimhan	3 years

Sl. No.	Project Title	Funded by	Principle/Project Investigator	Duration
16	Extending the d-band model of transaction metal Ca catalysts to S and P bands	IKST	Prof. Shobhana Narasimhan	-
17	J.C. Bose Fellowship	SERB-JCB	Prof. Srikanth Sastry	3 years
18	APCT - CADEMY joint workshop on multiferroics	APCTP	Prof. Sundaresan A.	-
19	Exploring A-site magnetic & A-site ordered spinel oxides for magnetoelectric & multiferroic properties	SERB	Prof. Sundaresan A.	3 years
20	Field effect transistor in nanoscale	AOARD	Prof. Swpan K. Pati	-
21	Memorandum of Understanding between JNCASR & IKST	IKST	Prof. Swpan K. Pati	-
22	Development of nano-particle based directed delivery systems for peptide therapeutics	DST	Prof. Tapas Kumar Kundu	3 years
23	Encapsulation and stabilization of metal or metal-complexes in nanoscale metal-organic frameworks (MOFs) for gas storage, magnetism, and heterogeneous catalysis	SERB	Prof. Tapas Kumar Maji	3 years
24	Consultancy & collaborative research work	SHELL	Prof. Umesh V. Waghmare	-
25	J.C. Bose Fellowship	SERB-JCB	Prof. V. Nagaraja	-
26	Molecular genetic & neuronal analysis of early & late emergence chronotypes in *drosophila melanogaster* populations	SERB	Prof. Vijay Kumar Sharma	3 years
27	Collaborative research work with Public Health England (PHE)	PHE	Dr. Jayanta Haldar	-
28	Develop a powerful new antibiotic that skills all resistant bacteria	SRISTI	Dr. Jayanta Haldar	2 years
29	Development of new class of glycopeptide antibiotics for tackling drug resistant bacterial infections	BIRAC	Dr. Jayanta Haldar	-
30	Financial assistance for Indian scientists to carry out experiments at International Synchrotron Radiation Facilities & Neutron facilities for materials science research	DST	Dr. Kanishka Biswas	5 years one month
31	DAE Young Scientist Research Award entitled efficient waste heat to electrical energy conversion in chalcopyrite AGINX2	DAE	Dr. Kanishka Biswas	3 years
32	Multi-scale modeling of complex fluids	SERB	Dr. Santosh Ansumali	3 years
33	Experimental realization of the topological insulators from the Heusler Compounds	SERB	Dr. Sebastian C. Peter	3 years
34	Design & development of new synthetic methods for novel heterocyclic motifs via multicomponent & domino reactions	SERB	Dr. Vibha Gautam	3 years

PUBLICATIONS

The Centre has registered a very good progress in its publications. A chart showing the year-wise number of publications and the impact factor thereof is appended below:



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Book Chapters

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Conference Paper

1. Varun Thakur, Sanjay Kumar Nayak, Kodihalli Keeriti Nagaraja, and S. M. Shivaprasad, Improved structural quality of GaN nanowall network grown on pre-nitrided c-sapphire Emerging Electronics (ICEE), 2014 ***IEEE 2nd International Conference***, DOI: 10.1109/ICEmElec.2014.7151177

RESEARCH PUBLICATIONS OF HONORARY PROFESSORS/HONORARY FACULTY/ ENDOWED PROFESSORS

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AWARDS / DISTINCTIONS

The following faculty and honorary faculty members of the Centre have received various honours and awards both at the national and international level in recognition of their significant contributions to the progress of science and technology.

Prof. C. N. R. Rao

Japan Government's highest civilian award, the Order of the Rising Sun, Gold and Silver Star.

Honorary Doctor of Science from Institute of Liver and Biliary Sciences (ILBS), New Delhi.

Honorary Doctor of Engineering from National Cheng Kung University, Tainan, Taiwan.

Kanbirkar Award 2016 of Shivaji University, Kolhapur.

Honoris Causa Doctorate of Science of D.Y. Patil University, Pune.

Honoris Causa Doctorate of Science of IIT Kanpur.

Prof. Roddam Narasimha

Guru Shreshta - 2015 from the Institution of Engineering and Technology, September 15, 2015.

Distinguished Alumnus in the Global Alumni Meet of University of Mysore Alumni Association on February 06, 2016.

Prof. M.R.S. Rao

Goyal Prize in Life Sciences for 2012-2013

Prof. Umesh V. Waghmare

Infosys Prize in Engineering and Computer Science (2015).

CNR Rao Prize Lecture in Advanced Materials, Materials Research Society of India (2016).

Prof. K. R. Sreenivas

Prof. Satish Dhawan Award Young Engineers for the year 2013

Prof. Tapas Kumar Kundu

Received the Dr. Nitya Anand endowment lecture award by Indian National Science Academy, 2015.

Received the G.P. Chatterjee Memorial Award for 2015-2016, awarded by the Indian Science Congress Association, Ministry of Science and Technology, Govt. of India. Presented at the 103rd Indian Science Congress, January 2016.

Prof. Srikanth Sastry

Distinguished Alumnus Award, Indian Institute of Technology, Bombay, 2015.

Dr. T. Govindaraju

Sir C V Raman State Award Young Scientists for the years 2014

Dr. Sebastian C. Peter

MRSI (Materials Research Society of India) Medal for 2016.

Dr. Subi J. George

NASI-SCOPUS Young Scientist Award 2015 in Chemistry.

Dr. Santosh Ansumali

2016 Outstanding Referee of American Physical Society (APS) journals.

Dr. Kanishka Biswas

NASI-Young Scientist Platinum Jubilee Award (2015) in Chemical Sciences.

Young Scientist Research Award, DAE-BRNS, India (2015).

Emerging Investigator 2015 in inorganic chemistry by Inorganic Chemistry Frontiers, Royal Society of Chemistry (RSC).

