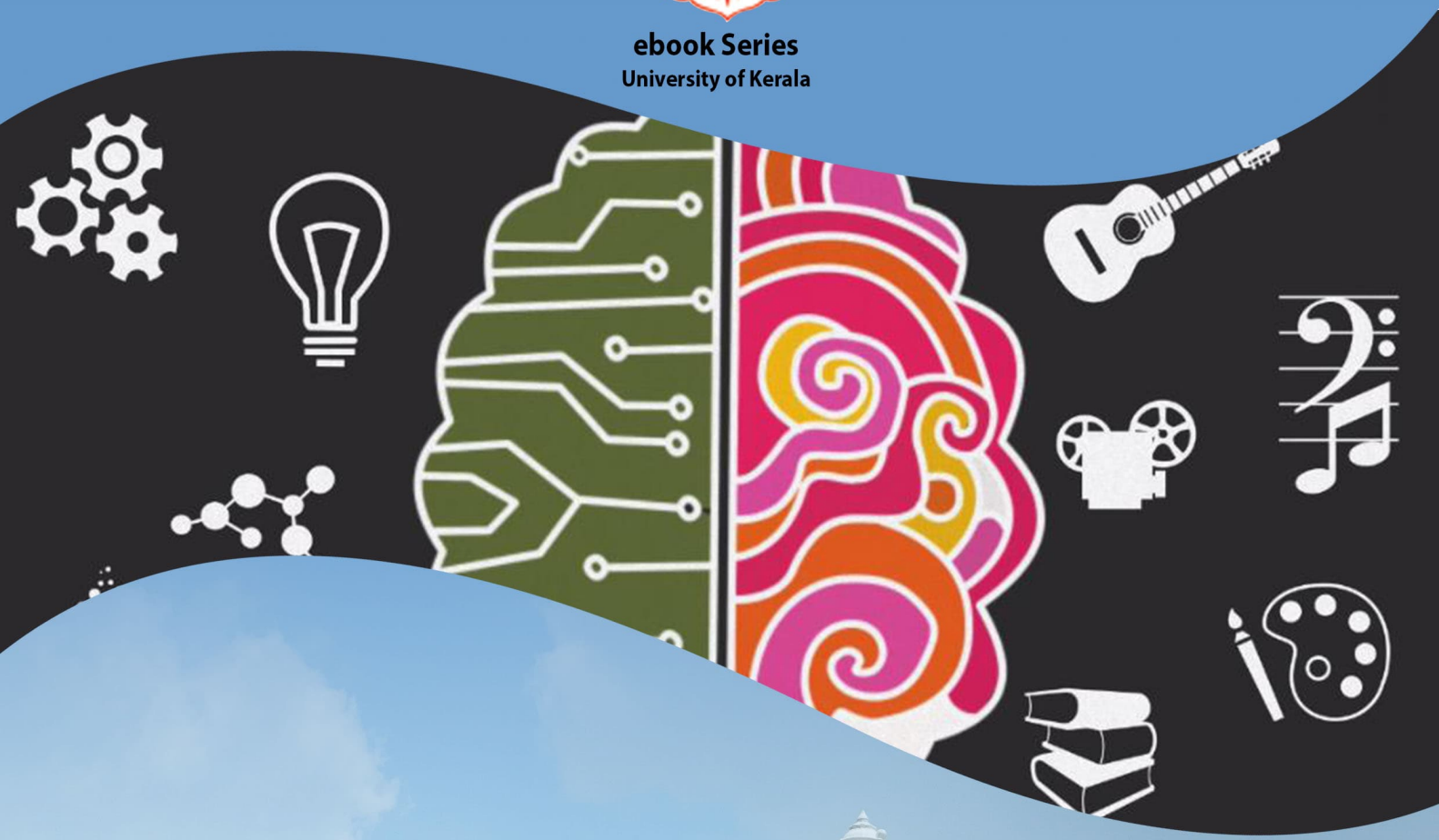
# INNOVATION IN UNIVERSITY OF KERALA

Achuthsankar S. Nair

ebook Series
University of Kerala



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## eBook Series




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# INNOVATION
# IN UNIVERSITY OF KERALA

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# Foreword

Although Kerala is recognized as the most socially developed state of India and one which has been declared as a state with total literacy, the extent to which it has been able to leverage these advantages for its economic development have left much to be desired. Many developed Nations have recognized the importance of innovation, namely the exploitation of new ideas, and leveraged it for their economic and social development. In order for the state of Kerala to achieve this, it is most critical that we develop a nurturing environment which can bring out the creativity and inventiveness of our people leading to innovations, which in turn can create economic opportunities for people living within the State. This will of course require a clear understanding of what innovation means and what drives it. The book by Achuthsankar Nair on "Promoting Innovation in University of Kerala" is therefore most timely. Achuthsankar, who is of course well known for his creative and inventive thinking, having him set up many innovative programs in the University of Kerala, has made a commendable effort in describing various aspects related to innovations from the University of Kerala. The book provides a good introduction to the subject of innovation, a historical perspective and description of some of the recent patents from the University of Kerala. Some recent initiatives of the University of Kerala on promoting innovation such as establishment of the Industrial Incubation Centre are also described. The book provides a good baseline on where the University of Kerala stands with respect to innovation and I am confident that it will also spur the development of it both within the University as well as in the state.

**Dr. Suresh Das**
Executive Vice President
Kerala State Council for Science, Technology and Environment
Ex-officio Principal Secretary to Govt. of Kerala,
Science and Technology Department.

# Contents

# 1. Introduction to Innovation

## 1.1 Introduction

During the last two decades, Higher Education Institutions (HEI) in Kerala have been glued to the terms 'quality' and 'excellence'. A new choice of HEI buzzword is 'innovation'. There is a lack of clarity in the meaning of the word in HEIs, whereas Government and Industries seem to be comfortable with the "patenting–commercialization–economic development" interpretation. For a multi-faculty University, the interpretation needs to be more wide and general. The term 'innovation' is seen to be used inter-changeably with 'applied research', 'translational research', 'patenting', 'technology transfer', 'student start-ups' and 'incubation'. All these are intimately related to innovation, but clarity and big picture view are required for effective planning and action. Also the "idea generation" phase of innovation is not automatic in, multi–faculty Universities as may happen with engineering colleges.

India has declared 2010-20 as the "Decade of Innovation". The Government, with an aim to promote science, technology and innovation, has established the National innovation Council (NinC). The Government of Kerala has established a State Innovation Council in 2013 (presently chaired by L. Radhakrishnan, Advisor to Chief Minister). The University of Kerala has entered a phase where innovation is starting to be prioritized, with many first level attempts clearly becoming visible. However, the history of innovation, inventions, production and management of intellectual property and attempts at industry incubation has not been documented so far. This book is an attempt to address these lacunae.

John Wood[1] points out that: *The report – " Entrepreneurial Impact: the Role of MIT " found that, at the end of 2006, there were 25,600 active companies founded by living MIT alumni, employing 3.3 million people and generating annual world revenues of nearly USD 2 trillion. The humanities, too, are huge potential contributors. Last year, for example, the British Library was able to demonstrate, via an independent study, that every public pound sterling invested in the library resulted in GBP 4.7 being generated back into the UK economy. Similarly, a recent study in Australia showed that a modest national investment in open public data can lead to returns of between AUD 1.9 and 6 billion".*

This observation is clear pointers to knowledge-wealth connection and has relevance for Universities in the new age.

[1] *John Wood, Research and innovation for global challenges, ACU Bullettin, March 2015*

## 1.2 A Working Definition for Innovation

Science, Technology & Innovation Policy of Govt. of India (2013) says: *Scientific research utilizes money to generate knowledge and by providing solutions, innovation converts knowledge into wealth and/or value. Innovation thus implies S&T- based solutions that are successfully deployed in the economy or the society.* Wikipedia says innovation is *producing "effective products, processes, services, technologies or ideas that are readily available to markets, governments and society".* Institutions like University of Kerala generate new knowledge using public funds. Such new knowledge may involve invention of new technologies, materials, processes or ideas. The new knowledge is often reported in a thesis or a journal (very rarely, results also appear in a patent application). When the invention is put to successful use by the University or another agency (Industry, Government or the society), then it becomes an innovation. An innovation ultimately creates wealth, through economic, social or environmental activity, by creating value, solving problems, creating jobs, etc. In short, we can adopt the following definition:

***INNOVATION ≡ INVENTION + ECONOMICALLY OR SOCIALLY SUCCESSFUL USE IN PRACTICE***

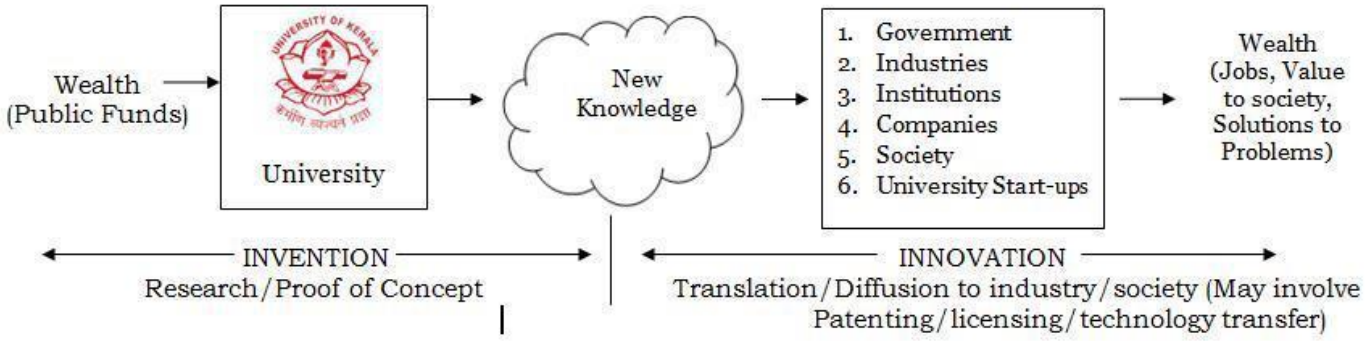



*Fig. 1.1 Invention to Innovation*

### 1.3 Examples of Innovation

Almost everything we use or see in day- to-day life was at one time an innovation that had revolutionary effect on life of the time. Clothes, tools, food, building materials, construction methods, traditional home utensils, appliances etc. Almost everything is evolved forms of great innovations of the past. Today, life-saving drugs, IT gadgets and services (Facebook, Google and WhatsApp), LED lights and a bunch of techy products and services have become the face of innovation.

The Sree Chithra Thirunal Institute of Medical Sciences and Technology, one of the organizations which have innovated most in the state of Kerala, transferred the technology of its heart valve to TTK Health Care and about 100,000 patients live with the heart valve produced by the Sree Chithra Institute. The first patient who used it, survived for 25 years. They have also transferred technology of non-toxic PVC formulations for blood bags to Termo Pen Pal / HLL.

A very good example of grass-root innovation from Kerala is that of automatically closing "Jayson water taps" invented and patented by J. Subramony of Trivandrum in 1960s. This was used in public water taps and used even today in railways, causing tremendous saving of water. Its production was an economic activity that created wealth (The company was first based in Trivandrum, but later moved to Coimbatore). More importantly it solved the problem of water wastage in public taps, which benefited the whole society.
Another example from Kerala is that of the coconut dehusking machine developed by Prof. Jippu Jacob and Joby Bastian, of Kelappaji College of Agricultural Engineering and Technology, Malappuram. This machine is now a common sight in homes across Kerala, adding value for the society and generating wealth by the production of the machine.

While innovations that catch attention of media are by and large high-tech, there are innovation which are triggered by common-sense and unique for their frugal nature.

Examples like "miti-cool" refrigerator are today branded as "Jugad innovation[2]". Jump-clips, stapler pins, hair pins, safety pins, ball-point pens etc also are Jugad innovations that continue to have markets. These need to be promoted along with high-tech innovations.

[2] *Jugaad Innovation by Navi Radjou, Jideep Prabhu & Simone Ahuja (Random House India, 2012)*

*Fig. 1.2 Jayson Water tap and Kera Mithra Dehusking Machine*

Students of Holy Angels Convent, Trivandrum recently proposed a 'Jugad innovation', they designed a base foot wear on which they can strap on designer pieces of different colors and styles so that the multiple foot wear are not required to match different dresses or occasions. Simple as the idea is, its market potential is enormous.

The University of Kerala has also innovations to cite even in its early years. The Second World War caused severe scarcity of petroleum products and the newly started State Road Transport Co-operation was badly hit. The Prime Minister (Diwan) of the State, who was also the Vice-Chancellor of University of Travancore, directed the University to research into alternative fuels and the University developed coconut shell charcoal based gas which was successfully used to run the buses at a cost cheaper than diesel (though the environment prolusion may have not been evaluated them).

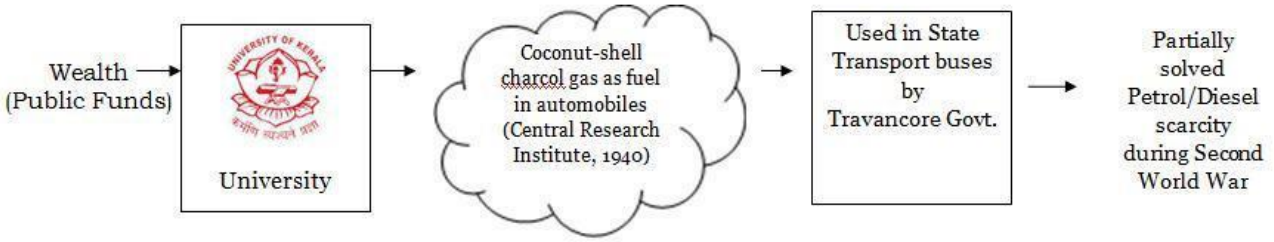



*Fig 1.3. Coconut shell Charcoal gas – An example of innovation from University of Travancore*

At the national level, CSIR is the undoubted leader in innovation. CSIR labs, spread all over India, have almost 1800 inventions in last 10 years, of which about 400 have been licensed for commercial use.

There are also systems or methods, which can be counted as innovation. UNEP cites the following example.: *Former Mayor of Baltimore, USA, Martin O' Malley pushed the city of Baltimore to use citistat, a performance measurement data and management system that allows city officials to maintain statistics on crime trends to condition of potholes. This system aids in better evaluation of policies and procedures with accountability and efficiency in terms of time and money. In its first year, Citistat saved the city $13.2 million.*

When an invention addresses a burning problem of the society, it is instantly an innovation. As far as Kerala is concerned, the well-known burning issues are detecting pesticide levels in vegetables and fruits, methods for effective handling of waste, preventing illegal dumping of waste in public spaces, detecting and managing diabetes, handling of street-dog menace, mosquito menace etc. The list is long and obvious. There could also be innovations which does not solve an existing issue, but adds new value. Creativity comes into play for such inventions.

# 2. The Innovation Pipeline

## 2.1 The Three Phases

As far as Universities are concerned, innovation proceeds in approximately 3 phases. These three phases are briefly described in this chapter.

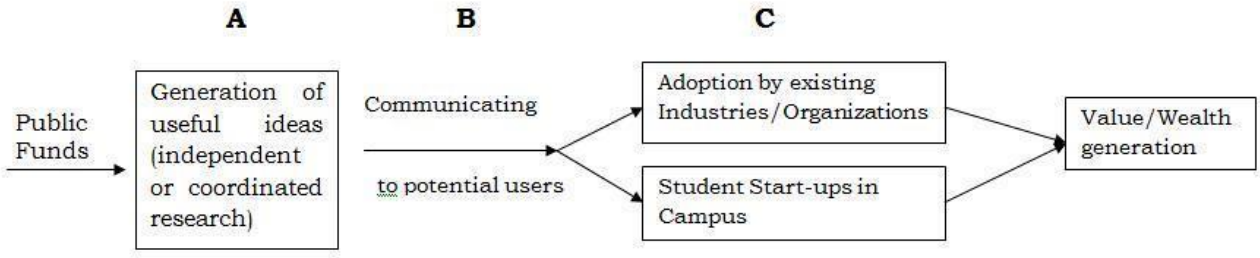



*Fig 2.1. Three Phases in Innovation Pipeline*

## 2.2 Phase A: Generation of useful ideas

This phase can be promoted by the University by having an effective policy and action plan. Research guides and students may be trained and encouraged to generate 'useful' knowledge instead of generating unplanned academic new knowledge. The University should compile requirements of industries, organizations and business houses and make the same available to research community. This way, when research efforts produce solutions for real problems, its adoptions by the industries will be automatic. A recent example of this relates to Hindustan Life Care Ltd., which asked a local engineering college in Trivandrum to design a silicon dust removal system. A great amount of effort is required to collect requirements of industries, organizations and society, so that such win-win associations are realized.

Universities must take extra care to handle innovative idea generation. Fear for bad ideas and failure, can stifle innovation. Teachers who adopt a traditional fault-finding critical attitude may switch off less confident innovative thinkers. Teachers and administrators need to be trained in this regard. Without experiments, innovation cannot evolve. In experiments, a high percentage of failure is very natural.

## 2.3 Phase B: Communicating ideas to potential users

Most post-graduate researchers and PhD scholars aim for research publications which communicate the knowledge they generate openly for anyone to use, without any permission

or payments. They need to be given effective awarenes about patenting and the benefits it offers in transferring technology. Their academic requirement for publication is not affected by patenting, since as soon as patent is filed, they can publish also. Our University does not have an impressive record of patenting and hence effective measures are required to produce a critical mass of patent attempts. Once the research community recognizes patents as proud achievements, the culture will spread fast. In addition to patenting, from the works of the recent past (both PG & PhD), brief summaries of findings need to be published as research bulletins and circulated to industries, organizations and potential clients so that the findings are brought to the notice of the potential users.

### 2.4 Phase C: Adoption by potential users

If a knowledge generated by the university is found useful by a potential user, then if patent is in place, a licensing can be negotiated. Initially, the quantum of income should not be the focus, as we have so far no technology transfer to claim. With Government industries and organizations, their standard licensing agreements should be accepted as such, or a 5-10% of the net profit may be negotiated. This policy can be reviewed in future when such licensing cases start rising.

Yet another option is that the researcher and/or other students of the University should be encouraged to launch student start-ups in the campus with support from the University. For this the students who are interested in entrepreneurship must be identified in the beginning of their studies and research and they may be encouraged to orient their studies and project work accordingly. Extra-departmental electives on the topics of their interest and electives on entrepreneurship may be provided to them. The University of Kerala has a industry incubation scheme in place and has already successfully incubated one company. Therefore this scheme can be scaled up.

# 3. Some Inventions and Innovations from University of Travancore

## 3.1 Introduction

The University of Travancore established in 1937 had a Central Research Institute for coordinated research. Its contributions are today forgotten. The research institute was spread out in the building that houses the publication division (near AKG Centre) and laboratories of University College and a few other Campuses.


*Fig. 3.1.Buildings in the Central Research Institute of University of Travancore*

The work of University of Travancore in early years mainly focused on fuels, aquatic products, and natural/forest products. Production agar-agar, oil distillation, petroleum testing, several marine products including shark oil, plant derivatives, textile chemistry, forest products (production of fuel from wood wastes), clarification and sterilization of forest honey, essential oils, soil survey and even crude penicillin are seen taken up by the University. The speciality one can observe is the strong linkage of research to needs of the society. The information given in the rest of the sections of this chapter are based on extracts from University of Travancore reports and articles by the then Director of Research, Dr. K. L. Moudgill, quoted verbatim[3],[4],[5].

[3] *Organized Scientific Research and Post-War Reconstruction by Dr. K. L. Moudgill (Travancore Information and Listener , September 1945)*

[4] *Fuels in Travancore Part I by Dr. K. L. Moudgill (Travancore Information and Listener, September 1947)*

[5] *Research Jottings by a layman (Travancore Information and Listener, September 1947)*

**3.2 Fuel Research during world war period:** During the war, on the advice of the Department of Research, rectified spirit was tried as fuel in the transport buses. It was found that straight spirit could be used in the petrol engine without any radical alteration and without any deleterious effects. Also Charcoal producer-gas was tried as alternative fuel for automobiles in Travancore, as in the rest of India. Apart from the inherent disadvantage in running on gas an engine designed for a liquid fuel, many difficulties were experienced because of the quality of the charcoal, and breakdowns were frequent. The Central Research Institute took up investigations at the request of the State Transport Department to find out (a) a simple method for the manufacture of charcoal and (b) the species of wood which give a charcoal of the required quality. Travancore Information Listener of April 1941 says**:** ***"****Power alcohol, manufactured by Travancore Sugars Chemicals Ltd., costing only 50 per cent of the price of petrol was mixed with petrol for use. High speed Diesel oil was produced by the Research Laboratory of the Travancore University at a cost much below then market rates. Experiments were conducted on the utilization of charcoal gas as a fuel and yielded satisfactory results. Very soon it is hoped, most of the vehicles of the Transport Department will be run on charcoal gas, when a reduction of approximately 75 percent on the fuel costs may be expected".*

The Department of Research's report documents that it carried out experiments on the various methods of production of charcoal and examined mango, cashew, casuarinas, maruthu, thanni, irul, vengai, punna, thembavoo and kudakapuli. As a result, it was found that:

1. *The pit method, which is now in vogue in some of the forests, gives a low yield of charcoal and the product is neither uniform nor clean.*
2. *The mud kiln gives a more satisfactory yield but requires excessive attention and is subject to risks of total loss of charcoal if it cracks.*
3. *A covered rectangular kiln, which can be made of burnt or sun-dried bricks and can be easily erected even in the forest and shifted from place to place, gives a uniform and clean product in good yield.*
4. *The Canadian type of kiln of the kind built experimentally by the fertilizers and chemicals, Travancore Ltd., though expensive to erect and difficult to be moved from place to place, gives the highest yield, even up to 38 per cent.*

The report continues that:

> *"There is a still more valuable product, coconut shell charcoal, which is not consumed to the extent to which it could be used in Travancore. While wood gives only a fourth of its weight of charcoal coconut shells yield 33 per cent charcoal of high calorific value. One drawback with the shells is that they occupy a lot of space. The cup like shape stands in*

*the way of close packing. They also produce acrid fumes when burnt and the fire is erratic resulting in heavy loss of heat output. The charcoal from coconut shell can be packed close, it burns without smoke and the fire is particularly hot. This charcoal possesses another striking quality. It absorbs gases and extracts out coloring matter from solutions. For the former reason, it was in great demand at the outbreak of the war when it was exported as important munitions of war for the filing of gas masks. It is also used for removing colouring matter in the refining of sugar or oils. When processed further, or activated, these properties are much more pronounced".*

Department of research also examined different methods of production of coconut shell charcoal and found that a small pit, capable of carbonizing about 7 to 10 thousand shells per day, with a cover made of mild steel, could be managed by one laborer and that with two such pits, working on alternate days, one ton of coconut shell could be carbonized each day. The power obtained from wood charcoal and coconut shell charcoal can be made into briquettes with the help of binding materials. These give a standard and useful fuel for consumption in the home, in the factory and in motor buses for the production of producer gas.

### 3.3 Aquatic Research

- **Agar agar:** Agar agar is the dried extract of certain sea weeds. It has been extensively used for preparation of edible jellies and desserts and as thickening medium for candies, ice-creams. The Department of research developed methods to produce this.

- **The usefulness of the Indian top minnows, *Alpocheilus panchax* and A. lineatus as destroyers of mosquito larvae:** This has been proved by various workers in the laboratory and the field experiments conducted in cisterns and reservoirs. These experiments have proved that a lineatus is a hardy fish, which can thrive in wells of all depths and tolerate foul water. It is not cannibalistic and it keeps the larval population under control.

- **Reducing growth of weeds in irrigation channels:** The Chief Engineer brought to the notice of the Department of Research that certain weeds grow profusely in the irrigation channels in South Travancore and obstruct the free flow of water in them.

  He enquired if some means of eradication or control of these weeds could bed suggested. The Professor of Botany, who inspected these channels, suggested that the weed growth may be reduced by "shading" the channels. In order to test how far this would prove

effective, it was suggested that a temporary cadjan pandal, (coconut leaves) be constructed across the channel for a length of about 100 feet. It was confirmed that there was a marked reduction in the growth of weeds in the shaded section. On the basis of the evidence the Department was advised to take adequate steps to cut off or reduce sunlight in the channels by (a) growing shade trees along both sides of the channel, and/or (b) cultivating a canopy crop across the channel.

- **Shark Liver Technology: -** Preliminary experiments on certain aspects of shark liver technology with special reference to the manufacture of ethical pharmaceutical preparations from various grades and varieties of shark liver oil were done. They include the preparation of malted oils and emulsions of shark liver oil with honey, glycerin and agar-agar, improving the flavour and taste of shark liver oil by washing it with hot milk, enzymic digestion of the oil with ricinus and pancreatic lipases, preparation of antiseptic unguents and embrocations from low grade oil and deodorization of oils by selective hydrogenation.

### 3.4 Agriculture and Plant Products

- **Insect Damage in Bamboos:** The general opinion is that the intensity of insect damage on bamboo depends on the amount of sugar and starch content of felled bamboos, which varies according to the different seasons of felling. During rains, new shoots are given out and all the stored carbohydrates are expended for this purpose while during summer, a high degree of storage of reserve materials takes place and bamboo cut during this part of the year is most susceptible to damage.

- **The colouring matter of the berries of Eugenia Jambolana:** Several varieties of Eugenia jambolana grows wild in Travancore. The berries along with the seed kernel, which contains alkaloid, are used in preparation of a tonic wine for persons suffering from diabetes.

- **Use of Coconut buttons:** The "Buttons" or the tender, undeveloped fruits of the coconut palm can be collected in considerable quantities from the coconut plantation of Travancore. A concentrated water extract was tried as a dyestuff on cotton hanks and found to yield with an iron mordant shades varying from silver grey to black, which were fairly fast to light and washing.

- **Tapioca and other Crops:** Research on tapioca, a major food and cash crop in the State, covers breeding and inter-breeding, the planting of cuttings and their needed length, the quantity of potash required for manure and its application, and the suitable stage in the life of the plant for harvesting the crop. The knowledge gained from research is quickly disseminated and both the producer and the consumer are benefitted.
- **Bunchy top disease plantation crops:** One of the more important fruit crops in the State is provided by plantain. It is subject to a contagious and destructive malady called the bunchy top disease which often ravages broad extents of the cultivation. After careful and continued experiments the Institute has selected an efficacious insecticide now in general use. The problem of pest-control in coconut trees is if anything more baffling. But the Institute has adopted a method of breeding and liberating a species of parasite to bring the attacks of the pest under control. It is an application with perhaps more in it than what meets the eye.
- **Salt Water in Paddy Fields:-** This interesting experiment is meant to estimate the good or bad effects of letting salt water into the paddy fields of Kuttanad. The problem was first studied under laboratory conditions. "Forty earthenware pots were filled with 100lbs each of well mixed soil from Monkompu in Kuttanad: the pots were grouped in three divisions of ten, each for treatment with saline water of different strengths, ten pots serving as controls. The pots were treated with saline water after the harvest and before the sowing.

### 3.5 Technology

- **Trend Analyser:** A mechanical device to smooth time series has been constructed based on a theoretical discussion by Schumann. S.
- **Mica Insulating Plates:** There are several different varieties of mica out of which only two are of commercial value namely, the phlogopite and the muscovite variety. The phlogopite variety, otherwise known as the silver amber, is the more sought after of the two and in India this variety is mined in Travancore. Samples of insulating plates were prepared and tested for their puncturing voltage; and the disruptive strength, in Kilovolts per mm. of thickness, ranged from 7 to 15.2 which is comparable with the value for homogeneous mica (17.5-28.5)
- **Effect of metals of vessels on the water held by them:** The effect of three metals, namely, copper, silver and brass on water has been examined in detail. Generally it is

observed that the intensity of light scattered by the sample of water increases rapidly in the first 5 hours and afterwards there is a slow but steady rise, reaching a maximum in about 48 hours. These results definitely indicate that the metal with which water is in contact goes into solution in the colloidal form. The amount of metal dissolved increases exponentially with time. The structure and size of the colloidal particle also change with time.

- **Improving design of pumps used in Kuttanad:** The paddy fields in Kuttanad get submerged in 7 or 8 feet water after the monsoons and have to be de-watered for sowing paddy in the month of November. Most of the pumps in use in Kuttanad are crude in design, all assembled and not suited to the prevalent conditions. Works started in 1941 to improve the design of the pumps. If the improved model pumps are installed, there should be a 50 per cent decrease in the cost of pumping.

# 4. Some Recent Potential Innovations from University of Kerala

**4.1 Introduction:** The research work of the University was very well documented during its early years but now it is not at all documented in a comprehensive manner and therefore innovation contributions are vague today. A random sample of recent innovation from Kerala University is presented in this chapter. Compared to 1940s, one can easily see that the high-tech cases are more, though plant products and chemistry still have a strong presence. The following sections are based on summaries provided by the concerned researchers or as reported by students of Department of Journalism and Communication in recent issue of "Univoice", newsletter.

**4.2 Studies on Annatto (Bixa Orellana L.):** Food additives are a large group of substances that are added to foods directly or indirectly either during the storage or processing of foods. Annatto placed as the second most important natural food colourant, is one of the 13 natural food colours listed by the US-FDA. Annatto can be used as a substitute to synthetic dyes in food and cosmetic industries. Annatto dyes are natural however, cytotoxicological and cyto-hazardous evaluations are a pre-requisite prior to promote the species. Cytotoxic evaluation of annatto (Bixa orellana L.) seed pulp extract on *Allium cepa* root tip cells was carried out. Cyototoxicity test system based on A. cepa root tips had proved that annatto dye is significantly less toxic compared to its synthetic alternative, orange red. Also, efficient methods were developed for both in vitro seed germination and micropropagation of an *Bixa odrellana* L. An in vitro propagation technique based on axillary bud proliferation was developed for the first time to mature annatto (*Bixa odrellana* L) tree. Maintenance of different floral colors was analyzed in relation to reproductive success of bixa orellana. The present study provides valuable information on the influence of petal color on maternal fitness in B. Orellana. Candidate plus trees (CPTs) of B. Orellana on the basis of seed output and bixin content were identified from northern, central and southern parts of Kerala State. The identification of elite trees with distinct genetic base will serve as source of planting material and also as parent plants for systematic scientific breeding for this crop. **(Dr. E. Siril, Department of Botany).**

**4.3 "Effect of Cristallinity of $Nb_2O_5$ electron blocking layer in dye sensitized solar cell":** The study investigated the effects of annealing on the structural, optical and

morphological properties of RF sputtered $Nb_2O_5$ Nano structured thin film on quartz substrate. Film annealed at 600 degree Celsius is crystalline in the erthrom bicphase. From the existence of mixed orthrombic and monoclinic phases in the film annealed at a temperature 900 degree, the film undergoes a complete phase transformation to monoclinic phase. Films have high refractive index and the values increase upon annealing. From the surface morphology, film in the monoclinic phase was porous in nature and hence not suitable as an electron blocking layer in Dye Sensitized Solar Cells (DSSC). DSSC with $Nb_2O_5$ blocking layers were studied. The effects of crsytallinity of the blocking layer were investigated. It is seen that the efficiency of the cell improves by about 50% with crystalline blocking layer. The blocking layer thickness also influences the cell performance, and also found that increased thickness of the blocking layer increases the current density of DSSC. (**Dr. V. P. Mahadevan Pillai and Collaborators, Dept. of Opto electronics).**

**4.4 Butterflies of Kariavattom Campus:** Butterflies are good biological indicators of habitat quality as well as general environmental health, as many species are strictly seasonal and prefer only particular set of habitats. Butterflies may react to disturbance and change in habitat and act as an ecological indicator and may get severely affected by the environmental variations and changes in the vegetation structure, as they are closely dependent on plants. Thus minor changes in their habitats may lead to either migration or local extinction. Because of their dependence on the plants, butterfly diversity may reflect overall plant diversity in the given area. Hence, butterflies can be used as umbrella species for conservation, planning and management. Of the 105 species of butterflies recorded in the campus, the highest number of butterflies was from *Nymphalidae* (40 species), followed by *Lycaenidae*(23 species), *Hesperiidae* (18 species), *Pieridae* (13 species) and *Papilionidae* (11 species). This study revealed that *Nymphalida*e was the most dominating family with a highest number of species and individuals. Most butterfly species were observed during June and May and least in April and March. Among the 105 butterflies recorded, 21 species come under the protection category as per the Indian wild life protection Act 1972 and 3 are endemic to Western Ghats. The present study reveals that Kariavattom Campus provides favourable ecological factors and habitat for butterflies. Rare and endemic species sighted in the Campus, raises the need for conservation of this area as a butterfly friendly ecosystem. In this study, they observed more diversity of butterflies in artificially maintained habitats suggesting the importance of creating such habitats like gardens, herbal parks, etc. Host plants of rare and endangered butterflies can be planted and conserved to improve the butterfly population. **(Dr. G. Prasad.**

**Dept. of Zoology).**

**4.5 Low Cholesterol leads to permanent hair loss:** Alopecia (hair loss) is considered as a neglected disease. The disease Alopecia can be classified into two categories. They are Cicatrical (Scarring) Alopecia and non-scarring alopecia. There is no clinically visible inflammation in most presentations although historic inflammation may be present. But in Cicatrical alopecia the inflammation affect the bulge region of hair and it leads to permanent hair loss. The study was conducted using scalp biopsies from 38 patients. The scalp biopsies are were subjected to gene expression profiling to identify gene expression variations in affected and non-affected samples. From this study it is clear that there is a difference of gene expression in PCA [Patients Affected Cicatrical Alopecia] tissues related to the normal tissues. It is found that the genes that are down regulated mostly include the cholesterol bio synthesis that regulates the genes; on the other hand the inflammatory genes showed a dramatic up regulation in cicatrical alopecia samples. So it states that reduction in cholesterol initiates permanent hair loss. **(Dr. P. Sreejith, Dept. of Zoology).**

**4.6 Sensor to Detect Pesticide Presence:** In the background of high pesticide content found in fruits and vegetables brought to Kerala from farms of Tamilnadu, researchers in the Department of Chemistry,University of Kerala have developed a novel potentiometric sensor for the determination of lindane ( $\gamma$ -*hexachlorocyclohexane*), an organo chloride pesticide. Lindane has been widely used as an insecticide and pesticide for the treatment of scabies and lice. It has been described by the international agency for research on cancer as a possible human carcinogen and has been linked with breast cancer and birth defects. In 2002, European Nations proclaimed a ban on the usage of lindane all over the region. They have designed a molecularly imprinted polymer based sensor from the surface modified multi-walled carbon nanotube. The presence of lindane modifies an imprinted polymer film on to the surface of copper electrode in the nanotube. The technique discovered by the researchers involves the detection of lindane by the sensor within a limit of 1*10^-10M. The work is featured in the cover of Biosensors and Bioelectronics, a journal by Elsevier Publications. **(Dr. T. S. Anirudhan, Dept. of Chemistry).**

**4.7 Method to Develop Ceria Based Mixed Oxide Composite Incorporated Aluminium with Enhanced Corrosion Protection:** Fabrication method to cast ceria OR ceria based mixed composite incorporated aluminium ingots and products for structural application in which the said composite aluminium exhibit enhanced self-corrosion protection.

The aluminium articles or products cast at 800'C feature almost all metallurgical and mechanical characteristics and hence suitable for wide applications. **(Dr. S. M. A. Shibli and Collaborators, Dept. of Chemistry).**

**4.8 Method to Develop Ceria Incorporated Composite Hot Dip Galvanic Zinc Coating:** The hot dip galvanic zinc coating method to protect iron products or articles from corrosion by sacrificial action of the zinc coating that comprises different layers in which ceria OR ceria based mixed composite are incorporated with different extent leading to minimum self-corrosion. The zinc coating formed on iron at 700'C features almost all metallurgical and mechanical characteristics of a general conventional galvanic coating and hence become suitable for general applications wherever conventional GI products are employed. (**Dr. S. M. A. Shibli, Dept. of Chemistry).**

**4.9 Anti-Cancer Molecules:** Marine alkaliod-thiazole hybrids and curcumin-thiazole hybrids are identified as novel anticancer molecules. Their structural design was inspired from structural motifs borrowed from marine alkaloids and terrestrial phytochemicals. The hybridization of these bioactivity promoting structural features have led to new molecular frame work. These were synthesized ad evaluated for their anticancer properties. Design and synthesis of curcumin and curcumin based heterocycles and their protein kinase activity in relation to memory and learning has been proven. Inhibition of protein kinase activity in brain has implications in neuronal excitotoxicity. This study was the first to suggest that curcumin could inhibit Calcium/calmodulin dependent protein kinase activity. Anticancer activity of diaminothiazoles DAT the anticancer potential of which was identified in 1997 in my laboratory based on the screening of our compounds at NIC, NIH USA. This led to the long standing fruitful collaboration with RGCB that has now resulted in several papers and three patents, all collaboratively. One of the papers remains one of the highly cited early papers on the anticancer activity of turmeric derived curcumin. We isolated as well as synthesized the three curcuminoids and provided these samples for this and several later collaborative studies with Amala and later with Annamali University which reported on the anticancer, antiiflammatory and antioxidant activities of curcumins. This long standing interest in curcumin continues and has recently led us to study the use of curcumin-boron trifluoride complexes in cyanide ion sensing. (Dr. **K.N. Rajasekharan and Collaborators, Dept. of Chemistry).**

**4.10 M-score: A new context specific score to assess scientific productivity with OEVGSI grading:** In this work, a new context specific score, named M-Score is being

proposed. This score is able to complement mock h-index ($h_m$ -index) and at the same time overcomes some limitations that other popular scientometrics such as h-index, g-index, etc., have. The proposed M-score is computed not only on the basis of an individual's performance in scientific productivity but also on the basis of the performance of other individuals in the field. This means that, the M-Score of an individual is an indicator towards his/her research performance relative to others in the field. Finally, based on the M-score of an individual, his/her research contributions are graded using OEVGSI (Outstanding, Excellent, Very Good, Good, Sufficient and Insufficient) grading system. The significance of context specific M-score has been proved with the help of sample dataset taken from Google Scholar. **(Dr. Madhu S. Nair, Dept. of Computer Science).**

**4.11 QR code based blind digital image watermarking with attack detection code:** A QR code based blind digital image watermarking technique with an attack detection feature is described here. The technique describes a key based framework to incorporate image, server port address or website address as watermark data; which increases the extended usability of the embedded data and the adaptability of the verification application. The watermarking problem is formulated as a signal communication problem with watermark data representation, embedding of watermark and attack detection as a source encoding, channel encoding and attenuation detection problems respectively. The mathematical aspects of the respective signal processing problems are extended to digital image watermarking with sufficient background support. The use of QR code ensures extended usability, while the application specific watermark data achieves adaptability of the verification application. The QR code is embedded into the attack resistant HH component of 1st level DWT domain of the cover image and to detect malicious interference by an attacker, a unique image registry code generated from the high frequency structural components of the stego-image is used. The key based approach and the attack resistant embedding domain makes this method robust against visually invariant attacks. The testing results show the compliance of the method with all the proposed aspects. **(Dr. Madhu S. Nair, Dept. of Computer Science).**