The Most Valuable Staff Member prize

Mr. H. S. Seetharama Sarma, Sr. Admin Assistant was awarded "The Most Valuable Staff Member" prize for the year 2015.

IPO Motivation Award 2015

A special award titled "IPO MOTIVATION AWARD" from Indian Patent Office has been conferred upon Jawaharlal Nehru Centre for Advanced Scientific Research in the National IP Awards 2015 function, in recognition of significant achievements of the organisation in the field of patent oriented R & D and IP promotion.

Best Ornamental/Vegetable Garden to the Centre

The Centre bagged consolidated prize for "Best Ornamental/Vegetable Garden" instituted by the Mysore Horticultural Society, Lalbagh, Bangalore. The prize was presented at a function on August 14, 2015.

AWARDS RECEIVED BY THE STUDENTS

Mr. S. R. Lingampalli (Ph. D. student, NCU), Mr. K. Gopalakrishnan (Ph. D. student, CPMU), Ms. Sunita Dey (Ph. D. student, CPMU) and Mr. Uttam Gupta (Ph. D. student, CPMU), research supervisor: Prof. C. N. R. Rao, were awarded the Sheikh Saqr Student Fellowships.

Mr. Divakara SS Murthy Uppu, a student of Prof. Jayanta Haldar, NCU received Gandhian Young Technological (GYTI) Award 2016 under Technological-Edge category (BIRAC-GYTI) at a function held at Rashtrapathi Bhavan, New Delhi on December 13, 2015. The research group will receive 15 lakh grant to take the invention forward.

Mr. Piyush Chaturbedy (Research Associate, CPMU; supervisor: Prof. M. Eswaramoorthy has received ACS Chemical Biology Best Poster Award in International Symposium on Chemical Biology and Drug Discovery at Kolkata during March 1-3, 2016.

Ms. Ananya Mishra (Ph. D. student, NCU; research supervisor: Dr. Subi George) was awarded best poster prize in the 18th CRSI National Symposium in Chemistry at Chandigrah during February 5-7, 2016.

AWARDS RECEIVED BY HONORARY FACULTY MEMBERS

Prof. Dipankar Chatterji

Padma Shri-2016

Prof. Raghavendra Gadagkar

Cross of the Order of Merit of the Federal Republic of Germany – 2015

FELLOWSHIPS

Prof. C.N.R. Rao

Corresponding Member of Australian Academy of Sciences

Prof. V. Nagaraja

President Elect, Indian Society of Cell Biology (2015-16)

Mrs. Indumati Rao

Fellow of the National Academy of Sciences.

Prof. Anuranjan Anand

Fellow of Indian National Science Academy (INSA), New Delhi

Prof. Chandrabhas Narayana

Sheikh Saqr RAK-CAM Senior Fellowships

Prof. Srikanth Sastry

Sheikh Saqr RAK-CAM Senior Fellowship
J C Bose National Research Fellowship, 2015.

Dr. Rajesh Ganapathy

Sheikh Saqr Career Award Fellowship

Dr. Ranjani Viswanatha

Sheikh Saqr Career Award Fellowship

FELLOWSHIP RECEIVED BY HONORARY FACULTY MEMBER

Prof. Ajay Sood

Fellow of the Royal Society, London.

MEMBERSHIPS / APPOINTMENTS

Prof. K. S. Narayan

Member of Physics - Expert Committee for DST-FIST Programme.
Member of DST - Solar Energy Research Initiative (SERI) Committee.
Member of Project Advisory Committee of the International Cooperation Programmes of DST-Materials Sciences and Engineering.

Prof. Shobhana Narasimhan

Member, Board of Governors, IIT Gandhinagar.

Member, Executive Council, Central University, Sagar, Madhya Pradesh.

Core Group Member, Young Scientists Expert Committee, SERB.

Dr. Kanishka Biswas

Young Affiliate of The World Academy of Sciences (TWAS) for the year 2015.

Dr. Ranjani Viswanatha

Founding member, Indian National Young Academy of Science (INYAS), a Young Academy under the umbrella of INSA.

Prof. Tapas Kumar Kundu

Vice President, the Society of Biological Chemists (India), 2015-16.

Adjunct Faculty in the Special Centre for Molecular Medicine, Jawaharlal Nehru University, New Delhi (2015-2020).

Visiting Professor in the Department of Biological Science, Indian Institute of Science Education and Research, Kolkata, 2015.

Dr. Sebastian C. Peter

Member, Indian National Young Academy of Science (2016-2020).

EDITORIAL BOARDS

Prof. Shobhana Narasimhan

Editorial Board Member, Current Science.

Editorial Board Member, Nature Scientific Reports.

Dr. T. Govindaraju

Member of the Board of Scientific Advisors of Bioorganics & Applied Materials Private Limited

EDITORIAL BOARD MEMBERSHIP OF HONORARY FACULTY MEMBER

Prof. Raghavendra Gadagkar

Member, Current Ethology (2015 -)

FINANCIAL STATEMENT

Name	**:**	**JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH**
Address	**:**	**Jakkur Post, Bangalore - 560 064**
Year Ended	**:**	**31st March 2016**
Assessment Year	**:**	**2016-17**

G.R. VENKATANARAYANA
CHARTERED ACCOUNTANTS
Partners :
CA. G.R. Venkatanarayana, B.Com., F.C.A.,
CA. G.S. Umesh, B.Com., F.C.A.,
CA. Venugopal N. Hegde, B.Com., F.C.A.,

No. 618, 75th Cross, 6th Block,
Rajajinagar, Bengaluru-560 010.
Ph: 23404921 / 64537325
Fax: 23500525
Email: grvauditor@gmail.com
1grvenkat@gmail.com

AUDITORS' REPORT TO THE MEMBERS OF THE GOVERNING BODY OF JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH

We have audited the attached Balance Sheet of **Jawaharlal Nehru Centre For Advanced Scientific Research** as at March 31, 2016 and also the Income & Expenditure Account for the year ended on that date and the Receipts and Payment account for the year ended on that date annexed thereto.