**4.12 Impact of air pollution:** I have led some research studies on the impact of air pollution on plants in the road side areas of Thiruvananthapuram district, and also in the industrial areas of Chavara, Kollam district. It was found that the air pollution problems were high in heavy vehicular intensity areas in Thiruvananthapuram district, especially in Thampanoor, Nemom and Ulloor; and it caused physiological and biochemical changes in trees

and shrubs in these areas. The road side greeneries are subjected to pollution stress and the different plant species showed considerable variation in their susceptibility to air pollution. Also the studies on air pollution problems in the Chavara and Panmana panchayats in Chavara taluk of Kollam district revealed that the concentration of total suspended particulate matter was high, and free chlorine was also detected in the surroundings of KMML industrial area, Chavara, Kollam. The trees, especially the *Cocus nucifera* (coconut trees) and *Mangifera indica* (mango trees) in this area were badly affected, which showed variation in the physio-biochemical parameters and less crop yield. The health survey conducted among the residents in this area also showed that children and adults were suffering from respiratory problems and other health problems including cancer. (**Dr.Jaya D.S., Dept. of Environmental Sciences).**

**4.13 Cytogenetics and Biosystematics:** My research is mainly on Cytogenetics and Biosystematics of South Indian Cucurbits, wild and cultivated species of *Sesamum*, *Passiflora* and *Amorphophallus*. Nutritional evaluation of wild and cultivated fruits and seed protein characterization.*Cucumis sativus* var. *hardwickii* (Royle) Alef., a wild progenitor of the widely cultivated *C.sativus* (cucumber) was reported for the first time **f**rom Peninsular India in 1992. Chromosome numbers of cucurbit species viz, *Trichosanthes anaimalaiensis* (n=11, 2n=22), *T. nervifolia* (n=11), *Gymnopetalum wightii* (n=12) and *Momordica denudata* (n=14) and in two varieties of *Passiflora foetida* ie, var. *foetida* (2n=16) and *P. foetida* var. *gossypifolia* (2n=20). Occurrence of *Sesamum alatum* Thonn. a wild species of *Sesamum* reported for the first time from Kerala, added a new record to the Flora of Kerala in 2013. Genetic diversity analysis by morphological and molecular markers in *Coccinia, Momordica, Passiflora* and *Sesamum*. **(Dr. Suhara Beevy S., Department of Botany).**

**4.14 Banana Cultivars:** Published protocols for micropropagation of local banana cultivars, an enhanced production of solasodine from *Solanum* trilobatum through in virtro pathway. Identified the mutation in the Chlacone synthase gene locus for the development of Red Banana, identified the enzyme for delayed ripening in banana cultivar Kadali. **(Dr. Ashalatha S. Nair, Dept. of Botany).**

**4.15 System and Method to Facilitate the Retrieval of Separated Endodontic Files from Human Root Canals:** System and method to facilitate the extraction of separated endodontic files from human root canals. The method facilitates the removal of separated NiTi and SS endodontic files trapped inside root canals through electrochemical

process, without the removal of radicular dentin. **(Dr. S. M. A. Shibli and Collaborators, Dept. of Chemistry).**

**4.16 Evaluation of Bioactive Compounds and Pharmacological Activity of Selected Mushrooms of Kerala:** An attempt was made to characterise the pharmacological potential and phytochemical constituent of wild mushroom *Omphalotus nidiformis* Berk, *Macrolepiota mastoidea* (fr.) Singer and *Termitomyces mummiformis* Heim was undertaken. *O. nidiformis* mushroom was reported from Kerala for the first time. The new host tree (Coconut tree) was also identified during collection. During this study six compounds including one new compound were identified and these pure compounds were tested for antioxidant, antibacterial and cytotoxic activity. We are planning to file a patent for the new compound. Coconut host and phenolics from *Omphalotus nidiformis* was considered as first international report. **(Dr. Radhamany P. M. and collaborators, Dept. of Botany).**

**4.17 Bio-sequence Analysis:** Digital signal processing has been used in bio-sequence analysis with superior success rate in identification of coding regions in genomic sequences through Fourier filtering. Specialized gene finding algorithms for short genes (less than 400 bp) which are not accepted by standard gene finding tools has been successfully developed. Two new tools to determine protein sub cellular localization from amino acid sequences have been developed. **(Dr. Achuthsankar S. Nair and Collaborators, Dept. of Computational Biology and Bioinformatics).**

**4.18 Bio-sequence Compression:** The big data storage challenges in Bioinformatics emphasize the need for High performance computing solutions for managing large genomic data. The problem may be mitigated by the development of specialized Bio-sequence compression algorithm. We have developed Compression of Large Genomic Datasets using COMRAD on Parallel Computing platform. Message passing library is used to distribute the different compression stages in clusters. The genomic compression algorithm helps to reduce the on-disk foot-print of large data volumes of sequences there by efficient archiving. **(Dr. Achuthsankar S. Nair and Collaborators, Dept. of Computational Biology and Bioinformatics).**

**4.19 Novel High *k* dielectrics:** Downsizing of the electronic devices has not only increased the functions of the circuits, but also has raised the switching speed and also reduced the power consumption. According to the Moore's law, the density of Si based

MOSFETs consisting of plysilicon-$SiO_2$- Si stacks have doubled about every 18 months leading to higher speed, increased functionality and lower cost. In-order to maintain capacitance of the dielectric layer, while laterally shrinking the transistor size, it has become necessary to continuously reduce the $SiO_2$ layer thickness. Reduction of the layer thickness, below 1 nm generates high leakage current due to electron tunneling across the oxide, which compromises reliability of electronic devices. Replacing $SiO_2$ with high dielectric constant material can solve this problem. Hence the requirements for high *k* dielectric are (i) Dielectric constant should be in the range of 10-30. (ii) They must possess large bang gap ($E_g$>5 eV). We found a series of novel rare-earth based silicate materials satisfying these stringent requirements. **(Dr. G Subodh, Dept. of Physics).**

**4.20 Extracellular Matrix:** The main focus of my research for the past three and a half decades has been extracellular matrix and its biological role. Extracellular matrix was believed to be a mere architectural support for the tissues. But in the 80s, availability of individual molecules and the structure- function analysis showed that the extracellular matrix has several biological functions. I started studies on extracellular matrix production by cells in culture during my first post-doctoral stint in Prof Kurt von Figura's lab in Munster Germany and then with Dr. RC Hughes at NIMR, an MRC laboratory in London. Then I could develop the facility in the Department of Biochemistry in the University of Kerala and continue studies on chemistry and molecular biology of ECM. We studied the influence of ECM on cell function, identified cell surface receptors for matrix proteins, and studied the signaling processes and molecules which can target specific pathways. Extensive studies on matrix remodeling were done and the first publication on matrix degrading MMPs in the country came from our laboratory. Later, we focused on angiogenesis which is a critical process in both physiological and pathological conditions and studied the modulation of endothelial function relevant to angiogenesis by basement membrane as well as the metabolite status of the cell. Several naturally occurring compounds which can target angiogenesis have been identified. Yet, when I am asked to comment on the best work we have done, I feel that the best is yet to come. However, a piece of work which Mr. Sameer Kumar did for his PhD, relating to modification of a growth factor viz. vascular endothelial growth factor which specifically activates endothelial cells leading to new vessel formation from pre-existing capillaries, deserves particular mention. Sameer, in the paper published in J Cell Physiology in 2007 showed that covalent modification of this growth factor reduces its biological potency. It is significant as it demonstrates a key regulatory mechanism linking energy and oxygen status

of a cell with the biological potency of the growth factor .When the cells in tissue starve for nutrients and oxygen, blood supply to these sites can be restored by formation of new vessels which among other factors is facilitated by increase in the biological activity of the growth factor. The significance of this work has been evident from the number of citations of this publication. **(Prof. P. R. Sudhakaran, Emeritus Professor, Dept. of Computational Biology & Bioinformatics).**

**4.21 Comparative Endocrinology:** Dr. Oommen V. Oommen's research venture over the past thirty six years has been focused mainly on the metabolic hormonal regulation in sub-mammalian vertebrates and has significantly contributed on comparative endocrinology in non-mammalian vertebrates by establishing a somewhat identical pattern in these vertebrates as in homeotherms. The collaborative research has resulted in describing stages of spermatogenesis, oogenesis, and on seasonality of reproduction of caecilians. Identification of a new species (Gegeneophis primus) of caecilian amphibian and an extensive taxonomic revision of hitherto poorly known rainforest caecilian species lchthyophis longicehalus. He has investigated the role of reactive oxygen species and the NOx complexes in metamorphosing tadpoles. His research team demonstrated that melanin has a role beyond pigmentation functions in the thyroid-mediated cascade of events in amphibian tail skeletal muscle degeneration. The research group had a serendipitous finding of a commonly used antioxidant functioning as a thyroid mimetic triggering metamorphosis. Over the last five years, he has been working on snake venom and natural product research and the area has extended been on plant based snake bite antidotes, molecular level taxonomy of snakes and venom informatics. The first report of melanistic form of Indian palm squirrel and its coat color association with Melanocortin-1-receptor (MCIR) gene were extensively researched under his guidance. **(***Ureaotyphlus oommeni***). (Dr. Oommen. V Oommen, Dept. of Zoology).**

**4.22 Development of substrates for surface enhanced Raman spectroscopy (SERS):** Development of substrates for surface enhanced Raman spectroscopy (SERS) and red emitting nanophosphors has been made. SERS substrates have been developed, including chemically synthesized gold nanoparticles with plasmon band in the near infrared and green synthesized gold nanoparticles. A new experimental method to understand the plasmon coupling between gold based nanoparticles has been demonstrated. Presently fabrication of SERS nanotags, Graphene photonics and synthesis of nanophosphors for white LEDs and displays is being attempted. **(Dr. K. G. Gopchandran, Dept. of Optoelectronics).**

**4.23 Lead molecules from Maine Organisms:** Two new cyclic depsipeptide derivatives, kahaladies R and S, together with two known congeners, kahalalides F and D, were isolated from the sacogolossan mollusc *Eysia grandifolia* collected from Palk Bay. The new derivative kahalalide R was found to exhibit comparable or even higher cytotoxicity than the potential drug candiate kahalalide F, which is under clinical trial, toward the MCF7 human mammary carcinoma cell line. This investigation was funded by DST-DAAD grant. Search for antimalarials of marine origin through multi institutional research program funded by DBT, Govt of India resulted in the discovery of several promising marine organisms and lead molecules. This was achieved by high through put Sybr green assay followed by RPHPLC purification. Purified molecules were found to be equipotent against chloroquine sensitive (3D7) and resistant (RKL9) strains of *P. falciparum*. The synthesis of the active molecules, "Lamellarins" is being attempted. **(Dr. K. Padmakumar, Dept. of Aquatic Biology and Fisheries).**

**4.24 Trawl Fishing, DNA Barcoding, and Jellyfish: Implications of trawling:** My research on the biodiversity associated with trawl fishing revealed that the trawlers land 12,022 tonnes of bycatch in the fishing harbours of Kerala coast, and explained implications of trawling in marine ecosystem. The research publications on this topic, including work on mean trophic index and review paper published in Current Science, recommended reduction of fishing pressure and use of bycatch reduction devices for the sustainable management of trawl bycatch in the southwest coast of India. These documents were later cited in several policy documents including publications of FAO and WWF, and were used as a supporting document in various courts of India to substantiate argument on ecosystem-level implications of trawling and to continue with total trawl ban during monsoon. **Use of DNA barcoding technology for documenting threatened marine mammals:** Though marine mammals are threatened and form a globally significant component of biodiversity, often those stranded along Indian coast are not properly identified due to the lack of local taxonomic expertise and poor quality of the specimens. Our research successfully demonstrated that even for identifying decayed specimens, we can use barcoding of mitochondrial genes and while the stranded Bryde's whale (*Balaenoptera edeni*) was identified using this technology in 2010, it was the second record of this species from the southwest coast of India, after a gap of about 100 years. **Serendipity but revealing:** Though I am not a herpetologist, rediscovery of Kerala Mud Snake from the Vellayani lake of Kerala was quite accidental, and we went ahead re-describing the species. However, when I have decided to expand the collaboration to understand the evolution of this

snake endemic to Kerala, we found that the freshwater Chinese Mud Snake *Myrrophis* (formerly *Enhydris*) *chinensis* and the Kerala Mud Snake *Dieurostus* (formerly *Enhydris) dussumierii* are sister species. This relationship provided potential insight into the evolution of salt tolerance in the homalopsid snakes. The study also proposed a hypothetical Asian coastal lineage, which includes the ancestor to Bennett's mud snake and the Kerala mud snake that evolved salt tolerance in Indochina or the adjacent Sunda Shelf. The species or its descendants then followed the tropical coastline of Asia where in entered river deltas and coastal swamps and evolved into many of the homalopsid species we see today. **Evidence of invasion through Suez Canal:** With the exception of documented intentional introductions, only rarely are the pathways and vectors of marine non-indigenous species (NIS) known from direct evidence. The jellyfish *Marivagia stellate* was first recorded from the Mediterranean Sea in 2006. At the time of its discovery, the authors argued that this species is a NIS, as it is highly unlikely that a large native littoral species, markedly different from all known scyphozoans in the Mediterranean Sea and the question of its origin remained unresolved. However, we have discovered this species from Vizhinjam, Kerala, India and this established the origin of this species in the Indian Ocean, and confirmed its introduction through the Suez Canal into the Mediterranean. (**Dr. A. Bijukumar, Aquatic Biology and Fisheries).**

**4.25 Micro fabrics and magnetic fabrics in the shear zones of south India:** My research interests focus on the micro fabrics and magnetic fabrics in the shear zones of south India. The outcome of such research has led to proposing models on the tectono-thermal evolution of the shear zones, which in turn are widely used in the studies of south Indian crustal evolution and correlation of Gondwanaland continental fragments. As the shear zones are the loci of mineral deposits and natural hazards the research findings have also found application in locating the natural resources and in the demarcation of potential hazard zones. In addition, I have been working on the application of geospatial technology in the investigation and management of natural resources including surface and subsurface water. The outcome of research in these two areas is being used in conjunction to solve many issues related to estimation of soil erosion risk, landslide zonation, groundwater management and morphotectonics. **(Dr. V. Prasannakumar, Dept. of Geology**).

# 5. Status of IP Management & Patenting in University of Kerala

## 5.1 Policy Initiatives

The emergence of knowledge as the major fuel of development requires us to reposition our University to ensure that the University use the great potential of traditional knowledge and human resources of Kerala to further its social and economic development. The University needs to gear up to face the new developments and approaches to intellectual property, so that the intellectual property is ploughed back into the society which funds us it for the generation of the same, without any exploitation.

The first step towards IP management in our University dates back to 1941. In the Syndicate meeting held on 18$^{th}$ July 1941 chaired by Dr. K. L. Moudgill, a proposal by the chair was approved as follows (Dr. K. L. Moudgill was himself an eminent researcher and the first Director of Research of our University)

- *The Patent shall be taken in the name or names of the persons concerned and his or their collaborators in the problem.*
- *The expenses in connection with the patents shall be borne by the University.*
- *Any profits accruing from the patents shall be equally shared between the University on the one hand and the patentees on the other.*
- *The patentees shall render free service in connection with the exploitation of the patent and the terms on which patents can be offered for exploitation shall be determined solely by the University.*

In the existing legal frame work of the University of Kerala, we can see that the above still echoes. Kerala University Ordinances, 1978, Section XIV provided for patents as follows:

1. ***Patents:-*** *It shall be competent for the Syndicate to take out patents in respect of any discovery or invention made by the teachers or research students working in the University.*
2. ***Right to be in joint name:*** *- The patent shall be taken in the joint names of the University and the person responsible for the discovery or invention.*
3. ***Expenses of registration****: - The expenses in connection with the registration of patents shall be borne by the University.*
4. ***Sharing of profits:-****Any profit accruing from the patent shall be shared equally between the University and the person responsible for the invention or discovery.*
5. ***Exploitation of patents****: - The person responsible for the invention or discovery shall render free service to the University in connection with the exploitation of the patent. The*

*terms on which patents may be offered for exploitation shall be determined solely by the Syndicate.*

The Kerala University IP Policy adopted in 2014 sets the tone for IP Management in the University as follows:

- *The University of Kerala recognizes the importance of generation of intellectual property by teachers and students and it shall do all that is within its powers and obligations to encourage increased creativity and innovation which will lead to generation of IP.*

- *As a public institution funded by the public money, the University of Kerala attaches prime importance to disseminate the knowledge it generates to the people, both locally and internationally.*

- *In case of a decision to patent an invention, the University of Kerala does not consider it as going against the principle of free knowledge dissemination, as the University would be able to, under social control; reinvest any share of returns from the licensing of the patent to further the case of IP generation and knowledge dissemination.*

- *The University of Kerala would encourage its teachers and students to take considered decision on a case by case basis to decide upon the use of the intellectual properties generated by the university. In case of inventions, this will involve a major discussion by the student and/or the teacher – "to publish or patent". In the case of publication, every effort should be made by the student and the teacher to consider an open access publication, provided other scholarly considerations are not compromised. This will ensure that results of public funded research are freely accessible to the public, without any barriers.*

- *The University of Kerala recognizes the need to educate and empower its teachers and students to encourage them to generate and manage IP as per the policies of the University.*

Action plan associated with the policy advocates promoting constant awareness about IP through:

- Conduct of IP Clinics.
- Free single window processing service to inventors in the University.
- Training on IP management.
- Liaising with the Departments and also Centre for Consultancy of the University.
- Initiating innovative measures to encourage and promote generation of IP.

As a means of encouraging generation of intellectual property, in addition to the share of profits due to the inventor (as provided in Kerala University Ordinances, 1978, Section XIV), the University has committed to consider using its own share to extend better facilities for the inventor in the department where inventors work. The University has also committed to consider appropriately rewarding persons who receive patents, to promote innovations.

Two recent books - "Open Innovation: The New Imperative for creating and Profiting from Technology" by Chesbrough and also "From Open Science to Open Innovation" by the same author discusses open innovation, a new approach. As our University's innovation scales up, in view of the social sensitivity of our University, open innovation will have to be increasingly considered in future.

## 5.2 Patent Attempts from Travancore/Kerala University

We list below the patent attempts from the University of Kerala/Travancore from its earliest days. Out of these, for the first six, no records except syndicate decisions to move for patenting, are available. Patents 7 - 10 are granted, only No. 7 being granted officially to University of Kerala. Two patents are international. Patent No. 13 – 17 are filed, with some of them pending grant for 5 years.

Decision to patent an invention, need not be seen as going against the principle of free knowledge dissemination. The Research Universities should be able to, under social control, reinvest any share of returns from the licensing of patents to further the cause of IP generation and knowledge dissemination.

***Patent 1:*** **Improved Mica Grinding Machine:** Patent in the joint names of the University and **Mr. D. L. Deshpande,** Principal, College of Engineering, Trivandrum to be taken out in respect of a mica grinding machine of an improved pattern. (Minutes of the Syndicate held on 4th December 1943 chaired by C. V. Chandrasekharan).