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 and financial performance and drawn up in prescribed forms as suggested by Department of Science & Technology of Government of India and are in conformity with the generally accepted accounting principles in India.This responsibility includes the design, implementation and maintenance of internal control relevant to 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 auditing standards generally accepted in India. Those standards require that we comply with the ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedure selected depends on the auditors' judgment including the assessments of risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditors consider internal controls relevant to the JNCASR'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 assessing the accounting principles used and significant estimates made by management as well as evaluating the overall financial statements presentation. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

G.R. VENKATANARAYANA Chartered Accountants BANGALORE

Opinion

In our opinion and to the best of our information and according to the explanations given to us, the financial statements have been drawn up in prescribed forms under the Department of Science & Technology of Government of India, and are in conformity with the generally accepted accounting principles in India and read along with the notes forming part of the accounts, give a true and fair view;

i) In the case of Balance sheet, of the state of affairs of the entity as at March 31, 2016; and

ii) In the case of Income and Expenditure account, of the excess of income over expenditure for the year ended on that date.

Report on other legal and regulatory requirements

1. We have obtained all the information and explanations, which to the best of our knowledge and belief were necessary for the purpose of our audit.

2. In our opinion proper books of accounts as required by law have been kept by Jawaharlal Nehru Centre For Advanced Scientific Research so for as it appears from our examination of those books.

3. The Balance Sheet, Income and Expenditure Account and Receipts and Payment account dealt with by this report are in agreement with the books of account.

4. The Balance Sheet and Income and Expenditure Account dealt with by this report are prepared in accordance with the Accounting Standards issued by the Institute of Chartered Accountants of India subject to the following observations:

(i) Non-Provisions of accrued liability in respect of leave encashment which is not in conformity with the Accounting, Standard 15 [Accounting for retirement benefits in the financial statements of Employers] issued by the Institute of Chartered Accountants of India. [Refer Note No.3 of Schedule No.24]

(ii) The amount spent on acquisition of fixed assets has been deducted from the total grants/ subsidies received in the Income & Expenditure account. This is not in conformity with the Accounting Standard- 5 issued by the Institute of Chartered Accountants of India. It has been explained that this format has been consistently used to present the accounts before the authority granting the funds.

(iii) Royalty received during the year Rs. 3,88,009/- has been credited to Corpus Fund and not to the Income and Expenditure Account, which is not in accordance with the generally accepted accounting principles.

G.R. VENKATANARAYANA Chartered Accountants BANGALORE

(iv) The Institution has to regularize the contributions/ grants received during the year from foreign funding agencies, as the registration granted to the Institution under the provisions of Foreign Contribution Regulation Act, 2010 has been withdrawn w.ef. June 19, 2015. The Foreign contributions received thereafter requires approval from the authorities concerned.

For M/s G R Venkatanarayana
Chartered Accountants

(G R Venkatanarayana)
Partner
Membership No. 018067
Firm Regn. No. 004616S

Place : Bangalore
Date : 14.07.2016

M/s. G.R. VENKATANARAYANA
Chartered Accountants
618, 75th Cross, 6th Block,
Rajajinagar, BANGALORE-560 010

JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH
BALANCE SHEET AS AT 31st MARCH 2016

Description	Schedule	Current year 2015-16 Amount	Previous year 2014-15 Amount
LIABILITIES			
Corpus/capital fund	1	2,35,72,86,607.27	2,29,87,92,268.05
Reserves & surpluses	2	18,72,372.55	-5,00,14,036.28
Earmarked and endowment funds	3	27,59,27,184.34	24,54,67,567.83
Secured loans and borrowings	4	0.00	0.00
Unsecured loans and borrowings	5	0.00	0.00
Deferred credit liabilities	6	0.00	0.00
Current liabilities and provisions	7	2,04,27,968.22	2,61,38,376.02
Other funds-cluster studies		39,541.00	39,541.00
Scheme balances		54,57,69,288.84	26,79,86,630.43
Total		**3,20,13,22,962.22**	**2,78,84,10,347.05**
ASSETS			
Fixed assets (Gross)	8	2,35,72,86,607.27	2,29,87,92,268.05
Investments-Endowment funds	9	25,35,59,101.88	22,30,01,170.00
Investment - Others	10	0.00	0.00
Current Assets, loans, advances etc.	11	59,04,77,253.07	26,66,16,909.00
Total		**3,20,13,22,962.22**	**2,78,84,10,347.05**
Significant accounting policies	24		
Contingent liabilities & notes on accounts	25		

Schedule 1 to 25 are integral part of accounts

This is the Balance sheet referred to in our report of even date.

For M/s G R Venkatanarayana
Chartered Accountants

[G.R.VENKATNARAYANA]
Partner
Membership No. 018067
Place : Bangalore, Date : 14/07/2016.

G.R. VENKATANARAYANA Chartered Accountants BANGALORE

For Jawaharlal Nehru Centre for Advanced Scientific Research

Sampad Patra
Accounts Officer

Prof. V. Nagaraja
President

A. N. Jayachandra
Sr. Administrative Officer

JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 MARCH 2016

Description	Schedule No	Current year 2015-16 Amount	Previous year 2014-15 Amount
Income			
Income from services	12	0.00	0.00
Grants/subsidies received	13	60,00,00,000.00	53,45,97,000.00
		60,00,00,000.00	**53,45,97,000.00**
Less: Extent of fixed assests procured		5,84,94,339.22	12,70,31,508.73
		54,15,05,660.78	**40,75,65,491.27**
Add:Proceeds of sale of fixed assets		0.00	0.00
		54,15,05,660.78	**40,75,65,491.27**
Income from fees/subscriptions etc	14	22,88,005.00	19,33,880.00
Income from investments	15	0.00	0.00
Royalty income, publication, licence fee etc	16	1,10,949.00	7,58,858.22
Interest earned	17	26,24,252.00	1,75,79,306.00
Other income	18	2,78,38,100.93	8,35,24,196.00
Increase/decrease in stocks	19	0.00	0.00
Total		**57,43,66,967.71**	**51,13,61,731.49**
Expenditure			
Establishment expenses	20	30,86,52,566.36	26,36,01,891.00
Other administrative expenses	21	21,36,58,488.11	24,22,06,205.70
Expenditure on grants, subsidies etc	22	0.00	0.00
Interest & bank charges	23	35,255.41	46,485.00
Total		**52,23,46,309.88**	**50,58,54,581.70**
Excess of income over expenditure		5,20,20,657.83	55,07,149.79
- Prior period expenses		1,34,249.00	0.00
Balance brought forward		-5,00,14,036.28	-5,55,21,186.07
Balance carried to balance sheet		**18,72,372,55**	**-5,00,14,036.28**
Significant accounting policies (Enclosed)	24		
Contingent liabilities & notes on accounts	25		

Schedule 1 to 25 are integral part of Accounts

This is the Income and Expenditure account referred to in our report of even date.

For M/s G R Venkatanarayana
Chartered Accountants

[G.R.VENKATNARAYANA]
Partner
Membership No. 018067
Place : Bangalore, Date : 14/07/2016.

G.R. VENKATANARAYANA Chartered Accountants * BANGALORE *

For Jawaharlal Nehru Centre for Advanced Scientific Research

Sampad Patra
Accounts Officer

Prof. V. Nagaraja
President

A. N. Jayachandra
Sr. Administrative Officer

JAWAHARLAL CENTRE FOR ADVANCED SCIENTIFIC RESEARCH
RECEIPTS AND PAYMENT ACCOUNT FOR THE YEAR ENDED 31.03.2016

OPENING BALANCES & RECEIPTS	2015-16 Amount	2014-15 Amount	PAYMENTS & CLOSING BALANCES	2015-16 Amount	2014-15 Amount
I.Opening balances:			I.Expenses;		
- Cash in hand & imprest at Centre	3,67,733.00	1,34,088.00	- Establishment Expenses	30,82,26,662.36	25,97,65,377.00
			- Administrative Expenses	20,37,45,452.11	23,23,97,416.05
Bank balances:			- Expenditure on behalf of endowments	32,91,776.00	40,58,298.00
			Sub total :	51,52,63,890.47	49,62,21,091.05
In savings bank accounts :					
- Canara Bank	2,37,14,947.57	30,00,144.13	II.Payment made against funds		
- Union Bank of India	1,82,177.00	1,75,103.00	for various projects:	0.00	0.00
- SBI	2,20,082.00	1,42,881.00			
In Deposit accounts :			III.Investments and Deposits made:	0.00	0.00
- At Canara Bank	5,69,67,000.00	11,39,08,000.00	IV.Expenditure on Fixed assets and		
- At SBI	6,15,00,000.00	6,15,00,000.00	Capital Work-in-progress:		
- At HDFC Trust	8,67,05,500.00	8,67,05,500.00	- Purchase of fixed assets	5,68,37,073.22	12,53,33,660.73
Sub total :	22,96,57,439.57	26,55,65,716.13			
II.Grants received:			V.Refund of surplus money/loans	3,00,00,000.00	56,781.00
- From DST-Grant in aid	60,00,00,000.00	53,45,97,000.00	VI.Finance charges(Bank charges)	36,312.41	0.00
- From Govt. agencies	0.00	0.00			
- From other agencies	0.00	0.00			
- On behalf of endowments/corpus	27,79,167.63	65,00,000.00			
Sub total :	60,27,79,167.63	54,10,97,000.00			
III.Income on investments :					
Interest on FD's:					
- From earmarked/endowment funds	36,34,816.00	94,33,904.00			
- From own funds	2,15,13,250.00	48,27,874.00			
Sub total :	2,51,48,066.00	1,42,61,778.00			
IV.Interest received on SB accounts:					
- From grant in aid	26,24,252.00	17,51,432.00			
- From own funds	6,48,677.00	0.00			
Sub total :	32,72,929.00	17,51,432.00			
Balance carried forward	86,08,57,602.20	82,26,75,926.13	Balance carried forward	60,21,37,276.10	62,16,11,532.78

JAWAHARLAL CENTRE FOR ADVANCED SCIENTIFIC RESEARCH
RECEIPTS AND PAYMENT ACCOUNT FOR THE YEAR ENDED 31.03.2016 (Contd...)