***Patent 2 & 3:*** **Process for Reconditioning of paper and hand machine for printing saree borders:** Patent in the joint names of **Mr. M. P. Gopalan Nair** (Principal, Institute of Textile Technology) **Mr. K. Kylas** (Professor of Textile Technology) and the University to be taken out in respect of a process for the reconditioning of written paper discovered and the hand-machine for printing sari borders invented in the Institute of Textile Technology (Minutes of the Syndicate held on 18th July 1944 chaired by Mr. H.C. Papworth, Pro-Vice-Chancellor).

***Patent 4 & 5:*** **New Method for Chemical Treatment of Monotile and New Anti-oxidant for Shark Liver Oil:** Accepted the recommendation of the Director of Research that patents in the joint names of the University and the respective research workers may be taken out in regard to (i) a new method for the chemical treatment of monazite found out by **Mr. R. Velayudhan Nair** (Maharani Sethu Parvati Bayi Research Fellow) and (ii) a new anti-oxidant for Shark Liver oil discovered by **Mr. T. A. Ramakrishnan** (Cochin Government

research scholar) (Minutes of the Syndicate held on 3rd March 1945 Mr. H.C. Papworth, Pro-Vice-Chancellor).

***Patent 6:*** **New method for obtaining baking enamel from cashew shell fluid:** Patent in the joint names of the University and **Mr. K. S. Madhavan Pillai,** Lecturer in Chemistry, University College, may be taken with regard to a new method of obtaining good quality baking enamels from cashew shell fluid discovered by **Mr. K. S. Madhavan Pillai.** (Minutes of the Syndicate held on 4th December 1943 chaired by Mr. H.C. Papworth, Pro-Vice-Chancellor).

***Patent 7:*** **Method for the Manufacture of A Protein and Polysaccharide Fraction from Black Gram:** The present invention relates to a method for the manufacture of a protein and polysaccharide fraction from black gram. The protein and polysaccharide fractions are particularly useful in the treatment of atherosclerosis, diabetes and similar conditions. In fact, the protein and polysaccharide fractions are isolated from black gram. The process of isolating the protein and polysaccharide may be accomplished by powdering the dry germinated or ungerminated black gram deflating the powder at room temperature with petroleum ether or similar solvent, extracting the defatted powder with 10% sodium chloride solution or any other protein solvents, centrifuging and dialyzing the saline extract against running water, further centrifuging the precipitated protein at room temperature and drying it to obtain the desired protein and extracting successively the saline extraction residue with 70% ethanol and 0.2% sodium hydroxide at room temperature or solutions of any other concentration or solutions of other alcohol or bases, washing the residue with water and drying it to obtain the desired polysaccharide. **Patent No. 133161 granted to University of November, 1973 (2 years[3] ). Dr. P. A. Kurup, Dept. of Bio Chemistry**

***Patent 8:*** **A New Solid Phase Method for The Preparation of Diaminoketothiazoles :** A synthetic diaminoketothiazole, its process of preparation and its use as a microtubule inhibitor, a probe ibr tubulin-microtubule system and a cytotoxic agent Diaminoketothiazole of the formula. **Dr. K. N. Rajasekharan and Collaborators, Dept. of Chemistry, University of Kerala. Patent No. 239492; granted on 23/03/2010 (6 years).**

[3] *Number of years taken for patent processing*

***Patent 9:*** United States Patent 8,158,806B2 granted on 17-04-**2012** in collaboration with RGCB and under the auspices of DBT. **Dr. K. N. Rajasekharan and Collaborators, Dept. of Chemistry, University of Kerala.**

***Patent 10:*** S. Sengupta and K. N. Rajasekharan, A synthetic diaminoketothiazole, its process of preparation and its use as a microtubule inhibitor, a probe for tubulin-microtubule system and a cytotoxic of DBT. **Dr. K. N. Rajasekharan and Collaborators, Dept. of Chemistry, University of Kerala. WIPO International Patent WO/2005/100332, 27.10.2005.**

***Patent 11:*** A patent attempt by Dr. R. Kalyesaraj of Department of Biochemistry was abandoned due to red-tape.

***Patent 12:*** **A Novel Format of Examination Answer Booklet:** Herein disclosed answer booklet comprises a fold back to the front cover page with a box cut opening in the front cover, plurality of intermediate leaves and a back cover page. While evaluation, the fold-back sheet of front cover page can be spread out for recording marks and is visible to the examiner irrespective of the page that the examiner is viewing. In accordance with this invention the said spreadsheet can be folded back to the original position after evaluation so that the processing of answer scripts will not suffer from any intricacy. It is therefore with the current invention the entire process of valuation is simplified and the problem faced by the conventional answer booklet has been rectified. **Dr. Achuthsankar S Nair, Dept. of Computational Biology and Bioinformatics, Patent No. 2883/CHE/2009; Date: 24-11-2009 (6 years).**

***Patent 13:*** **Novel Examination Answer Book Design:** The present invention relates to a novel concept in an examination answer booklet that implements a new, efficient and fool proof way of concealing the identity of the candidates. The present invention does not require conventional false numbering or bar coding to ensure anonymity of the script or the candidate thus saving considerable labour, effort and money and speeds up the evaluation process since no coding -decoding is required in the present invention to determine the candidate's real identity. The present invention incorporates a custom made transparent plastic sticker having self-sticking adhesive on one side and a scratchable opaque film on the other side. The sticker io affixed in the area containing the answer booklet number as well as the register number of the candidate/candidate code thereby concealing the original numbers before the scripts are sent out to the examiners for valuation thus ensuring anonymous nature of the script as well

as the candidate. After the valuation is over, the scratchable surface is scratched to reveal the original script number as well as the register number/ candidate's code and the marks awarded to the candidate by the examiner is entered in the system directly thereby reducing any errors in the coding-decoding process as well as saving considerable time, stationary and effort on the part of examination personnel in the University/Institution. **A. Jayakrishnan**[4] **, University of Kerala, Patent No.3181/CHE/2009, 01/07/2011 (4 years).**

**Patent 14: Inhibitors of Hepatitis C Virus:** This was an invention related to a compound that inhibits serine protease activity, particularly the activity of hepatitis C virus NS3 protease. As such, they act by interfering with the life cycle of the hepatitis C virus and are useful as antiviral agents. The invention further related to pharmaceutically acceptable compositions comprising said compounds for administration to a patient suffering from HCV infection. The application for filing the patent was sent to KSCSTE on 19-06-2009. After the database search the application was forwarded to TIFAC. They had constituted a 3 member committee empowered for the recommendation of filing patent in India. The committee has made the following observations: The molecules have to be synthesized, inventors are adviced to generate data on its activity against HCV: the test could be invitro or invivo (animal trails) and present the data (21-01-2011). Due to various reasons, it did not proceed. ***(Registrar, Amjesh R, Achuthsankar S. Nair and Sugunan V.S., University of Kerala).***

***Patent 15:*** **Biodegradable, Biocompatible Wound Healing Composition**: The present invention provides a Biodegradable, Biocompatible wound healing composition. The present invention also provides an ointment of biodegradable, biocompatible wound healing composition. The invention also provides dressing material, bandage, a kit comprising an ointment and bandage or dressing material comprising Biodegradable, Biocompatible wound healing composition. **(**Dr. **G. Muraleedhara Kurup, Thomas Sabu, Dr. Rauf Arun A., Sulaima, Mohsin**, **Dept. of Bio–Chemistry; Patent No. 840/DEL/2013; date: 10/04/2013).**

***Patent 16:*** **System and Method to Facilitate the Retrieval of Separated Endodontic Files from Human Root Canals:** System and method to facilitate the extraction of separated endodontic files from human root canals. The method facilitates the removal of separated NiTi and SS endodontic files trapped inside root canals through electrochemical process, without the removal of radicular dentin. (**Dr. S. M. A. Shibli & Collaborators**,

[4] *Dr. A. Jayakrishnan, Eminent Scientist, was Vice- Chancellor of University of Kerala. During his tenure at SCTIMST, he had held 15 patents, some of which were commercialized.*

**Department of Chemistry; Patent No. 3567/CHE/2015 A; date 31/7/2015).**

***Patent 17*: Ayurvedic Wound Healing Formulation for Diabetic Non Healing Ulcer and a Process for Preparation of the Same: A** novel herbomineral composition for the treatment of diabetic non-healing ulcer. Diabetic foot ulcer is the prime complication of diabetes mellitus, leading to lower-leg amputations. Existing treatment of diabetic foot ulcers is based on medicated dressing. Even though a wide range of dressings are commercially available, they have been reported to have side effects on long term use. An alternative method of selecting natural product is taken for the present study. The use of natural products in the manufacture of skin care products is gaining wide acceptance because of less side effects. Classical ayurvedic texts have cited effective formulations, research on which helps to develop novel effective formulations. The current invention includes the pharmaceutical modification of classical ayurvedic formulations into a user friendly and effective artefact in the treatment of diabetic foot ulcer **(Team of Junior Scientists and Faculty, Dept. of Computational Biology and Bioinformatics, 570/CHE/2015).**

## 5.3 A World- wide comparison of Patent records of selected institutions

| Sl. No. | University/Institution | Patents/Year Granted/ Applied |
|---|---|---|
| 1 | University of California[5] | 453 |
| 2 | Massachusetts Institute of Technology | 275 |
| 3 | Tsinghua University, China | 230 |
| 4 | Council of Scientific and Industrial Research, India[6] | 187 |
| 5 | Stanford University | 182 |
| 6 | Korea Institute of Science and Technology, Korea | 114 |
| 7 | IIT, Bombay[7] | 90 |
| 8 | University of Tokyo | 35 |
| 9 | Nanyang Technological University, Singapore | 25 |
| 10 | Peking University, China | 22 |
| 11 | Kerala Veterinary and Animal Sciences University[8] | 15 |
| 12 | Kerala Agricultural University | 9 |
| 13 | Mahatma Gandhi University | 6 |
| 14 | Cochin University of Science and Technology | 5 |
| 15 | University of Madras | 4 |
| 16 | SCT Institute of Medical Sciences & Technology, Trivandrum[9] | 4 |
| 17 | Rajiv Gandhi Centre for Biotechnology, Trivandrum[10] | 3 |
| **18** | **University of Kerala** | **3** |
| 19 | Kerala University of Fisheries and Ocean Studies | 3 |
| 20 | Jawaharlal Nehru University | 2 |
| 21 | University of Calicut | 2 |
| 22 | Sree Sankaracharya University of Sanskrit | 2 |
| 23 | University of Travancore[11] | 0.25 |
| 24 | University of Mumbai | 0 |
| 25 | University of Punjab | 0 |
| 26 | Kerala University of Health Sciences | 0 |

[5]Source of Sl. No. 1- 9: *Top 100 World-wide Universities which are granted U.S Utility Patents, 2014, published by National Academy of Inventors (US) and IP Owners Association (US).* Note: non-US universities may have additional patents in their home country too.

[6]Source of data of CSIR: *Spicy IP Web site:* CSIR has 1872 active Indian patents, 400 licensed (ie, about 20% commercialization). Patenting expenses of about 75 Crores, with about 2 Crores spent in filing in India. Out of 2117 foreign patents (it is not clear if they overlap; most likely they do), 813 are in U.S., 328 in EU and 147 are in Japan.

[7]Source: Media reports in 2014

[8]**Source f**or all Universities in Kerala: Chancellors Award, the data is the best filing in last 3 years. (2012-14)

[9]Source: SCTIMST web site: Data from 1983-2005: 92 Indian & 16 International Patents including that of the famous Sree Chithra Heart Valve, commercialized through TTK Healthcare.

[10]**Source on RGCB: M**edia reports available on the web – 11 Indian patents and 4 international patents (2008- 12).

[11]6 patent filings in early years of the University, whether they were granted is unknown (1937-56).

**Note:** Patents/per capita (2013) for various countries: South Korea – 4451; Japan – 3716; Germany – 2288; US – 9 Canada – 748; China – 541; Russia – 237; India- 17 (India's absolute numbers is impressive, boosted by MNC filing)

# 6. Department Level Action Plans

## 6.1 Introduction

Though every Department can innovate, it is more likely in Science and Technology Departments and also some other selected non-science Departments such as Journalism, Management etc. The candidate Departments in University of Kerala with scope for generating patents are: Physics, Chemistry, Aquatic Biology, Zoology, Botany, Bio-Chemistry, Future Studies, Geology, Mathematics, Statistics, Library Science, Bio-technology, Bioinformatics, Computer Science, Opto electronics, Environmental Science, Linguistics, Management, Commerce, Education and Psychology. Looking at tradition, the Departments of Chemistry and Bio-Chemistry have greatest potential in our University for bringing out innovations. Any initiative to promote innovation can start with a focus on these two Departments, before spreading it to others.

## 6.2 Action Plan

The identified Depts. (or to begin with, Chemistry and Bio-Chemistry Departments) may consider the following activities.

1. Provide an effective awareness and training programme in innovation to all faculty, researchers and students. This should not be limited to scholarly lectures, but should involve actionable knowledge like TRIZ problem solving methodology, creative thinking, patent process, patent claim writing etc. Local case studies should be discussed and persons who have patented and transferred technology to industries must be invited for interactions.

2. Identify even remotest scope of innovation in MSc, MPhil, PhD projects of last 3 years. The students and/or guides may be supported to try patenting them. This should not end up in red tape, a person must be authorized to process it in a time bound manner and a budget of 7 lakhs must be provided each year (estimating the cost to be around 60-80,000 for each filing, for maximum of 10 filings a year).

3. A panel of patent Attorneys may be called for and selected. Rates may be negotiated with them and the details communicated to the Departments, so that they can engage any one of them for the filing process. The expenses for filing should be met from DDF/Project funds, if available, otherwise University should provide. CUSAT has recently offered

patent advice and filing assistance including meeting expenditure, to other Universities.

4. The official procedure for proceeding with filing should be as per the IP policy approved by the University. The approach should be followed in the letter and spirit: "*University level decision on patenting shall be made liberal to encourage every kind of new ideas so that inventers are not inhibited in putting up a proposal for patenting".*

5. A subject level committee should be constituted to make recommendation to the syndicate on patenting, with one internal expert, one external expert and the Inventors as invitees. On recommendation of this committee, with the approval of the Vice Chancellor, the consent of the University should be considered inventor(s) to proceed with the patent processing, subject to ratification of the syndicate.

6. Each Dept. should meticulously identify list of client industries/institutions/business organizations/Govt. Departments that might even be remotely interested in utilizing the project/research results of the Department. Every year, an edited summary of all projects at MSc, MPhil & PhD levels should be produced and sent out to these clients. They may also try to get these institutions to suggest problems to work on, and then direct students to choose from such problems, thereby creating a useful relationship with the clients.

### 6.3 Visibility

As mentioned elsewhere in this book, the visibility of innovation activities is almost nil in University of Kerala. In the Department notice boards, web sites and media, with colorful graphics, innovation activities and achievements need to be promoted. In addition, the public relation Department should liaise with media to carry stories of innovations from Kerala University. Also, brochures, newsletters etc need to be prepared and widely circulated, especially to target industries.

### 6.4 Changes in Syllabus

As departments have action may to change syllabus, they may consider offering courses related to creativity, innovations and research with a practical perspectives. See appendix for a sample.

# 7. Industry Incubation History of University of Kerala

## 7.1 Introduction

Industry-Institute Interaction is an idea toyed many times in the past, but except in case of a handful institutions (to be precise, persons in these institutions) and in a handful areas, such interactions have never taken off in a big way. The IITs and other islands of excellence like PSG Tech, Coimbatore (which runs an industry in the campus) have proved it is possible, but in Kerala we are definitely devoid of such towering role models. Today, with the emergence of IP as a major fuel to the turbine of global economy, new underpinnings are to be considered. Invention of researchers from the University can be transferred to existing industries if their requirements are met with inventions. Another approach increasingly becoming popular is to integrate innovation with educational programmes itself and encourage students float companies in the campus around their innovations. Today, many Engineering Colleges across the State are vigorously promoting incubation of industries in the campus. With the startup village coming up in a big way, Kerala is becoming a role model for the country. A number of recent success stories of startup clearly show their University origins[12].

University of Kerala had a proud land mark in 2006 itself, with a company successfully incubated in Karyavattom Campus. The rich experience that the University gained and the highly pragmatic scheme that it evolved, are both forgotten and untapped now. This chapter documents some of it.

## 7.2 Industry Incubation Centre (IIC) at University of Kerala

IIC was established vide order no. **PlA/418/2006 dated: 14/06/06**, to provide various Departments/Institutions of the University with an attractive industry incubation facility in the Campus to promote entrepreneurship among the student community. This was aimed to ensure that the University will have a live bond with the business ventures, which incubate out of the Campus, and which will have a positive feedback effect on future students in terms of placement, industrial training etc. The University will thus become an active catalyst in economic development of the state by partnering with student-entrepreneurial ventures. Dr. Oommen V. Oommen was the first CEO of the Industry Incubation Centre (after he retired, no one was appointed in his place).

In view of the ease of setting up infrastructural requirements, the Industry Incubation

[12] *Jessica Livingston, "Founders@ work - stories of startups' Early days", 2007.*

Centers were proposed to be set up with focus on Knowledge industries. Infrastructural facilities for small and medium-scale knowledge enterprises were proposed to be provided on a subsidized basis to student entrepreneurs, by the concerned Departments, with equipment support from Industry Incubation Centers. The flow chart of processing proposals by the Industry Incubation Centre was as follows.

| | |
|---|---|
|  | Student entrepreneur(s) have a potential idea to launch a business operation. Initial focus is on knowledge-based industries. |
|  | They approach the Industry Incubation Centre with an informal statement of purpose |
|  | An expert committee consisting of technocrats, subject experts, management experts, company secretaries does brainstorming with proposers. |
|  | A comprehensive project proposal is evolved with free assistance from consultants arranged by the Industry Incubation Centre |
|  | After approval by the expert committee, the entrepreneur is given approval to move into minimal incubation facility at Industry Incubation Centre at token rent, where they can enhance the proposal, conduct further market survey, draw up detailed business plan and also explore venture funding |
|  | Registration of the company and MOU with University finalized with assistance from Industry Incubation Centers Consultants |
|  | Company starts operations at Industry Incubation Centre. It shall, on an MOU with University utilize University's facilities and also outsource work to University Departments. |
|  | As company matures; rental is increased in steps to market rates. Companies may choose to come out of Industry Incubation Centre and operate outside. |

*Fig. 7.1 Kerala University Industry incubation Flow Chart*

The business operations were required to be registered as per applicable laws of the land. The students/their assignees shall enter into an agreement with the University to the effect that (i) They shall abide by all terms and conditions to be stipulated by the University in this regard (ii) They shall not involve the University in any legal dispute or financial liability arising out of the business operations (iii) all intellectual property issues shall be mutually agreed on (in case of usage of any facilities other than unfurnished space), failing which such intellectual property shall vest with the University.

It was proposed that the University shall fix a nominal rental for the incubation facility which shall be maximum of 25% of the existing average commercial rates (excluding Techno park), for the first 6 months of operations. The rate were to be enhanced to be on par with the existing average commercial rates (excluding Techno park), for the next one year of operations, and for each year thereafter, the rates shall be enhanced unilaterally by the University (the idea being to encourage the startups to move out). Electricity, Water and Net charges shall be borne by the business concern. For any other facility of the University used by the companies, mutually agreed rates were to be arrived at first before utilization, and the same was to be remitted to the university on a monthly basis. If the company has been in an existence for more than 3 years, and has made a working profit in the 3rd year, it has to remit to the University twice the difference in rent from commercial rates for the first 6 months, or 25% of its net profit, whichever is higher. For the first 5 years during the operations within the campus and/or outside the campus, the business concern was required to undertake to train/permit project work of the sponsoring Departments or institutions, for a mutually agreed number of students, for no charges, except consumables.