OPENING BALANCES & RECEIPTS	2015-16 Amount	2014-15 Amount	PAYMENTS & CLOSING BALANCES	2015-16 Amount	2014-15 Amount
Balance brought forward	86,08,57,602.20	82,26,75,926.13	Balance brought forward	60,21,37,276.10	62,16,11,532.78
V.Other Income:			VII. Other payments:		
- Royalty	0.00	9,11,856.22			
- Licence fee	0.00	1,230.00	- Earnest money deposit returned	0.00	0.00
- Collections from visitors, guest room etc	22,70,417.00	19,55,929.00	- Staff advances (Festival adv. etc.)	10,47,400.00	6,48,000.00
- From fee, subscription etc	6,64,075.00	4,81,782.00	- Refund to projects	0.00	3,75,00,000.00
- CSIR fellowships,UGC, DBT, SRFP	1,98,91,074.00	1,51,17,533.00	- Other advances	7,000.00	0.00
- Overhead recoveries	0.00	2,00,00,000.00	- Security deposit returned	6,06,442.00	0.00
- From corpus	0.00	0.00	- TDS payments	39,00,358.00	0.00
- From others	30,18,092.93	21,80,722.00	- Advances to faculty	29,69,991.00	38,15,532.00
Sub total :	2,58,43,658.93	4,06,49,052.22	- Payment to sundry creditors	1,56,82,861.80	10,81,55,520.85
			Sub total :	2,42,14,052.80	15,01,19,052.85
VI.Amount received from projects	0.00	3,00,00,000.00	VIII.Closing balances:		
			- Cash in hand & imprest at Centre	1,60,650.00	3,67,733.00
VIII.Other receipts:					
			Bank balances:		
- Income tax refunds	13,52,978.00	7,44,878.00	*In savings bank accounts at:*		
- From sundry creditors	0.00	10,17,33,491.85	- Canara Bank	2,83,40,348.23	2,37,14,947.57
- Staff advances recovered	3,882.00	3,000.00	- Union Bank of India	1,89,537.00	1,82,177.00
- Settlement of advance to faculty	2,91,439.00	4,59,085.00	- State Bank Of India	4,95,435.00	2,20,082.00
- Earnest money received	0.00	0.00	*In deposit accounts at:*		
- Project funding received	0.00	0.00	- At Canara Bank	5,69,67,000.00	5,69,67,000.00
- GSLI receipt	0.00	35,192.00	- At SBI	7,72,66,669.00	6,15,00,000.00
- Support to meetings	81,26,908.00	50,87,400.00	- At HDFC Trust	10,67,05,500.00	8,67,05,500.00
Sub total :	97,75,207.00	10,80,63,046.85	Sub total :	26,99,64,489.23	22,92,89,706.57
TOTAL	89,64,76,468.13	1,00,13,88,025.20	TOTAL	89,64,76,468.13	1,00,13,88,025.20

This is the Receipts and payment account referred to in our report of even date.

For M/s G R Venkatanarayana
Chartered Accountants

[G.R.VENKATNARAYANA]
Partner
Membership No. 018067
Place : Bangalore, Date : 14/07/2016.

G.R. VENKATANARAYANA * Chartered Accountants * BANGALORE

For Jawaharlal Nehru Centre for Advanced Scientific Research

Prof. V. Nagaraja
President

A. N. Jayachandra
Sr. Administrative Officer

Sampad Patra
Accounts Officer

JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH
CPF & NPS FUND STATEMENT OF AFFAIRS FOR THE YEAR ENDED 31.03.2016

Particulars	Amount	Amount	Particulars	Amount	Amount
CONTRIBUTORY PROVIDENT FUND			**INVESTMENT OF FUNDS :**		
SUBSCRIPTION :			Investments in :		
Opening balance		6,44,33,036.00	Government of India 8 % Bonds (SHCIL)	1,40,00,000.00	
Add :Subscriptions received during the year	67,88,791.00				
Amount not consider in prior years	5,81,357.00				
Loan repayments	31,85,226.00		Fixed Deposits at Canara Bank	3,62,48,573.00	
Interest on subscriptions	58,67,625.00	1,64,22,999.00	Fixed Deposit at HDFC	6,20,00,000.00	11,22,48,573.00
		8,08,56,035.00			
Less: Loans granted during the year	23,76,469.00		Closing Cash and Bank Balance :		
Less: Final settlement	7,18,460.00				
			Cash at Bank :		
Closing balance		7,77,61,106.00	SB A/C No.17513		
			Canara Bank,IISc branch	39,62,347.15	
CONTRIBUTION			Net Closing balance at Bank		39,62,347.15
Opening balance		4,50,76,016.00			
Add : Contribution during the year	25,46,449.00		TDS GOI Bonds (2013-14) receivable		1,48,000.00
Amount not consider in prior years	1,00,745.00				
Interest on total contributions	38,80,643.00	65,27,837.00	TDS-GOI Bonds (2014-15) receivable		1,48,000.00
		5,16,03,853.00			
Less: Final settlement	3,44,803.00		TDS-GOI Bonds (2015-16) receivable		1,49,400.00
Closing balance		5,12,59,050.00			
			Accrued interest on Deposits in HDFC		1,03,82,033.33
NEW PENSION SCHEME					
SUBSCRIPTION			Accrued interest on Deposits in Canara		10,74,704.79
Opening balance		80,551.00			
Total		80,551.00			
Withdrawal		0.00			
Closing balance		80,551.00			
CONTRIBUTION					
Opening balance		74,482.00			
Total		74,482.00			
Withdrawal		0.00			
Closing balance		74,482.00			
Payable to Centre		2,399.00			
Payable to canteen		2,500.00	Balance deficit		10,67,029.73
Total		12,91,80,088.00	Total		12,91,80,088.00

For Jawaharlal Nehru Centre for Advanced Scientific Research

For M/s G R Venkatanarayana
Chartered Accountants

[G.R.VENKATANARAYANA]
Partner
Membership No. 018067
Place : Bangalore, dated : 14/07/2016.

G.R. VENKATANARAYANA * Chartered Accountants * BANGALORE

Prof. V. Nagaraja
President

A. N. Jayachandra
Sr. Administrative Officer

Sampad Patra
Accounts Officer

JAWAHARLÀL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH

Schedule forming part of the accounts

Description	2015-16	2014-15
	Amount	Amount
SCHEDULE 1- Capital fund:		
Balance as at the beginning of the year	2,29,87,92,268.05	2,17,17,60,759.32
	2,29,87,92,268.05	**2,17,17,60,759.32**
Less : Depreciation up to the end of previous year	69,89,00,407.00	60,45,84,316.00
	1,59,98,91,861.05	**1,56,71,76,443.32**
Add : Addition to fixed assets during current year	5,84,94,339.22	12,70,31,508.73
	1,65,83,86,200.27	**1,69,42,07,952.05**
Less : Deletion to fixed assets during current Year	0.00	0.00
	1,65,83,86,200.27	**1,69,42,07,952.05**
Less : Depreciation for the current year	9,09,74,642.00	9,43,16,091.00
	1,56,74,11,558.27	**1,59,98,91,861.05**
Add : Depreciation reserve per contra	78,98,75,049.00	69,89,00,407.00
TOTAL	**2,35,72,86,607.27**	**2,29,87,92,268.05**
SCHEDULE 2- Reserves and surpluses:		
General reserve:		
Surplus/deficit in income and expenditure account	**18,72,372.55**	**-5,00,14,036.28**
SCHEDULE 3- Earmarked / endowment funds:		
A : Infrastructure corpus fund		
Opening balance	17,22,35,149.54	20,74,14,037.54
Additions during the year	1,03,88,009.00	0.00
Funds-Income from investments made	1,60,99,198.39	1,48,21,112.00
Interest from savings bank - Endowment account	6,48,677.00	0.00
Sub total	**19,93,71,033.93**	**22,22,35,149.54**
Less : Support to grant accounts	**0.00**	**5,00,00,000.00**
Total : Infrastructure corpus fund	**19,93,71,033.93**	**17,22,35,149.54**
B : Other funds		
Opening balance of the Funds	7,32,32,418.29	6,67,95,008.29
Add : Additions :		
Funds/donations/grants/royalties	23,94,733.63	81,73,206.00
Funds-Income from investments made	44,45,774.49	39,95,708.00
	8,00,72,926.41	**7,89,63,922.29**
Less : Funds-utilisation/expenditure incurred	35,16,776.00	57,31,504.00
Total : Other funds	**7,65,56,150.41**	**7,32,32,418.29**
Grand Total - Infrastructure corpus and other funds	**27,59,27,184.34**	**24,54,67,567.83**
SCHEDULE 4- Secured loans and borrowings:	0.00	0.00
SCHEDULE 5- Unsecured loans and borrowings:	0.00	0.00
SCHEDULE 6- Deferred credit liabilities:	0.00	0.00
SCHEDULE 7- Current liabilities and provisions		
Sundry creditors EMD/security deposits	57,91,246.00	52,30,156.00
Sundry creditors for others	1,44,23,504.22	2,09,08,220.02
Unpaid stipend/salary	2,13,218.00	0.00
TOTAL	**2,04,27,968.22**	**2,61,38,376.02**

Sampad Patra
Accounts Officer

JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH

Schedule forming part of the accounts

Description	2015-16 Amount	2014-15 Amount
SCHEDULE 8- Fixed assets		
Land - Free hold	1,77,15,351.00	1,77,15,351.00
Buiildings :		
General	8,78,33,491.26	8,78,33,491.26
Hostel building	1,56,60,055.00	1,56,60,055.00
New lab building - AMRL	2,59,30,339.00	2,59,30,339.00
Animal house	67,88,701.00	67,87,344.00
Staff housing	43,19,353.00	43,19,353.00
ETU building	30,91,348.00	30,91,348.00
Engineering & mechanical unit block	74,26,272.00	74,26,272.00
Other buildings like extn. to hostel, College etc.,	1,18,83,626.00	1,18,83,626.00
Nano science block	70,42,909.00	70,42,909.00
Extention to pauling building - Biology block	47,66,109.00	47,66,109.00
Dining hall & kitchen block	1,24,04,330.00	1,24,04,330.00
Radio active lab	2,03,233.00	2,03,233.00
International centre for material science	5,01,48,316.00	5,01,48,316.00
Lecture hall & academic block	96,36,712.00	96,36,712.00
Hostel phase II	1,95,52,377.00	1,95,52,377.00
STP building	2,91,699.00	2,91,699.00
Hostel phase III	2,75,01,103.00	2,75,01,103.00
International house	2,31,42,418.00	2,31,42,418.00
CNR Rao hall of science	1,03,33,669.38	1,03,33,669.38
Extention to HIV lab	10,16,085.00	10,16,085.00
Security office block	7,42,632.00	7,42,632.00
Animal house - Additional block	82,92,632.00	82,92,632.00
Residential quarters (Sr. AO)	36,59,034.00	36,59,034.00
Child care centre	7,28,827.00	7,28,827.00
Hostel phase -IV	2,59,34,842.00	2,59,34,842.00
Extention to biology lab	1,94,24,005.00	1,94,24,005.00
SCADA - DG room	2,40,660.00	2,40,660.00
President's residence	77,88,054.00	77,88,054.00
Visiting students hostel	3,39,82,070.00	3,39,82,070.00
Health centre	32,43,422.00	32,43,422.00
Nano institute shivanapura	37,09,242.00	37,09,242.00
EOBU lab block	2,09,11,646.00	2,09,11,646.00
Post-Doc housing-Srirampuram	1,54,86,086.00	72,07,547.00
Material science lab block	5,54,31,961.00	5,54,31,961.00
New auditorium	2,20,24,759.00	1,18,69,596.00
Radio active lab-Type II	28,32,158.00	13,99,038.00
	55,34,04,175.64	**53,35,35,996.64**
Infrastructure facilities:		
Roads, streetlights, drianages, partitions etc	9,60,86,502.32	9,35,62,366.32
Tubewells and water supply	2,48,912.00	2,48,912.00
	9,63,35,414.32	**9,38,11,278.32**
Plant/machinery/equipment:		
Scientific equipments/plant/machinery	85,69,65,732.74	83,92,10,112.45
ICMS - Laboratory equipments & facilities	25,55,39,691.00	25,24,63,341.00
Equipments - Chemistry & physics of materials	7,40,41,456.00	7,40,41,456.00
	1,18,65,46,879.74	**1,16,57,14,909.45**
Others :		
Vehicles	38,12,510.00	27,03,373.00
Furniture and fixtures	7,60,00,105.87	7,14,85,500.87
Office equipment	2,00,56,041.41	2,00,56,041.41
Computer/peripherals	7,47,66,175.00	7,22,15,961.00
Electrical installations	11,27,38,560.00	11,27,38,560.00
Library books	2,86,10,377.14	2,83,97,426.21
Library journals	17,08,36,276.15	16,50,90,479.15
	48,68,20,045.57	**47,26,87,341.64**
Intangible Assets: Softwares	1,64,64,741.00	1,53,27,391.00
TOTAL	**2,35,72,86,607.27**	**2,29,87,92,268.05**
Less - Depreciation up to the end of previous year	69,89,00,407.00	60,45,84,316.00
Depreciation for the current year	9,09,74,642.00	9,43,16,091.00
Written down value of the assets as at the year end	**1,56,74,11,558.27**	**1,59,98,91,861.05**
Add - depreciation reserve per contra	78,98,75,049.00	69,89,00,407.00
TOTAL	**2,35,72,86,607.27**	**2,29,87,92,268.05**