THIRUVANANTHAPURAM
*** THE HINDU • WEDNESDAY, APRIL 5, 2006



# Kerala University to set up business incubation facility

## Rs.30 lakhs sanctioned for the purpose

G. Mahadevan

**THIRUVANANTHAPURAM:** The State Government has given its nod for the setting up of a business incubation facility (BIF) at the University of Kerala. It has also sanctioned Rs. 30 lakhs for the purpose. The money can be utilised for setting up infrastructure other than buildings and furniture.

Vice-Chancellor M.K. Ramachandran Nair told *The Hindu* here on Tuesday that the facility, now informally operating out of a room at the Department of Botany, would be shifted to the building of the Centre for Bioinformatics, which was scheduled to come up soon at Karyavattom. The bioinformatics company Soorya Kiran, set up by former students of the centre, is now based at the department.

"Eventually, when the multi-storey building of the Institute of Distance Education comes up inside our Palayam campus, the BIF minus its laboratories will be taken over there. The university will now proceed full steam to set up the BIF," he said.

The Information Technology Department has also promised to help the university in running the facility. The department has, reportedly, told the university that it will help the facility find space in the Technopark, should such a need arise. "The Government has, however, put one condition: no permanent post should be created at BIF that would lead to financial commitment from it. We can, however, manage BIF by taking people on contract or by other similar arrangements. The university should bear the cost for all that," Mr. Ramachandran Nair explained.

### Central computing facility

The university has also decided to set up a central computing facility (CCF) at Karyavattom that will act as a central repository of all teaching and research-related data. The facility will be set up in phases at a cost of Rs. 80 lakhs.

All the teaching departments, recognised research centres and libraries of the university will be networked, with the facility as the hub. Different software required for teaching and research will be hosted by the facility.

"The departments of commerce and management may, for instance, require the same software for teaching or research. Now, they need not purchase it separately. Moreover, the CCF will also act as a channel of communication between departments and between them and the university administration. If I want to know the current areas of research at, say, the Department of Botany, I need not call up the department," Mr. Ramachandran Nair said.

The university has commenced the work on setting up the CCF anticipating financial assistance from the University Grants Commission, he added.

## 7.3 Sooryakiran Bioinformatics (P) LTD

Students of the first batch of M.Phil (Bioinformatics) were the first to come forward to utilize the facility. Since as per the scheme, the concerned Department had to provide space, the same was initially arranged in a temporary room in Department of Botany and later in the new premises of the Centre for Bioinformatics (now Department of Computational Biology and Bioinformatics). Sooryakiran Bioinformatics was registered as a private limited company (Reg. No. 473100KL2006PTC019531) on 15th June 2006. The directors were Gopakumar G and Anoop P. K. Sooryakiran signed an MOU with the University on 17-09-07 **(See Appendix).** By January 2007, the Industry Incubation Centre provided equipments such as PC's and printers on rent to Sooryakiran. Sooryakiran Bioinformatics targeted to offer world class tools and services in the field of Bioinformatics. They focused their expertise in genome analysis, RNA analysis, SNP discovery and protein modeling. The initial project of Sooryakiran was "Cashew Germ": a database creation and management project for Kerala Agricultural University. Two successful Bioinformatics tools (Gensnip and Sifter) were delivered to the US based company, Argus Biosciences. Some Bio PHP tools were delivered for the open source project Bio PHP (www.biophp.org). The tool GEN-SNiP which finds polymorphisms present in test DNA sequences also resulted in a joint publication. (David B. Whyte, Gopakumar, Achuthsankar S. Nair and Oommen V. Oommen, "GEN-SNiP: an online tool to find polymorphisms in a genome", In Silico Biology 9, 0026(2009). (http://www.bioinfo.de/isb/2009/09/0026/).

A major project "Genome Designer" of Riken Genomic Centre, Yokahama, Japan, for developing a unique workbench for Synthetic Biology was soon awarded to Sooryakiran. This became the most significant achievement for them. The other major projects executed were Rex-RNA explorer, a tool for predicting the secondary structure of RNA with minimum energy calculation and mitEX-mitochondria Analysis Tools, an array of mitochondrial genome analysis tools. The company was also able to give projects for M.Phil students from Centre for Bioinformatics with fellowship. The turn-over of the company in two years was over 30 lakhs.

Sooryakiran later shifted its operations to Nila, Technopark. The company did not survive after it moved out, as most of its employees had moved out to more established companies. But it did not make any losses. Its employees moved out as confident and motivated individuals into the bigger business world. Its CEO, Srijith is presently a professional working with Scigenome Pvt. Ltd, Kochi. It may be noted that student startups run the risk of failure, over 90% of them are reported to close down in a few years after launch. This is to be understood as normal. Another knowledge based company Gene Locuz, which was initiated by the third batch of M.Phil students of Centre for Bioinformatics had expressed their interest to start operation in IIC. Due to various reasons, it did not go ahead.

## 7.4 Lessons Learnt

Very valuable lessons were learnt by the Industry Incubation Centre and Sooryakiran experiment. As a person who was completely involved in it, I share the same.

(a) When I asked one of the US clients as to why they chose Sooryakiran Bioinformatics to entrust their project, the US scientist told me that it was because "the company is small and it works out of an Indian University Campus"[13].

(b) The technical skills were never an issue. The real challenges were soft skills and HR management. Students struggled to write professional emails, and they could not manage the conflicts between themselves, about the future of the company, involving investors etc. There were a few who took the risk as working investors whereas a few others were non- working partners who were simply hoping that the company would grow somehow and did not want to lose control if that dream came true. They, in fact, prevented many decisions which would have helped the company overcome its limitations. The mentoring required was to solve these issue and not technical ones!.

(c) The hyper critical reaction to any change, typical of the Kerala intelligentia, naturally occurred in the case of Sooryakiran Bioinformatics also. Some in the highest body of the University initially analyzed the initiative politically (Is it a neo-liberal trap? Is it a capitalist conspiracy to finish off our University? Is it not against the idea of the University to have a business concern inside it?). There were anonymous letters sent out to all faculty members defaming me personally and alleging that Sooryakiran Bioinformatics had not ensured equity of access to all castes. (This incidentally was not

[13] *I have stood corrected from that moment; I had believed so far that these were our limitations.*

the case, even though not by design. The CEO belonged to SC and one of the two Directors was a member of ST community. In fact, Indian Express carried a news about the initiative with the title "A Dalit son rises in the sunrise sky"). When there were student strikes in the campus, Sooryakrian was forced to be closed, which was finally averted by some senior political leaders instructing the student leaders to abstain from it.


(d) The media and industries were highly supportive. All major newspapers carried positive reports on Sooryakiran Bioinformatics. Former Technopark CEO G. Vijayaraghavan, his successor Satheesh Kumar, Sri. Satheesh Babu of InApp solutions, etc. all spent their valuable time to advice the student start up. The Vice-Chancellor Dr. M. K. Ramacharan Nair, a professor of Management himself, had a special interest in the project and was constantly encouraging it. Dr. Oommen V. Ommen, CEO of IIC was a great force in the whole initiative.

(e) Media reports also cite an initiative by engineering students who claims to have been inspired by Sooryakiran Bioinformatics. Today, with the startup village, the ideas of student startups have become well accepted. Re-starting the Industry Incubation Centre will be easier now as the first reaction has been consumed. Fair criticisms may continue, but blind criticism is unlikely to be there.

## About Us

SooryaKiran Bioinformatics (P) Ltd is a unique entrepreneurial venture by the first batch MPhil. students of Centre for Bioinformatics, University of Kerala, targeting to offer world class tools and services in Bioinformatics. SooryaKiran Bioinformatics provides a bouquet of tools and services to cater national and international clients. Our target clientele are pharmaceutical companies, research and development labs, worldwide and academic institutions in the field of Bioinformatics.

Visit : www.sooryakiran.com

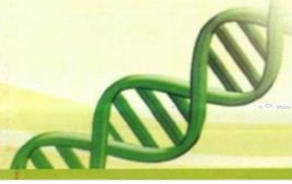
Email : kiran.soorya@ gmail.com

## Centre for Bioinformatics, University of Kerala

Centre for Bioinformatics was established by the University of Kerala in 2005 to take up teaching, research and extension activities in Bioinformatics and Computational Biology. It is a truly interdisciplinary initiative. It offers the only MPhil programme in Bioinformatics in the country

Visit : www.cbi.keralauniversity.edu

Email : bioinformatics@cbi.keralauniversity.edu



## You can trust us ...

- Proven proficiency
- Expertise and domain knowledge as a Bioinformatics company
- Strong backup in both computer science and Life Science
- Cost effective solutions
- Time bound delivery
- Continuing support
- Confidentiality of work and data
- Association with Centre for Bioinformatics, University of Kerala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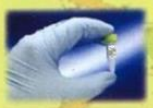
# Bioinformatics Services for Life Scientists





**Sooryakiran**

BIOINFORMATICS

Bioinformatics has emerged out of the inputs from different areas such as biology, biochemistry, biophysics, molecular biology, biostatistics, and computer science. It is the science of managing and analyzing biological information, an emerging field that combines the skills of computer science and biology. SooryaKiran Bioinformatics is here to cater your Bioinformatics needs.....

## Want to analyze DNA sequence of your interest?

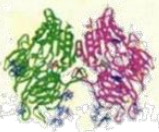
Analysis of biological sequences forms the core of Bioinformatics. As more and more genome is getting sequenced everyday there is an increased demand for sequence annotation and analysis. SooryaKiran Bioinformatics offer to analyze the DNA sequence of your interest for identifying gene, promoter, transcription factor binding site etc.

## Designing Primer....is it a big task?

Primers are used for amplifying various regions of likely functional significance in a gene of interest. SooryaKiran Bioinformatics is here to provide cost effective insilico primer designing solutions. We are using widely accepted Bioinformatics tools with high accuracy and efficiency.

## Want to model a protein?

Homology modeling is used to predict the 3 Dimensional structure of an unknown protein based on the structure of its homologous proteins. We can assist you to model your protein of interest.



## DNA Barcoding ?

DNA barcoding is the technique for characterizing each species using a short sequence from a standard and agreed upon position in the genome. Want to Barcode the flora and fauna of your interest? SooryaKiran Bioinformatics is at your service.

## Want to ponder on the secrets of evolution ?

Modern phylogeny uses information extracted from genetic material mainly, DNA and protein sequences. We offers help in analyzing evolutionary relationships among biological macromolecules using Bioinformatics techniques.

## How a protein interacts with other proteins ?

Want to study more about protein-protein interactions computationally? SooryaKiran Bioinformatics can assist you in identifying and studying the active site of your protein, studying interactions with small molecules using molecular docking techniques.

## Flood of Data ? Think about Database.

Deluge of data annoys you? Organize your data in to database. It will make the analysis and understanding of your data handy. SooryaKiran Bioinformatics is offering cost effective database techniques, management and services.

## Microarray Image to Process?

Microarray experiments and analysis of images are intended to find out the differential expression levels of genes in different tissues and at different time. This technique is particularly useful in analyzing the expression levels of genes in various disease conditions. SooryaKiran Bioinformatics offers microarray image analysis at an affordable price...

## Want computational tools to ease your work ?

Do you have difficulty in exploring and locating your biological data? Do have difficulty in handling computational tools which aid your research? Contact SooryaKiran Bioinformatics. We design and deliver Graphical User Interfaces, sophisticated tools to explore biological sequences, and various protein and DNA visualizing and evaluation tools at an affordable cost.

SooryaKiran Bioinformatics also provides world class in house and on-site training modules in the high end areas of Bioinformatics. We also offer academic projects in vibrant and significant areas of Bioinformatics.

## Our Clientele includes

**Argus Biosciences** is a pioneer in mitochondrial DNA sequencing. Their major focus is personalized DNA sequence analysis. In addition to offering sequence analysis of medically significant genes, they have recently added a suite of products in the area of molecular genealogy. www.argusbio.com

**GEN-SNiP** SooryaKiran Bioinformatics developed an online SNP extractor tool named GEN-SNiP for Argus Biosciences, USA. The main aim of this tool is to find out SNPs in a set of mitochondrial DNA sequences against any standard reference sequence. The tool is available online at www.argusbio.com/sooryakiran/gensnip/gensnip.php

**SASNET** South Asian Studies Network is a forum for scientists of South Asian Countries, Sweden and other countries for exchanging information in the field of food fermentation and its practical application. www.fermented-foods.net

## 7.5 Entrepreneurship Development Initiative

An Entrepreneurship Development Cell has been functioning in the University of Kerala in recent times. In 2012, Government issued an order sketching a Student Entrepreneurship Scheme. The order was implemented in University of Kerala vide UO No. Ad.Misc/3/H.Edn/2013 dated: 21-10-2014. The scheme explains the background as follows:

> *Over a lakh of students in both engineering and non-engineering discipline, graduate every year in Kerala. There are a significant number of students who have valuable entrepreneurial ideas which do not germinate and grow to completion, for want of the necessary environment and support. Allow students, both engineering and non-engineering to start working on innovative ideas even while in Universities. Colleges and poly-techniques, could contribute significantly to the growth a robust entrepreneur eco system in the state. Government of Kerala recognizes that it is imperative for growth of Kerala to support home grown companies through a specific incentive for student startup companies.*

The scheme details the phases and process of support to student entrepreneurs, especially on the procedure to utilize Technology Business Incubators and Startup village (see Appendix). The scheme also proposes award of grace marks of 4% and the same has been implemented in University of Kerala vide UO mentioned above. In addition, duty leave and flexibility in attendance is also provided through this UO.

## 7.6 Conclusions

An indication of changing campus climate is evident from the following news report in 2015 about a student's Union, which runs as follows:

> *"The students union at the Kerala University Fisheries and Ocean Studies (KUFOS) has formed Tesla, a club that will help students in developing business ideas in the diversified areas of fisheries, agri-business, food production, value– addition, fish processing and marine drugs. The best ideas will be transferred to the University's Centre for advanced Training in Entrepreneurship Development (CATED), for transforming into reality. "Tesla" will focus on promoting students to utilize their entrepreneurial tastes and creative ideas by organizing contests and reality shows. The club has already received a slew of ideas, such as organic aqua-culture unit, launch of fisheries outlets offering fish products and settting up an innovative aquaponic system, from the students", said students union Chairman V Shanuj. Tesla was inaugurated by Adrine Mendez, winner of the award for 'Best young Entrepreneur.*

In 2015, all Universities in the state were considering giving 5 per cent grace marks and 20 percent attendance every semester for student startup teams that had at least one woman as a co-founder. Students were also being permitted to undertake their industrial seminar, project seminar and industrial visit at Technology Business Incubators (TBIs). The Kerala Startup Policy proposes and facilitate venture capital funding of a minimum of 2,000 Crore.

The times for confidently to encourage and incubate at least 10,000 technology product startups opening the doors of our University to innovation and student startup have arrived. The whole University community needs to wake up to this reality and deliver their historic duty to development of our country.

# Appendix: A1

**Full Specification of Patent No. 133161 granted to University of Kerala in 1973**

Application and Provisional Specification filed on 7th October,1971. Complete Specification filed on 3rd October, 1972. Acceptance on 24th November, 1973.

**"METHOD FOR THE MANUFACTURE OF A PROTEIN AND POLYSACCHARIDE FRACTION FROM BLACK GRAM"**

THE UNIVERSITY OF KERALA, OF TRIVANDRUM, KERALA STATE, INDIA

*The following specification describes the nature of this invention:-*

The present invention relates to a method for the manufacture of a protein and polysaccharide fraction from black gram. The protein and polysaccharide fractions are particularly useful in the treatment of atherosclerosis, diabetes and similar conditions. In fact, the protein and polysaccharide fractions are isolated from black gram.The process, in short, of isolating the protein and polysaccharide may be accomplished by powdering the dry germinated or ungerminated black gram defatting the powder at room temperature with petroleum ether or similar solvent, extracting the defatted powder with 10% sodium chloride solution or any other protein solvents, centrifuging and dialyzing the saline extract against running water, further centrifuging the precipitated protein at room temperature and drying it to obtain the desired protein and extracting successively the saline extraction residue with 70% ethanol and 0.2% sodium hydroxide at room temperature or solutions of any other concentration or solutions of other alcohol or bases, washing the residue with water and drying it to obtain the desired polysaccharide.

Details of the process are described here in after. In order to isolate the protein and polysaccharide fraction, black gram is first powdered. It is however, preferred to use black gram which is germinated and dried in an oven to a temperature which may be less or more than say, $60^0$ C. The drying need not necessarily take place in an oven only but it can be by hot air, sundrying or any other methods. The powdered gram is defatted with petroleum ether (b.p. 40-$60^0$ C), petroleum ether (b.p. 60-$80^0$C) hexane, ether, benzene or any similar solvent. The defatted powder is thereafter extracted with 10% sodium chloride or sodium chloride solution of any other concentration, or other buffer solutions, dilute alkali, aqueous dilute alcohol, or any other protein solvents. The temperature of extraction may be room temperature or a temperature lower or higher than ambient temperature.

The protein can be obtained by dialysis, dilution of the extract with water or precipitation with ammonium sulphate, sodium sulphate and other salts or precipitation with alcohol, acetone and other similar solvents, or by any method, involving chromatography or gel filtration or similar process. The protein precipitate can be obtained by centrifugation, filtration or any other similar process.

Finally, the protein precipitate is dried in vacuum at room temperature (lower or elevated temperature) or at ordinary or high pressure or at any temperature or by blowing hot air, or any other process involving the use of dehydrating agents like alcohols or other similar solvents. For the isolation of polysaccharide the residue after protein extraction is extracted successively with 70% ethanol and 0.2% sodium hydroxide (or solutions of any other concentration) or solutions of other alcohols or bases. The residue after the

extractions is washed free of alkali, dried at $60^0$C at atmospheric pressure or any other temperature and pressure or by blowing hot air or any similar process.

**Example**

The black gram was germinated and then dried at $60^0$C in an oven and powdered. The powdered gram was defatted with petroleum ether (40-$60^0$) either in sochlet or in an aspirator or other containers at room temperature or any device where the material is kept in contact with the solvent i.e. petroleum ether. The defatted powder was extracted thrice at room temperature with 10% sodium chloride solution for 24 hours in a mechanical shaker. The saline extract was centrifuged and dialyzed against running water for 48 hours followed by dialysis against distilled water for 24 hours or alternatively the saline extract was diluted with water. The precipitated protein was centrifuged off and dried in vacuum at room temperature. This product furnishes the protein. The residue, after protein extraction, was extracted successively with 70% ethanol and 0.2% sodium hydroxide. The extraction, with each solvent, was carried out thrice in a mechanical shaker at room temperature for 24 hours. The residue after the extraction was washed with water till free of alkali and dried at $60^0$C. The product furnishes the polysaccharide.

Dated $7^{th}$ day of October, 1971.

**WE CLAIM:**

1. A process for the manufacture of a protein and polysaccharide from black gram which comprises powdering black gram, defatting the powder at room temperature with a

solvent as herein described, extracting the defatted powder with a protein solvent, centrifuging and separating the extract, precipitating the protein by any of the methods as described, herein further centrifuging the precipitated protein at room temperature and drying it to obtain the desired protein, extracting the residue so obtained after protein extraction successively with an alcohol and a base as herein described herein at room temperature, washing the residue with water and drying it to obtain the desired polysaccharide.