Sampad Patra
Accounts Officer

JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH
Schedule forming part of the accounts

Description	2015-16 Amount	2014-15 Amount
SCHEDULE 9- Investments - Earmarked/endowment funds		
Long term deposits		
Fixed deposits with HDFC (Trust deposits)	10,67,05,500.00	8,67,05,500.00
Fixed deposits with Canara Bank	5,69,67,000.00	5,69,67,000.00
Fixed deposit with SBI	7,72,66,669.00	6,15,00,000.00
Interest accrued on fixed deposits with banks / HDFC	1,26,19,932.88	1,78,28,670.00
TOTAL	**25,35,59,101.88**	**22,30,01,170.00**
SCHEDULE 10- Investments - Others		
Short Term Deposits	0.00	0.00
TOTAL	**0.00**	**0.00**
Schedule 11- Current Assets, loans, advances etc.,		
Cash & bank balances (Schemes)		
Cash in hand - Schemes account	63,211.00	98,790.00
Cash at bank - Schemes - Canara Bank	92,28,654.58	5,28,87,840.43
Fixed deposit with Canara Bank (Schemes)	47,42,00,000.00	18,50,00,000.00
Fixed deposit with SBI (Schemes)	18,71,395.00	0.00
Sub total	**48,53,63,260.58**	**23,79,86,630.43**
Loans and advances (Schemes)		
Interest accrued on fixed deposits with banks	1,37,82,162.00	0.00
TDS receivable	4,58,463.00	0.00
Receivables from various funding agencies	4,61,65,403.26	0.00
Sub total	**6,04,06,028.26**	**0.00**
Total of Schemes	**54,57,69,288.84**	**23,79,86,630.43**
Cash & bank balances		
Cash in hand grant account	1,40,320.00	3,17,568.00
Cash in hand endowment account	20,330.00	50,165.00
Cash at bank - Canara Bank - Grants	2,20,11,844.67	64,92,555.64
Cash at bank - Canara Bank - Endowments	63,74,804.56	1,72,22,391.93
Cash at bank - Union Bank	1,89,537.00	1,82,177.00
Cash at bank - SBI	4,95,435.00	2,20,082.00
Sub total	**2,92,32,271.23**	**2,44,84,939.57**
Loans and advances		
Advances to staff	9,78,882.00	4,22,619.00
Other advances & receivables	14,29,777.00	7,03,144.00
Receivable from scheme	1,00,00,000.00	0.00
SRFP - Receivables	6,38,405.00	0.00
TDS receivable	23,95,770.00	29,95,104.00
Imprest balance	32,859.00	24,472.00
Sub total	**1,54,75,693.00**	**41,45,339.00**
Total of other than Schemes	**4,47,07,964.23**	**2,86,30,278.57**
TOTAL	**59,04,77,253.07**	**26,66,16,909.00**

Sampad Patra
Accounts Officer

JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH
Schedule forming part of the accounts

Description		2015-16	2014-15
		Amount	Amount
SCHEDULE 12- Income from sales / services		**0.00**	**0.00**
SCHEDULE 13- Grants/subsidies :			
Grants - DST		60,00,00,000.00	53,45,97,000.00
Grants - From Governement agencies/travel grants etc.		0.00	0.00
Grants - From other Institutes		0.00	0.00
Grants - Other international agencies		0.00	0.00
	TOTAL	**60,00,00,000.00**	**53,45,97,000.00**
SCHEDULE 14- Income from fee/subscriptions etc :			
Income from fee, subscriptions, medical contribution etc.,		22,88,005.00	19,33,880.00
	TOTAL	**22,88,005.00**	**19,33,880.00**
SCHEDULE 15- Income from investments;		**0.00**	**0.00**
SCHEDULE 16- Royalty income, publication, licence fee etc :			
From royalty		0.00	6,20,403.22
Licence fee		1,10,949.00	1,38,455.00
	TOTAL	**1,10,949.00**	**7,58,858.22**
SCHEDULE 17- Interest earned:			
From term deposits		0.00	1,58,27,874.00
From SB acounts with nationalised banks		26,24,252.00	17,51,432.00
	TOTAL	**26,24,252.00**	**1,75,79,306.00**
SCHEDULE 18- Other income:			
From Visitors house,Guest rooms,Students residense etc,		45,52,850.00	42,47,473.00
CSIR Fellowships, ICMS, SRFP reimbursement etc,.		1,58,52,986.00	1,51,17,533.00
Prior Year Receipts - SRFP		40,38,088.00	
Overhead recoveries		0.00	90,00,000.00
Support from JNC Corpus		0.00	5,00,00,000.00
Miscellaneous income		1,16,675.00	0.00
From others (tender fee & other fee collected)		32,77,501.93	10,17,026.00
Other Receipts (Uncashed Cheques reversed)		0.00	41,42,164.00
	TOTAL	**2,78,38,100.93**	**8,35,24,196.00**
SCHEDULE 19- Increase / decrease in stock:		**0.00**	**0.00**

Sampad Patra
Accounts Officer

JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH
Schedule forming part of the accounts