2. A process as claimed in Claim 1, wherein the black gram is dry germinated black gram.
3. A process as claimed in Claim 1 or 2, wherein the solvent for defatting the powder is petroleum ether (b.p. 40-60$^0$ C).
4. A process as claimed in Claim 3, wherein the solvent is petroleum ether (b.p. 60-80$^0$C) hexane.
5. A process as claimed in Claim 3, wherein the solvent is ether.
6. A process as claimed in Claim 3, wherein the solvent is benzene.
7. A process as claimed in any of the proceeding claims wherein the protein solvent is 10% sodium chloride.
8. A process as claimed in Claim 7, wherein the protein solvent is aqueous solution like butter solutions, dilute alkali or any other protein solvent.
9. A process according to any of the preceding claims, wherein the defatted powder is extracted with protein solvent at room temperature.
10. A process as claimed in any of the preceding claims wherein the step of separating protein from protein extract is carried out by dialysis.
11. A process as claimed in Claim 10, wherein said step is carried out by dilution of the extract with water.
12. A process as claimed in Claim 10, wherein said step is carried out by precipitation of the protein extract with ammonium sulphate or sodium salts.
13. A process as claimed in Claim 10, wherein said step is carried out by precipitation of the protein extract with alcohol or acetone.
14. A process as claimed in Claim 10, wherein said step is carried out by chromatography or gel filtration of the protein extract

15. A process as claimed in any of the preceding claims wherein the step of drying to obtain the protein is carried out in vacuum at room temperature.
16. A process as claimed in any of the preceding claims wherein the residue after protein extraction is extracted successively with 70% ethanol and 0.2% sodium hydroxide.
17. A process as claimed in any of the preceding claims wherein the polysaccharide is dried at $60^0$ C and at atmospheric pressure.
18. A process for the manufacture of a protein and polysaccharide from black gram substantially as herein described with reference to the foregoing example.

Dated this $28^{th}$ day of September, 1972

# Appendix: A2

## A2.1 Selected Patents from Kerala

1. **Patent No. 192670; Date: 25/08/1995 (10 years): "A COCOUNT HUSKING TOOL":** A coconut husking tool with a stationary wedge, a movable wedge, a lever, and a pedestal having a base is described. The stationary wedge is mounted upright on a convenient pedestal having a base. Bottom of the movable wedge is hinged below the stationary wedge facilitating its opening and closing. The lever fixed nearly perpendicular to the movable wedge at its bottom provides the necessary mechanical advantage in husking. Self-weight of the lever forces the two wedges together forming a larger wedge. Holding the coconut with both the hands it is thrust onto the wedge piercing the husk at its pedicel end and parallel to its longitudinal axis. On pulling the lever upward a sector the husk is loosened off the nut. The operation is repeated for the other two or three sectors and the nut is retrieved. **Jippu Jacob, Joby Bastian Kelappaji College Of Agricultural Engineering And Technology, Malappuram.**

2. **Patent No. 191547; Date: 08/08/2005 (9 years); "LATEX BASED ADHESIVE COMPOSITON":** The latex based adhesive composition of this invention has controllable viscosity and enhanced penetrating properties. The composition has a blend of centrifuged rubber latex or creamed rubber latex, casein dissolved in ammonia, starch solution having granules disrupted by treating in water, known vulvanising agents, accelerators, preservatives and antoxidants. The viscosity of the adhesive composition can be varied as required by changing the proportion of latex, starch and casein. **(By Veliyil Velayudham Pavithran, The Travancore Mats Matting Co; Pb No.5, Cherthala).**

3. **Patent No. 225516; Date: 27/03/2009 (6 years); "A NOVEL PROCESS FOR THE PRODUCTION OF OLEORESIN FROM FRESH GREEN CHILLI":** 'The present invention relates to a novel process for the production of oleoresin directly from fresh green chilli (Capsicum \ L.). This invention leads to the production of an oleoresin conforming to the quality characteristics of the product now being produced commercially from dried ripe chilli with reference to its pungency. The product has the additional advantage of having the characteristic green chilli flavour. High pungent green chilli **powder** is a useful by product in the process. **(By Sankarikutty Amma, Padmakumari Amma, Chami Arumughan, Sumathikutty, Ambujam Nirmala Menon, Sreekumar, RRL (CSIR), Trivandrum).**

4. **Patent No. 211865; Date: 11/01/2008 (9yeras); "AUTOMATED MULTILEVEL MODULAR SYSTEM FOR PARKING VEHICLES":** This application discloses an Automated Multilevel Modular System for Parking Vehicles which comprises a parking system provided with a platform which is removable and capable of rotation within its axis ; having a plurality of circular parking racks for parking vehicles, the system also provided with an entry/exit section wherein a vertical telescopic shaft having plurality of threaded blocks capable of moving up and down on its axis by a screwing mechanism, each block having at its bottom locking means for preventing the block from going down beyond a predetermined position in the shaft, the vertical telescopic shaft facilitating the indentifying placing and removing the vehicle appropriately. **(By Shri. Joy Abraham, Manna, Gandhipuram, Sreekariyam, P.O. Trivandrum 695017).**

5. **Patent No. 204289; Date: 29/06/2007 (3 years); "A METHOD FOR NOISE REDUCTION IN DATA ACQUISITION SYSTEMS" :** The invention relates to a method for eliminating noise in data acquisition systems. The signal to be acquired is sampled and digitized at a rate that is several times the required sampling rate. Then the sample values are averaged to derive a single representative value that is free of the influence of high frequency random noise. To eliminate the effect of low frequency systematic noise, the number of samples to be averaged must be an integral multiple of fs/fn where fs is the sampling frequency and fn is the noise frequency. Over sampling of the input signal simplifies the anti-alias filter requirements. System calibration techniques may be employed to further reduce the effect of component non-linearities, offsets, reference errors etc. and a digital multiplier, to enhance the measurement range. **(By Sreekumar Sankarattil, Sreelal Sreedharan Pillai, Sumalayam Ponnamma Sumadevi, Vikram Sarabhi Space Centre Trivandrum 695022).**

6. **Patent No. 250229; Date: 23/12/2011 (6 years); "ELECTRICAL FLOOR CLEANING MACHINE":** An automatic floor cleaning machine which can be used for scrubbing or for mopping or as a machine which carries out both the activity simultaneously. The components of the machine are mounted on a frame made of aluminum angles and consist of a single phase induction motor coupled by a belt and pulley arrangement to a crank shaft carrying two cranks spaced 180 degree apart and carrying two connecting rods the other ends of which are connected to two brush holder fixing units which are prevented from tilting by four bearings resting against a smooth surface on the top of the frame. The travel of the brush holder fixing units is restricted to a straight line by a guide rod fixed on two

supports on the frame. When the machine is switched "ON" brushes come together and move apart along the same line thus mopping on the floor repeatedly. Electric supply to the machine is effected through a flexible cable carried through a hollow handle which carries a touch switch for controlling an "ON-OFF" contactor. The status of machine is indicated by LEDs. Water for cleaning is can be sprayed manually or by a tank fixed on the frame having nozzles. A brush cleaning tray having two inlets and two outlets for entry and overflow of water carrying a stainless steel grill welded at both ends also forms part of the invention For cleaning the brushes the machine is placed on the above tray so that the brushes portion rests on the grill. Fresh water is let in through inlet holes of the tray and the machine is switched "ON". The brushes will wipe over the grill and the dirt get removed from the brushes and the dirty water will flow out through the outlets. The machine can then be used for further cleaning. **(By Boby Kurian, C/O Mathew K Thomas, Anugraha, Gnp 116, P.O. Peroorkada. Thiruvananthapuram-5 Kerala).**

7. **Patent No. 242563; Date: 03/09/2010 (6 years); "DEVICE FOR PREVENTING SNORING" :** A device for preventing snoring comprising two flexible, hollow, tabular members/tubes with a plurality of holes at rearward end, an elongated flexible connector being used to connect the said members/tubes there-between at forward end, each of the members /tubes adapted for insertion into a nostril of a person, outer surface of the each of the members being smooth, for comfortably engaging the nostril to prevent accidental removal of the member from the nostril. **(By E.K. Abdul Rahman, Hibathullah Manzil, Near G H S Koduvally P.O, Calicut, Kerala-673 572).**

8. **Patent No. 242544; Date: 03/09/2010 (5 years); "AN AYURVEDIC MEDICINE FOR CURING VIRAL HEPATITIS AND THE LIKE DISEASES" :** An ayurvdic medicine / formulation for curing viral hepatitis /jaundice, Australia antigen, chronic hisnophilic cold and the like diseases by flushing out of the body excess biluribum and virus comprising extract of dry fibrous fruit of Luffa Aegyptiaca / Luffa Aegyptica / Luffa Cylindrica or Aluffa Acutangula or Luffa Operculata and seeds of Cuminum Cyminum, human breast milk / animal milk / water forming a homogeneous solution. **(By Jacob Susamma Kondooparampil House, Kalpetta, Wynad, Kerala, Thomas K JacobKondooparampil House, Kalpetta, Wynad, Kerala).**

9. **Patent No. 221871; Date: 12/09/2008 (5 years); "A WATER LEVEL INDICATOR":** A water level indicator comprises a sensor adapted to be connected one of its end to a cable

which is wound on a rolatable wheel mounted on a stand, the other end of said cable is connected to a circuit having means for a audio and video signals, this circuit having means being connected to the power supply means -fixed on said wheel, a handle being provided with said wheel for facilitating winding and unwinding of said cable thereon.**(By Markose Eldose, Karikkathottathil, Chennaippara, Peechi, Thrissur District, Kerala 680 653).**

10. **Patent No. 207634; Date: 02/11/2007 (4 years); "A MANUAL WASHING MACHINE":** The invention provides for a manual washing machine for cleansing clothes comprising an outer casing (1) having a cover on the top end thereof, wherein a cylindrical perforated drum (2) mounted on a shaft (3) being disposed in said casing rotatably, pedals (9) secured with said shaft being provided on both sides of said casing, an opening being provided on one side of said perforated drum for loading and unloading the clothes in said drum, a water inlet (10) is provided at the top end of the said casing, an outlet (12) being provided at the bottom end of said casing. Fig 1. **(By Jose Ramya, Malappuram , Kerala-676521).**

11. **Patent No.200983; Date: 02/02/2007 (7 years); "AUTOMATIC COCONUT PALM CLIMBER":** The automatic Coconut Palm climber can climb the Coconut tree or any other pole to any height as wished by the operator on ground and carry any type of tools to carryout operations such as cutting any bunch of Coconut, or leaves spray pesticides, fell the tree piece by piece and climb down. These tools for different duties will be designed later. **(By P.M. Cleetus, Pandialakal, Ottemassery Thiackal, P.O., Cherthalai, Kerala - 688554).**

12. **Patent No. 200731; Date: 23/02/2007 (4 years); "A CUPBOARD SAFETY MECHANISM TO PREVENT FORCED OPENING OF THE CUPBOARD DOOR":** A Cupboard safety mechanism to prevent forced opening of the cupboard door, which consists of an angular, structured slot made on the lever, and it acts uniquely such that when once the door is closed, handle of the door gets set right and the angular, structured slot will exactly fit into the bolt given in the cage and this creates a fool proof locking mechanism, jamming the door, when it is tried to be opened forcibly. **(By Jacob Mathew Relish Sho Shops Ltd., Relish Tower, M.C Road, Thiruvalla, Kerala, India).**

13. **Patent No. 199157; Date: 09/06/2006 (3 years); "INVENTION OF A NEW DEVICE TO DESTROY MOSQUITOES":** Equipment invented to control and annihilate mosquito genus. The main parts of this equipment are plastic containers having two doors at top part and net. Pockets fixed on doors. The meshes of net pocket are small that only eggs of mosquitoes can pass through and not a mosquito. Water filled in the container attracts female mosquitoes to lay eggs. The mosquito eggs reach the bottom of containers through mesh of net pockets and become new mosquito but because they are under net pocket they cannot fly out and die. **(By Muthukulathil Joseph, Puranjan, Post Chemperi, Kannur District, Kerala State, Pin 670 632).**

14. **Patent No. 198668; Date: 23/02/2007 (7 years); "SOLAR MOSQUITO DESTROYER":** This invention is a Solar Mosquito Destroyer, a non-mechanized device for trapping and destroying mosquitoes and houseflies consisting of a gas inlet tube which has fine perforations and covered with fine mesh on the inner end and through which biogas from a drainage tank or septic tank or such other sources flow in; a system box to which the inlet pipe is fitted; a gas exhaust tube through which mosquitoes enter the system box; a transparent plate on the lid of the box and a trap hole on the lid of the box at one end of the plate; a transparent conical tube fixed just over the trap hole so as to cover it; and a solar finance into which the mosquitoes pass through the vertical tube which they enter through the trap hole. The operation of the device being such that the mosquitoes being attracted by the gases flowing out through the gas exhaust tube, enter the system box through the gas exhaust tube and on entering they tend to fly towards the transparent plate attracted by the sun light seeping in through the transparent plate ultimately finding their way to the trap hole; the upward flight trough the transparent conical tube taking the mosquitoes to the solar furnace at the top of the device there to perish with the heat of the sun; the trapped mosquito bodies being clearable by detaching the reservoirs on either side of the solar furnace**. (By Mathews Kaithavayalil**, **Mathew Kaithavayalil House, Vanchimala P.O, Kerala 686 508).**

15. **Patent No : 197050 ; Date: 23/11/2007 (6 years); "A PROCESS FOR THE PRODUCTION OF LAURIC RICH COCONUT OIL AND PROTEIN RICH FRACTION":** The present invention discloses a process for the removal of phenolic constituents of test a from fresh coconut to result in the production of a lauric rich coconut oil and a protein rich fraction, by removing copra and/or coconut kernel from coconut, treating the copra and/or coconut kernel with hydrochloric acid, separating the treated

copra and/or coconut kernel and removing the excess acid by washing it with water, drying the treated copra and/or coconut kernel, extracting the dried and treated copra and/or coconut kernel with a food grade hexane as solvent to obtain lauric rich coconut oil and protein rich fraction containing extract. **(By Natarajan Sreedhara, Regional Research Laboratory, CSIR, Thiruvananthapuram - 695 019, Kerala).**

16. **Patent No. 193206; Date; 24/07/2009 (14 years); "MAKING AIR CONDITIONED COT":** An air- conditioned cot comprising a cot and a flexible hood over the cot. The hood provides an enclosed space over the cot. This enclosed space is air conditioned so that a very low capacity air-conditioner is sufficient. The hood will be of thermally insulating flexible material and can be rolled up and down on a support structure on the cot. A safety door that opens automatically when the air-conditioner stops is provided on the support structure. This is accomplished by using expandable bladders or bellows that expands by the air pressure from the air-conditioner to close the door. Some areas on the hood and structure are made transparent to have visibility. A tailor made low capacity air-conditioner is connected to the cot using flexible hoses. **(By K. Krishnakumar , Pranavam, Kottapoyram, Tripunithura, Ernakulam, Kerala at Tripunithura-682301).**

17. **Examples of patents from a private Engineering College:** (Amal Jyothi Engineering College has established reputation for innovation): Intelligent light dimmer for automobiles E- Diagonoser, Temple security system, Cocobot – robot for coconut harvesting, Low cost pepper separator, Robot for bore-well rescue, Gum from thermocol, Electricity from home water tank, Economic fuel consuming vessel, Low cost creep testing machine with data logging and internet access, Low cost advanced cardmom drier, Solar based AC system, Low cost pepper separator, Bevel gear used universal joint, Universal adjusting spanner, Cellular Anaeorbic digestion, Ergonomic waste compacter.

18. **Patent applications filed in patent office through PIC, KSCSTE:** As on June 2015, 24 Patent applications were filed through PIC-Kerala. Among them, 19 applications are from R&D Institutions, Universities and Colleges. 5 applications are from financially poor grass root innovators were also filed through PIC and the expenses for the drafting and filing of these applications were borne by PIC.

| Sl. No. | Title of Invention & Name of the Inventor(s) | Institution |
|---|---|---|
| 1 | Water sampling device, Dr. E. J Zachariah , Mr. C. J Jhony | Centre for Earth Science Studies, Trivandrum |
| 2 | MCF7-Bid Ds Red stably expressing cells as a tool for large scale screening of anticancer agents, Dr. T. R. Santhosh Kumar | Rajiv Gandhi Centre for Biotechnology, Trivandrum |
| 3 | Cancer diagnosis using diffuse reflectance spectral Ratio R540/575 of oxygenated hemoglobin absorption peaks, Dr. N. Subhash | Centre for Earth Science Studies, Trivandrum |
| 4 | Tooth caries detection by curve fitting of UV laser- induced fluorescence emission, Dr. N. Subhash | Centre for Earth Science Studies, Trivandrum |
| 5 | Use of Dially trisulfide (DATS) as an inhibitor of Nuclear Factor-kappa B and for synergistic effects with anti-neoplastic agents", Dr. D. Karunakaran | Rajiv Gandhi Centre for Biotechnology, Trivandrum |
| 6 | Suction Irrigation, Dr. George Mammen | Centre for Water Resources Development & Management, Kozhikode |
| 7 | Photo acoustic Scanning STIC | Sophisticated Test and Instrumentation Centre, CUSAT |
| 8 | Chalcone Synthase (Chs) Gene From Ginger, Dr. E. V. Sonia | Rajiv Gandhi Centre for Biotechnology, Trivandrum |
| 9 | Synthesis and anticancer activity of a novel CU(II) carbohydrazone coordination Complex Dr. Priya Srinivas & 3 others | Rajiv Gandhi Centre for Biotechnology, Trivandrum |
| 10 | Cryogrinding of Cured Vanilla Beans without loss of Volatile Constituents, Dr. Mini Abraham, Dr. K B Sheela, Dr. R. Rajendrakumar | Kerala Agricultural University, Thrissur |
| 11 | Pressure sensor for the pressure range 0-120 kpa based on E-field sensing, Dr.Jacob Philip, Ginson T.J. | Sophisticated Test and Instrumentation Centre, Cochin |
| 12 | Multi Slotted orifice plate for flow, measurement of liquids Dr. Nagaraj Sitaram Raghu Varma Sagi | National Transportation Planning and Research Centre, Trivandrum |
| 13 | Novel oral dehydration agent for enhancement of water and electrolyte absorption in acute diarrhoea. A. Subramoniam & 7 others | Tropical Botanical Garden & Research Institute, Trivandrum |
| 14 | Studies on metabolite production in callus cultures derived from gamma irradiated seedlings of Andrographis paniculata, | Sanatana Dharma College, Alappuzha |

| | | |
|---|---|---|
| | Dr. Susila Kuruvilla Dr.P.Unnikrisha Pillai | |
| 15 | Lygodium palmatum for use as a biopesticide Dhaniya M V, Dr. Susha Dayanandan | University of Kerala, Trivandrum |
| 16 | Power shifting device for regenerative braking system, Jebin Thomas, Dr. Sadiq. A., & 4 others | TKM College of Engineering, Kollam |
| 17 | RFID based smart library system Vishnu, Varun, Karthika, Arya, Divya | College of Engineering, Perumon |
| 18 | Low cost pepper separator M.S. Steve & 4 others | Amal Jyothi College of Engineering, Kottayam. |
| 19 | A Novel Process for Cashew Cutting and Peeling, Dr. V.P.Potty, Dr. Sabna Prabhas S, Vincent Vineeth Leo, Vinod Viswanath | C.E.P.C Laboratory & Technical Division, Kollam |
| 20 | 'High efficiency wood burning stove for community use', Jayaprakash. V. | Not attached to institution |
| 21 | 'Horizontal three stroke safety door lock with a single key and simultaneous handle locking system', Natarajan. M. | " |
| 22 | Design & Development of new models of firewood burning stoves with high efficiency, Santhosh C.J. | " |
| 23 | 'Plant Climber arrangement', S. Madhusoodhanan Nair | " |
| 24 | 'Micro Springler' , M. Avaran | " |

## 19. Some local innovations reported by media

Hindu BusinessLine

# Patent for solar mosquito destroyer

**Our Bureau**

*Thiruvananthapuram, April 27*

A solar mosquito destroyer that traps the insect in a transparent plastic contraption and fossilises it has earned a coveted India patent.

The invention has been put to use by leading hospitals to good effect, says Mr Mathews K. Mathew, the inventor from Kottayam district. He has been conducting researches in pest control for the last 12 years, all on his own.

Mosquitoes and houseflies as vectors are a serious public health concern and the existing control measures either suffer from drawbacks or are themselves blamed for causing unwelcome side effects.

**HOW IT WORKS**

The solar mosquito destroyer offers a cost-effective and environment-friendly solution to destroy mosquitoes. It works simple: attract the flies from a drainage/septic tank and trap them into the translucent top ('solar furnace'), where they perish in the heat of the Sun. Mosquitoes have low heat resistance capacity.

During summer and dry seasons, natural water resources dry up, denying a safe haven for mosquito larvae to grow.

The flies in turn get attracted to the comparatively cooler and humid homes. The chemosensory abilities guide the flies into septic/drainage tanks where they multiply by several folds.

The mosquito destroyer uses the fuming biogas escaping from these tanks, a big 'turn on' for the flies, to trap and expose them to their death. But one caveat is in order: it has to be fitted in such a manner that the sunlight hits the solar furnace directly.

# An innovation at their fingertips

**By Athira M.**

April 19

**Five ambitious students of UIT, Kuravankonam, have developed a new fingerprint identification system**

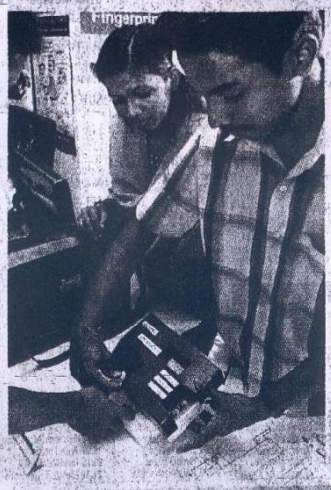
Nature never duplicates — the theory on which fingerprint identification, the ultimate weapon in crime fighting, is based. The common procedure involves the use of computer and manual identification. An ambitious group of students at University Institute of Technology, Kuravankonam, has, however, charted a different course of action.

The students, doing their final year at the Department of Electronics at the institute, have developed a new fingerprint identification system as their study project. The equipment, titled 'Live Digital Identifier', has been displayed at the Kerala Police Fingerprints Bureau stall at the ongoing Police exhibition at Chandrasekharan Nair Stadium as part of the golden jubilee celebrations of Kerala Police.

"In the present system, the computer plays a role in matching and shortlisting the fingerprints. And you need the help of an expert to give the final result. But our equipment does both fingerprint identification and retrieval. They are done using a biometric sensor and the respective software development kits (SDK) where manual identification is completely reduced," says Sreejith K.Nair, one among the five students who prepared the project.

The others in the group are Unnikrishnan S.P., Ajay Thomson, Sarath Kumar J. and Preetha S.

Instead of the computer, the device uses an interfacing mode. The FDA01 fingerprint recognition module, which has been imported for the purpose, comprises an optical sensor as scanner and processing board. There is a high-speed CPU and accurate performance algorithm. It has got faster recognition speed. Since it contains CPU and memory in the processing board, the user enrollment and authentication for fingerprint recognition are available without using a separate PC.



Sreejith K.Nair and Preetha S., students of University Institute of Technology, explaining the working of Live Digital Identifier at the police exhibition. Express

The system has a built-in fingerprint authentication function. It can upload or download the user's fingerprint data. Depending on flash memory, the information on any number of users can be stored, says Preetha. The students have spent nearly Rs 45,000 on the whole project and they were ably guided by the Fingerprint Bureau.

The students also suggested that as a next step, the data collected in the equipment can be stored in a computer and this database can be put to use by the fingerprint bureaux, passport offices and airport migration offices. "We have not yet reaped the benefits of using the biometric identification technology. These students have done a laudable work. Unfortunately, we have no provision to support them financially," says Fingerprint Bureau director Mohammed Easa.

■ See also P 3, 4

THE HINDU - 08/05/2007

# A machine to make chappati

The hot, tasty chappati on your plate may soon be hands-free. Six final year students of the Department of Mechanical Engineering, Sree Chitra Tirunal College of Engineering at Pappanamcode have developed an automatic machine that can churn out chappatis in large numbers without being touched by hand.

The automatic chappathi maker uses a digitally controlled process to weigh and mix the flour into dough and to roll and bake it into the final product. The size, thickness and number of chappatis can be digitally controlled.

The machine has been developed for use in hotels, restaurants and canteens with large requirement of chappathis. The weighing system consists of a hopper that can store and dispense the required amount of material to the mixing chamber. There are three weighing chambers for flour, hot water and oil.

The three ingredients are blended using a shaft and blade arrangement in the mixing chamber. The dough is then passed through a squeezer and cut into pieces. The cut pieces are transferred to a drive mechanism to flatten the dough. The baking system consists of two discs provided with heating coils.

A wiper mechanism is used to wipe out the chappati to a collecting vessel. It also cleans the plate after baking. Hydraulic systems are used to control all the motions.

**INGENIOUS:** *The team which developed the machine.*

The students who developed the machine, P.R. Ganesh, S. Lijo, S. Hareesh, S.V. Harikrishnan, A.S. Jithin and G. Jino, are confident that the simple design, low cost and high productivity of their invention would appeal to the potential users. By varying the addition of ingredients and the design of the machine, it can also be used for preparation of other food items like nan, roti, batura and puri.

T. NANDAKUMAR

HINDU BUSINESS LINE

# Infrared device for night drives wins patent

**Our Bureau**

*Thiruvananthapuram, May 7*

Poor traffic sense and deplorable driving habits combined with abysmal condition of roads go to make Kerala a motorist's nightmare.

The threat perception gets further amplified during nights when drivers aim to 'beam' each other into submission by blazing away with high-powered headlights. They refuse to 'dim' to make way clear for the opposite number, resulting in accidents, injuries and even deaths.

Vehicle manufacturers don't seem unduly perturbed about this 'anomaly' and service providers couldn't care less, during sales or after. Even if it has meant leaving a prospective safety glitch unattended, or worse, playing with customers' lives!

**THE INVENTORS**

An enterprising inventor from Malappuram in Kerala is offering a helping hand thanks to a patented technology for automatic lighting and signalling system in vehicles. He claims that this will help bleary-eyed drivers negotiating treacherous road stretches find a safe way home.

According to Mr T.P. Abdul Razak, inventor, and Mr Shanmughan Unni, co-inventor, accidents during night happen largely because drivers do not show the courtesy to dim or dip headlights, resulting in temporary blackout.

Not are proper signals served to vehicles coming from behind. Drivers also don't keep the right distance and go overboard jumping lanes without assessing room.

Vehicles parked on the kerb or those stalled due to mechanical problems have also been involved in accidents. Ill-lit road tunnels and subways are other accident-prone areas.

**ONE-SWITCH SOLUTION**

Mr Unni and Mr Razak say the electronic equipment working on their patented technology will offer a 'one-switch solution' to all these problems. It makes use of infrared rays and is unaffected by intervening mercury light, fluorescent light or neon lamps.

The technology helps automatically dip/dim, at the right distance, headlights of vehicles approaching from opposite direction. The lights will be set back to original power as the vehicles pass each other.

Those coming from behind will be given a 'don't overtake' message in case if there is another one heading in from the opposite direction. If the road is empty, an 'OK' message will be promptly beamed.

Drivers will be alerted to 'switch themselves on' when there is not sufficient light in the evenings. Similarly, a vehicle trailing another will be given a 'there is no room for you, please don't overtake' message if the distance between itself and another cruising just ahead is less than the required to accommodate the aspiring driver.

Messages are flashed with respect to stalled vehicles on roads, whether or not their own lighting/switching conditions are working.

The equipment requires no switches or remote control system and is activated automatically. The inventors are confident that the instrument could be made available for no more than Rs 500 apiece on bulk production. A few parties have made business inquiries, Mr Unni said.

# A2.1Patents from Travancore (1921-25)

The following list is from the Annual Reports of Administration of Travancore. It gives a glimpse of some early patents from the states.

## 1.1921-22 (30 patents, 4 from Travancoreans)

1. An improved apparatus for speedily drying monazite and other mineral-bearing sands before concentration or separation.
2. Visible Malayalam Typewriter.
3. Manufacture of match boxes from the sheathing petioles of all species of plantains (Musa Paradisiaca).
4. Manufacture of matches from the leaf-stalk of the cocoanut tree.

## 2. 1923-24

1. The Rapid Tapioca Slicer (Mr. Panachikal John Kurien, a Travancorean)
2. Improvements in or relating to the system of raising liquids.
3. .Do.(the specification being different from that for No. 2)
4. Improved methods of recovery of calcium oxalate and the like from trees.
5. Process for obtaining oxalic acid or its salts.
6. Recovering calcium oxalate or other oxalates from trees.
7. Improvements in and relating to the manufacture of paints.
8. System of operating fluid for prime movers.

## 3.1924- 25

1. Improvements in or relating to power driven vehicles for service on roads and rails.
2. Improvements in or relating to motive power vehicles for service on roads and rails.
3. Improvements in and relating to the manufacture of Caoutchoue, Guttapercha, Balata and analogous Vegetable resins.
4. Electron Discharge Device
5. Method of generating positive Ion current and apparatus therefor.
6. Improvements in or relating to blow off cocks
7. Marine Tractor Plough (Mr. Panachikal John Kurien, a Travancorean)
8. Methods of and means for packing tea or other loose material into boxes or the like.
9. Improvements in or relating to tea leaf rolling machines.

# Shreya, Nanma in pest fight

Special Correspondent

**THIRUVANANTHAPURAM:** Scientists at the Central Tuber Crops Research Institute (CTCRI) here have developed two new biopesticide formulations found to be effective in protecting horticultural crops against sucking pests.

The research team led by C.A. Jayaprakas, Principal Scientist (Entomology) and Head, Division of Crop Protection has standardised the use of the biopesticides for pest management. The products named Shreya and Nanma have been taken up for field application by the Sanghamythri Farmers Producer Company at Pallichal near here.

Among the sucking pests, mealybugs, which are common in almost all vegetable crops, are highly resistant to insecticidal treatment as their body is well guarded by a waxy coating. Shreya was found to be capable of killing the mealybug larva by dissolving the protective coating. Nanma was effective against other sucking pests like aphids, thrips and scale insects that infest vegetable crops and as a prophylactic measure against pseudo stem weevil, a borer pest in banana.

**CTCRI develops biopesticides for protection of horticultural crops.**

## 100 farmers

Dr. Jayaprakas said 100 farmers under the Sanghamythri collective in Thiruvananthapuram had come forward to field test the biopesticides. A similar initiative is being launched by Krishi Vigyan Kendra, Kasaragod also.

The products will be launched at Pallichal on Tuesday evening.

The team has also designed a new stem injection syringe for application of Menma, a cassava-based biopesticide found to be effective in protecting banana and coconut crops. The special applicator ensures targeted discharge of the biopesticides and kills the pests in their juvenile stage.

CTCRI, along with the Centre for Innovation in Science and Social Action (CISSA), a Thiruvananthapuram-based NGO and KVK, Kasaragod, has launched a programme for the management of pseudo stem weevil in Thiruvananthapuram, Malappuram, and Kasaragod districts. The first phase of the programme had covered 30,000 banana plants in farmers fields in the three districts. The trial was later extended to over 1.5 lakh plants across the State. A package has also been formulated for the management of rhizome weevil.

The team had also set up a pilot plant at CTCRI with technical support provided by the Vikram Sarabhai Space Centre and financial assistance from the Kerala State Council for Science, Technology and Environment and Defence Research and Development Organisation (DRDO).

The researchers are also developing a cassava-based bio-fumigant for potential use in godowns where food grains are stored.

# Online tool for tracing matrilineal ancestry

Manorama - August 16, 2006.

## Former Kerala University students design special software

G. Mahadevan

**THIRUVANANTHAPURAM:** Sooryakiran Bioinformatics, a company functioning in the Industry Incubation Centre (IIC) of the University of Kerala, has designed a software that can be used, among other things, to trace a person's matrilineal ancestry using the technique of mitochondrial DNA sequencing.

The company, which was set up by the former students of the Centre for Bioinformatics of the University, has developed this software for a U.S.-based life science company Argus Biosciences.

The software 'GEN-SNiP' is available for free use on the web site 'http://www.argusbio.com/sooryakiran/gensnip/gen-snip.php'. The software was designed by a team led by G. Gopakumar and Lijo Anto.

Apart from its use in tracing the matrilineal ancestry, the software can also be used to find out whether two animals share a common ancestry and also for mapping the family tree of plant varieties.

Acuthsankar S. Nair, head of the Centre for Bioinformatics, told *The Hindu* that for detecting common ancestry in people the software finds out common patterns in the sequences of their mitochondrial DNA. "There is a region in the mitrochondrial DNA sequence called the D-loop consisting of 1,100 base pairs.

Also known as the hypervariable region this records evolution-induced changes in the DNA sequence much faster than any other region. People with similar mitrochondrial mutations are group into what is called a haplogroup. Each person in a haplogroup can trace his or her ancestry to a single person," he explained.

- Software developed by KU industry incubation centre
- Entrepreneurial venture by former students
- Uses mitochondrial DNA sequencing technique
- Handy tool for molecular taxonomy studies

### 'Mitochondrial Eve'

Mitochondrial DNA is inherited only from the mother. It has been scientifically determined that the 'Mitochondrial Eve'— the common maternal ancestor of all people alive today — lived in Africa approximately 1,60,000 years ago, he added.

GEN-SNiP by default uses the revised Cambridge Reference Sequence (rCRS) — the revised sequence of the first human mitochondrial genome to be completely determined in 1981— for its operations.

However the software can also compare any two given DNA sequences for similarities or variations.

Argus Biosciences reportedly charges 400 U.S. dollars for sequencing the mitochondrial DNA of a client and 40 dollars for isolating the D-loop. According to Dr. Nair, the D-loop isolation can also be done in India. Once this is over the comparison can be done online for free using Sooryakiran's software.

According to information made available from the company the software uses the technique of 'sequence alignment' to identify similar patterns in two DNA sequences.

### Molecular taxonomy studies

Sooryakiran's software would come in handy for scientists engaged in molecular taxonomy studies, the head of the department of Zoology, University of Kerala Oommen V. Oommen told *The Hindu*.

"Comparing DNA sequences are very laborious. Using a software this can be speeded up and made more precise," he added.

The real importance of this product, according to Dr. Nair, is that a group of former university students who set up an entrepreneurial venture — one that is being incubated by the University itself — were able to develop a software as per the requirements of an overseas client.

"Dr. David white who heads Argus has appreciated the product's quality and its on-time delivery," Dr. Nair added.

The University has set up the IIC for encouraging similar entrepreneurial ventures from its students.

## Appendix: A3
# Selected Innovations from India Innovation Report 2013

**1. <u>Intelligent LP Gas Detector (IGD) by Anand Shenoy, Kanpur:</u>** The "Intelligent LP Gas Detector: is safety product for Lp gas users and has been expected to have a huge vertical market. IGD module can be easily incorporated over the existing LPG gas with a high preset-able sensitive rang (500-10,000ppm). It gives alarm in first stage safety when ppm level of the LP gas crosses the first threshold, if the LP gas crosses the second threshold point than IGD switch's out the gas flow totally through the supply system. The main innovation stands in the power supply for the operational circurity. The circuit is passive one and it generates it power from the gas flow and rate of change of flow though a propeller module. In normal mode it says in sleep mode until the sensor gets activated. The total module is fire insulated. This system can give the metering of flow rate and total flow of the gas which give an added value to the innovation.

**2. <u>Temperature indicating Chalks by Sreedhar. G. Patil, Bangaluru:</u>** In varieties of industries like petroleum refineries, textile, casting, forging and fabrication industries, it is necessary to measure the surface temperature of the metal or objects. For the purpose, a variety of instruments are used. Most economical and convenient method is by using thermal crayon/chalks. In the present innovation, the technology has been conceived, designed, developed and commersialized for temperature indicating crayons/chalks in the range of $350^0$C to $1200^0$C. A mark of the crayon is made on the surface of the object where temperature has to be measured. The mark would melt and indicate glossy appearance as soon as the surface reaches the rated temperature of the mark. These crayons are very sensitive to temperature and made to melt within + 1% of their rated temperature. (Innovator is owner of a self startup company, M/s VPL Chemical Pvt. Ltd)


**3. <u>Device for Draining of Boiled Rice/Cereals by Dr. B. Ramesh, Kalady:</u>** The device having height of about 2 feet, consists of two parts. The inner part consists of semi circular ring having a pressing movable device that can be screwed tight to hold the vessel. Once the vessel is tighhtened in the inner movable ring, it can be locked to prevent its

dislocation by locking it with a cross iron rod. After that, it can be fitted 450 to 600 for draining. The working of device is easy and can be operated by any person. Apart from low cost, it has zero maintenance. The device has domestic application and may also find use in Hotel industry.

## Appendix: A4
## Questions and Answers on Patents
## (Courtesy Patent Information Cell[14], Kerala State Council for Science, Technology and Environment, Govt. of Kerala)

**1. What is Patent?**

Patents are granted for inventions. Patent is the exclusive right granted by the Government to the owner of the invention to make/use/sell/manufacture/import the patented invention and prevent others from performing these activities, for a limited period of 20 years, within the geographical boundaries of the nation. Patent rights are territorial rights and re granted in exchange of full disclosure of the invention to the Government.

**2. What can be patented?**

Only inventions can be patented. Invention means it should either be a new product or a new process involving an inventive step and capable of industrial application. Also, the invention shall not fall under section 23 and 4r? Of Indian Patent Act, 1970, which covers the inventions which are not patentable?

**3. Who can apply for a patent?**

The true and first inventor or his assignee or legal representative of a deceased inventor or his assignee may make an application for patent either alone or jointly with others.

**4. What rights does a Patent Owner have?**

A patent owner has the right to decide who may-or may not- use the patented invention for the period in which the invention is protected. The patent owner may give permission to, or license

[14] *The permission of PIC, KSCSTE is gratefully acknowledged. The PIC assists patenting, please see www. http://www.kscste.kerala.gov.in/index.php/programmes-initiatives*

other parties to use the invention on mutually agreed terms. The patent owner may also sell the right of the invention will enter in to the public domains ie: the owner no longer holds exclusive rights over his invention, which becomes available to commercial exploitation by others.

**4. Why are Patents necessary?**

Patents provide incentives to the inventors by offering them recognition for their creativity and material reward for their marketable inventions. These incentives encourage inventions, which assures that the quality of human life is continuously enhanced.

**5. When should an application for a Patent be filed?**

The patent application should be filed at the earliest possible date and should not be delayed. The application can be filed either with provisional specification or complete specification. If the invention is not completed, the applicant can file provisional specification. The application field with provisional specification helps to claim the priority of the invention.

**5. Who Grants Patents?**

A patent is granted by a National Office or by a Regional Office does the work for a number of countries. Under such regional systems, an applicant requests protection for the invention in one or more countries, and each country decides as to whether to offer patent protection within its borders.