Description	2015-16 Amount	2014-15 Amount
SCHEDULE 20- Establishment expenses:		
Salaries & scholarship to students	22,63,32,391.11	18,34,62,695.00
Wages	6,19,07,509.00	5,83,95,633.00
Allowances (Medical reimbursements etc.,)	63,84,799.25	74,28,874.00
Bonus	3,09,708.00	2,79,391.00
Contribution to CPF	47,88,803.00	35,53,015.00
Contribution to new pension scheme	48,40,482.00	37,16,036.00
Contribution to group gratuity scheme	23,19,171.00	15,00,000.00
Leave encashment benefits	5,96,231.00	8,97,355.00
Retirement & terminal benefits	0.00	28,01,907.00
LTC	11,73,472.00	15,66,985.00
TOTAL	**30,86,52,566.36**	**26,36,01,891.00**
SCHEDULE 21- Other Administrative expenses		
Electricity & power	4,97,04,585.00	5,38,49,099.00
Water charges	59,60,871.00	45,80,521.00
Insurance	8,33,263.00	7,32,753.00
Repairs & maintenance	3,71,85,964.00	4,06,34,393.00
Rents, rates & taxes	6,63,283.00	8,42,329.00
Vehicles running & maintenance	65,78,250.00	63,15,438.00
Postage, telephone & communication	74,40,320.00	66,82,422.00
Printing, stationery, books	76,69,264.00	50,69,699.48
Travelling and conveyance	61,68,955.00	35,13,233.00
Expneses on seminars/workshops/discussion meetings	58,83,684.06	1,26,72,974.50
Membership & subscriptions	1,54,330.00	4,95,019.00
Professional charges	67,93,304.00	1,40,15,036.00
Laboratory consumables	4,88,48,872.28	4,69,86,895.72
Frieght inwards	4,62,250.00	21,49,262.00
Advertisement & publicity	27,25,721.00	37,20,479.00
Student residence, guest house, I house, etc	29,53,420.00	28,99,878.00
Statutory audit fee	70,000.00	56,180.00
POBE & POCE prgramme	5,30,064.00	12,13,037.00
Summer research fellowship & student programme	44,81,153.77	19,54,728.00
ICMS - Workshops, Schools etc,.	14,13,435.00	16,84,991.00
ICMS - Visitor programmes (National & international)	1,99,492.00	3,81,500.00
ICMS - Recurring expenses	81,69,029.00	86,45,200.00
ICMS - Scientists & supporting staff	86,88,778.00	54,66,788.00
Commonwealth meeting	80,200.00	1,76,44,350.00
TOTAL	**21,36,58,488.11**	**24,22,06,205.70**
SCHEDULE 22- Expenditure on grants, subsidies etc:	**0.00**	**0.00**
SCHEDULE 23- Interest and bank charges:	**35,255.41**	**46,485.00**

Sampad Patra
Accounts Officer

SCHEDULE NO. 24

Accounting policies for the Year 2015-16

1. The fixed assets are stated at cost. The Centre has identified depreciation on Fixed Assets, and since they are created out of grant in Aid funds, they have been classified the same in the statement of affairs under Capital fund and also under Fixed Assets schedule respectively.

2. Grants received and utilized for procurement of Fixed Assets have been reduced from the total grants received in the Income and Expenditure Account and the same have been included under the Capital Fund Account.

3. The leave encashment to the staff members is accounted as and when it is paid.

4. Investments of the Centre are stated at cost.

5. The foreign currency transactions are translated at the rates prevailing on the date of transaction.

6. Previous year figures have been regrouped and reclassified to read in conformity with the current year's figures.

7. The Centre has put in to operation a system whereby the accounting standards with respect to the above are brought in conformity with the mandatory accounting standards recommended by the institute of Chartered Accounting of India

8. Royalty and overhead have been accounted under Corpus Fund.

9. The Expenditure listed under Schedule 20 as Establishment Expenses included the salaries paid to Faculty, Scientific and Research Personnel. The Expenditure listed under the Schedule 21 as Administrative Expenses included the expenses towards Laboratory Consumables and Seminar/Workshops/Discussion meetings exclusively incurred for Research purpose.

10. Fluctuations in foreign currency on account of procurement of fixed assets are capitalized with the respective fixed asset.

Sampad Patra
Accounts Officer

A. N. Jayachandra
Sr. Administrative Officer

Prof. V. Nagaraja
President

For M/s G R Venkatanarayana
Chartered Accountants

G.R. VENKATANARAYANA Chartered Accountants BANGALORE

[G.R.VENKATNARAYANA]
Partner
Membership No. 018067

Place : Bangalore
Date : 14/07/2016.

JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH
Schedule forming part of the accounts

SCHEDULE 25

A. Contingent liabilities :	2015-16	2014-15
	Amount	Amount
1. Claims against the entity not acknowledged as debts	NIL	NIL
2. Letter of credit outstanding	NIL	NIL
B. Notes on accounts :		
1. Estimated amount of contracts remaining to be executed on capital account and not provided for.	NIL	NIL

Sampad Patra
Accounts Officer

Inauguration of Neuroscience building by Hon'ble Union Minister of Science & Technology & Earth Sciences, Dr. Harsh Vardhan, February 09, 2016.

Dr. Harsh Vardhan, Hon'ble Union Minister of Science and Technology and Earth Sciences visited the Centre for an interaction with Prof. C.N.R. Rao and faculty members. He also inaugurated the Neuroscience Unit building on February 09, 2016.

Prof Umesh V. Waghmare received the prestigious Infosys Prize (Engineering & Computer Science) 2015. Hon'ble President of India, Shri Pranab Mukherjee presented the prize at a function held on February 13, 2016.

Mr. Kris Gopalakrishnan, speaker of ISRO Satish Dhawan Lecture, with Prof. C.N.R. Rao and Prof. V. Nagaraja, February 24, 2016 at Kannada Auditorium, JNCASR.

National Science Day Programme, February 25, 2016.

The first JNCASR-Industry meeting (March 08, 2016)

JAWAHARLAL NEHRU CENTRE FOR
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