**7. What kind of inventions can be protected?**

An invention must fulfil the following conditions to be eligible for getting patent protection.

i. The invention must be new and novel. It shall not be published in India or elsewhere or shall not be prior use or prior public knowledge anywhere in the world.

ii. The invention must involve an inventive step. The invention must have an inventive step. Inventive step is the feature of the invention that involves technical advancement as compared to the existing knowledge or having economic significance or both that makes the invention not obvious to a person skilled in the art.

iii. The invention must be capable of industrial application. The invention shall be capable of being made or used in the industry.

iv. The invention shall not fall within the provisions of section 3 and 4 of Patent Act 1970.

**8. Can I get Patent for my invention, which has been published or used in public?**

No. One of the criteria for getting patent protection is that the invention should be novel. Novelty means the invention should not be published anywhere in the world in any language or in prior public use before the date of filing of the patent application. The novelty of the invention loses by publication or getting it used publicly. Hence such inventions cannot be patented.

**9. What are the inventions which are not patentable?**

Section 3:

a. An invention which is frivolous or which claims anything obviously contrary to well established natural laws.
b. An invention the primary or intended use or commercial exploitation of which could be contrary to public order or morality or which causes serious prejudice to human, animal or plant life or health or to the environment.

**10.What is the patent filing and prosecution procedure in India?**

**Step 1: Filing of Patent Application.**

The first step in the procedure is the filing of patent application. Application is to be filed at the appropriate Patent Office under whose jurisdiction he normally resides or has his domicile or has a place of business or the place from where the invention actually originated. For the applicant, who is non-resident or has no domicile or has no place of business in India, the address for serviced in India or place of business of his patent agent determines the appropriate patent office where applications for patent can be filed. Applicant shall submit the following documents while filing the application.

Form 1 – Application for the Grant of Patent.
Form 2 – Provisional/Complete specification to describe the
invention. Form 3 – The statement and undertaking under section 8
Form 5 – Declaration of Inventor ship
Form 26 - Power of Attorney (if filed through Patent Agent/Attorney)
The patent applications can also be filed electronically through the website of the patent office (www.ipindia.nic.in)

**Step 2: Publication**

The patent applications will be published in the official journal of Patents after the expiry of 18 months from the date of filing or date of priority of the application. However the applicant can submit request for early publication in Form 9, by paying required fee, up on

which such patent application will be published within one month from the date of request. The patent journal is available in the website of Patent Office and will be published once in a week.

**Step 3: Opposition**

Upon publication of the patent application, any person can file pre grant opposition (based on different grounds) to the Controller of Patents against the grant of patent. However the opposition will be taken up by the patent office only after the filing of request for examination by the applicant. Pre grant opposition may be filed within 3 months from the date of publication of the application.

**Step 4: Request for Examination**

The applicant or any interested person must file request for examination for getting their patent application examined by the Patent office. Every patent application will be examined only up to the receipt of such request. The applicant has to submit the request in form 18 by paying the prescribed fee, within 48 months from the date of filing or priority; otherwise, the application shall be treated as withdrawn by the applicant.

**Step 5: Issuance of First Examination Report (FER)**

The patent office will conduct detailed examination on the patent application to check whether the invention possesses the criteria of novelty, inventiveness and industrial application and issues a First Examination Report (FER) to the applicant, which contains the gist of objections raised by the Patent Office.

**Step 6: Reply to the Examination Report**

If the applicant meets the objections and clarifications raised in the FER, the Controller will grant patent and the details of the Patent will be entered in the register of Patents. Patent certificates will be issued to the applicant within one month from the date of grant of patent and the details of grant of patent will be published in the Patent Journal. If the applicant does not clear the objections, Patent Office will issue the second examination report and thereafter hearing will be conducted for the applicant on request. If the clarifications sought by the Patent Office are not cleared even after the hearing, the Controller General will reject the patent application. However the applicant can approach intellectual Property Appellate Board (IPAB) against the decision of Controller and he may further move to the High Court and finally the Supreme Court.

**Step 8: Renewal fees:**

To keep the patent in force, renewal fees should be paid before the expiration of the second year or the succeeding year from the date of filing of patent. While paying the renewal fee, the number and date of the patent concerned and the year in respect of which the fee is paid shall be quoted.

**Step9: Post grant opposition**

Upon grant of patent also, any interested person, based on different grounds, may file a post grant opposition [Section 25 (2)] in form 7 to the Controller against the grant of patent within one year from the date of publication of grant of patent.

**11.What are the documents required for filing a patent application?**

- Application form for filing patent (Form 1) in duplicate.
- Provisional or Complete specification (Form 2) in duplicate. If the provisional specification is filed, it must be followed by the complete specification within 12 months.
- Drawings in duplicate (if necessary).
- Abstract of the invention in duplicate
- Information & Undertaking listing the number, filing date & current status of each foreign patent application (Form 3) in duplicate
- Priority document (if priority date is claimed) in convention application, when directed by the Controller.
- Declaration of Inventor ship (Form 5) where provisional specification is followed by complete specification or in case of convention/PCT national phase application.
- Power of Attorney (Form 26), if filed through Patent Agent.
- Fee (to be paid in cash /by cheque/by demand draft).

(Note: The cheque or demand draft should be payable to the "Controller of Patents" drawn on any schedule bank at a place where the appropriate office is situated).

**12. What is a Provisional Specification?**

A provisional specification is named a provisional because it is not complete and acts as a placeholder for a later complete specification. Provisional specification describes the nature of the invention to claim the priority date of filing of the application in which only the inventive idea needs to be disclosed.

The inventor lets additional time of 12 months from the date of filing of provisional speciation for filing complete specification, without losing the novelty and priority of his patent application. A provisional specification is a proof that the inventor had the concept and idea at the time of filing of provisional. However, a Provisional Specification must be followed by a Complete Specification within 12 months from the date of filing of the provisional application; otherwise, the application will be deemed to have been abandoned.

**13. What is the Term of Patent in India?**

In India, the term of Patent is 20 years from the date of filing the Patent application.

**14.What is the legislation covering Patents in India?**

Patent Act 1970 (Amended in 1999, 2002 & March 2005)

**15.Is there any fee for renewing the patent?**

Yes. The term of Patent is 20 years and the applicant has to renew the patent from the $3^{rd}$ year up to the $20^{th}$ year by paying the renewal fee, to make it active. The applicant can pay the renewal fee year wise or he can pay in lump sum. A patent shall cease to have effect, if the renewal fee is not paid within the prescribed period.

**16. Who is eligible for drafting the patent application?**

As per Indian Patent Act 1970, the applicant himself can prepare his own patent application or a registered agent. An agent can draft the patent application on behalf of the applicant. A Patent Agent is a registered person with the Indian Patent Office who has been declared qualified the Patent Agent Exam conducted by the Patent Office. Patent Agents will have their registration number.

**17. Is an Indian Patent valid in other Countries?**

No. Patent rights are territorial rights, which will be valid within territory of the Country which has issued Patent. Hence, an Indian Patent, which is granted by the Indian Government, will be valid only in India.

**18. What is Patent Co-Operation Treaty (PCT)**

Patent Laws differ from Country to Country and there is nothing like "World Patent" or "International Patent". However, there is an international filing system known as Patent Cooperation Treaty (PCT) system. When a PCT application is filed, an inventor of a member country of PCT can simultaneously obtain priority for his/her

invention in all the PCT member countries, Patent right is granted only by the particular member country after entering the national phase in that country (CORRESPONDING TO THLE INTERNATIONAL APPLICATION). India joined PCT on 7th December, 1998. All activities related to PCT are coordinated by World Intellectual Property Organization (WIPO) situated in Geneva.

**USEFUL INFORMATION TO INVENTORS TO PROTECT INVENTION**

- Maintain records of your research work methodically.
- Do not publish your invention before filing the patent application. Even oral description may cause your invention lose its novelty.
- File Patent application as early as possible. You may even file application with provisional specification.
- Conduct patent search before filing the patent application to judge the patentability of your invention.
- After the patent is granted, pay renewal fee regularly to keep your Patent alive.
- Ensure maximum commercial exploitation of the right within the tenure of Patents.

**USEFUL WEBSITES FOR PATENT SEARCH**

- www.ipindia.nic.in (Indian Patents)
- www.uspgto.gov ( US Patents)
- ep.espacenet.com (European Patents)
- www.wipo.ingt (PCT applications)
- www.google.com/patents (US Patents, European patents, PCT applications, Chinese Patents, Japanese, Korean, etc.)

**FEE SCHEDULE (for e-filing)**

| | **Natural person** | **Small entity** | **Others except small entity** |
|---|---|---|---|
| Filing of patent application (form 1 & 2) | 1600 | 4000 | 8000 |
| Early Publication | 2500 | 6250 | 12500 |
| | 4000 | 10000 | 20000 |
| Renewal Fee 3rd year to 6th year | 800 | 2000 | 4000 |
| Renewal Fee 7th year to 10th year | 2400 | 6000 | 12000 |
| Renewal Fee 11th year to 15th year | 4800 | 12000 | 24000 |
| Renewal Fee 16th year to 20th year | 8000 | 20000 | 40000 |

**WHERE TO FILE THE PATENT APPLICATIONS FROM KERALA?**

Controller of Patents and Designs, Patent Office, Intellectual Property Office Building, G.S.T. Road, Guindy, Chennai – 600032, Ph: 044-22502081-84 Fax: 044-22502066, Email: chennai-patent@nic.in Website: www.ipindia.nic.in.

# Appendix: A5
## Industry Incubation Documents
## A5.1 UO Establishing IIC

20.6.06

UNIVERSITY OF KERALA
(Abstract)

Starting of an Industry Incubation Centre in the University – Setting up with the Department of Zoology and Nomination of Dr.Oommen V.Oommen, Professor & Head, Department of Zoology as the CEO – Sanctioned – Orders issued.

PLANNING A SECTION

No.PLA/418/2006 Thiruvananthapuram, Dated 14.6.2006.

Read: 1. Letter dated 23.12.05 from the VC, University of Kerala.
2. Note from the FO vide Finance II/06-07 dated 28.4.06..

ORDER

The Vice-Chancellor, Dr.M.K.Ramachandran Nair, vide letter read (1), had suggested the setting up of an Industry Incubation Centre to the Principal Secretary Higher Education (B) Department. As requested by the Govt., the University had forwarded a detailed proposal stating the intention of the University to provide the students in the various departments/Institutions of the University, with an attractive incubation facility in the Campus to promote entrepreneurship among the student community. On the basis of discussions the Director (P&D) and Dr.Achuth Shankar Hon. Director, Centre for Bioinformatics had had, with the Secretary to Govt., proposals to start the Centre has been finalized and as per the outlay of state plan Assistance 2005-06 a sum of Rs. 25 lakhs has been allotted for the setting up of an Industry Incubation Centre in one of the Departments.

Sanction has therefore been accorded by the Vice-Chancellor, exercising the powers of the Syndicate of the University, as envisaged under section 10(11) and 10(16) of the Kerala University Act, to approve the proposal to set up an Industry Incubation Centre in the University. Sanction has also been accorded by the Vice-Chancellor, to attach the centre with the Department of Zoology in the initial state and to nominate Dr.Oommen V.Oommen, Professor & Head, Department of Zoology, as the CEO.

Orders are issued accordingly.

Sd/-
Dr.G.Muraleedhara Kurup
Director (P&D)

To
1. The Vice-Chancellor
2. Dr.OommenV.Oommen, Professor & Head, Dept. of Zoology
3. The Finance Officer
4. The Director (P&D)
5. PA to the Finance Officer
6. PA to the Director (P&D)
7. The Audit Section, KVTM.
8. Stock file/file copy

Forwarded / By Order

Section Officer

# A 5.2 Meeting Minutes of IIC

Planning A Section

**Minutes of the meeting on the Industry Incubation Centre – Implementation of the facility at Kariavattom Campus held at 3 pm on 3.8.2006 in the PVC's chamber**

**Members Present:**

Dr.V.Jayaprakas, Pro-Vice-Chancellor Sd/-
Dr.Oommen V.Oommen, CEO, Industry Incubation Centre Sd/-
Dr.Achuth Sankar, Hon. Director, Centre for Bioinformatics Sd/-

Sub: The Industry Incubation Centre as a facility for the University to promote entrepreneurship among the student community –reg.

During the course of the meeting the following points were discussed:

1. The University students in their final semester or within 3 years after completion of courses can start of business operations in less than a weeks notice.
2. The establishment of the Centre is in its initial stage. As such a separate State-of-the-art one, shall be provided at a later stage. Fort the time being, the incubating company shall be in the premises of the consultant department of the Kerala University Campus.
3. Infrastructural facilities for, small and medium scale knowledge enterprises with a focus on knowledge industries are proposed to be provided on a subsidised basis to student entrepreneurs.
4. The business operations shall abide by all terms and conditions stipulated by the University strictly without any indulgence in legal disputes. Further, all intellectual property shall be mutually agreed on, failing which it shall vest with the University.
5. The University shall fix a nominal rental for the incubation facility which shall be less than 25% of the existing average commercial rates (excluding Technopark). The rates shall be enhanced unilaterally by the University. Additional electricity, water and net charges incurred by the business operation, besides the minimal facilities, shall be borne by the business concern. Any other facility used by the companies, shall be on a mutual agreement, on a monthly basis. If a company exists more than 3 years, and makes a working profit in the 3rd year, it shall remit to University twice the difference in rent from commercial rates for the first year, or 25% of its net profit, whichever is higher.
6. The business concern shall undertake to train/permit project work of the sponsoring department, within or outside the campus, during the first 5 years of the operations, for a mutually agreed no. of students for no charges except consumables.
7. The faculty of University shall be permitted to offer consultancy services as per University rules. They shall also be permitted to hold honorary positions and no remuneration shall be received without the University Order.

8. The rates for the different services such as space rental, Broad Band Internet Connection etc. of the participating departments shall be decided by an Advisory Committee.
9. A website by the address www.iic.keralauniversity.edu shall be set up.
10. The following committees as part of the Management has to be set up
    (a) Board of Advisers
    (b) A Sub Committee to frame rules
    (c) Provision of a head of account and release of office funds
    (d) Panel of Legal, CA, HR consultants to be approved

11. The proposal from Sooryakiran Bioinformatics may be accepted

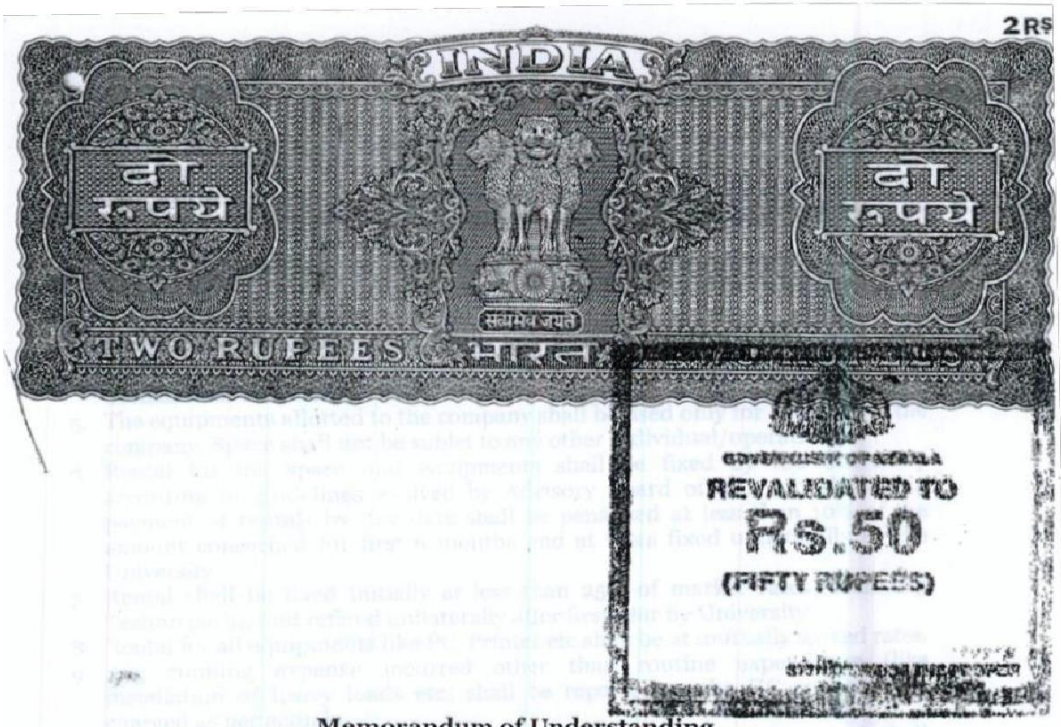
- The proposed panel of advisers are:
    1. The Vice-Chancellor, University of Kerala (Chairman)
    2. The pro-Vice-Chancellor
    3. Dr.Oommen V.Oommen, CEO
    4. Deans, Faculties of Science, Applied Science & Engineering & Technology
    5. Sri.G.Vijayaraghavan, Former CEO, Technopark, Thiruvananthapuram.
    6. Sri.Ramesh Dutt, Industry Incubation Centre, Technopark.
    7. Dr.Achuth Sankar S.Nair, Hon. Director, Centre for Bioinformatics
    8. Sri.K.Madanan, Additional Director, Industries & Commerce, Govt. of Kerala
    9. Dr.G.Muraleedhara Kurup, Director (P&D)

Sub Committee:
1. Dr.Oommen V.Oommen, CEO of IIC as Chairman
2. Dean, Faculty of Applied Science
3. Dr.Achuth Sankar S.Nair
4. Sri.K.Madanan

The meeting came to an end at 4 pm.

Sd/-
Registrar

## A 5.3 MOU with Sooryakiran Bioinformatics




**Memorandum of Understanding**
**between**
**University of Kerala and SooryaKiran Bioinformatics (P) Ltd**
**concerning**
**the usage of Industry Incubation Centre facilitated by University of Kerala.**

This Memorandum of Understanding (hereinafter called the "MoU") is entered into by University of Kerala (hereinafter called "University of Kerala" or "University") and SooryaKiran Bioinformatics (P) Ltd, a company registered under the Indian Companies Act (hereinafter called "SooryaKiran" or "the company") this day.....17/9/07.....

AND WHEREAS University of Kerala by order (order no: PLA/418/2006 dated: 14/06/06) facilitated an Industry Incubation Centre at Karyavattom campus for promoting entrepreneurship in University students

WHEREAS SooryaKiran is a Bioinformatics start up by the alumni of University of Kerala, offering services and products in the domain of Bioinformatics.

THIS MEMORANDUM sets out the principles of association and roles expected from both parties as follows:

1. The company being incubated shall agree to all terms and conditions as stated here in and further as decided by the University from time to time.
2. The company shall be a registered entity within 6 months of starting its operation. All operations of the company shall be governed by provisions of the acts under which it is registered.
3. The University shall not be held responsible / made a party in any legal dispute arising out of either direct or indirect actions of the company or the directors of the company.
4. The company shall be responsible for upkeep of the space allotted to them and also for the working condition of the equipments allotted to them, except normal wear and tear.

5. The equipments allotted to the company shall be used only for activities of the company. Space shall not be sublet to any other individual/operations.
6. Rental for the space and equipments shall be fixed by the University according to guidelines evolved by Advisory Board of IIC. Any default in payment of rentals by due date shall be penalized at less than 10% of the amount concerned for first 6 months and at rates fixed unilaterally by the University.
7. Rental shall be fixed initially at less than 25% of market rates (excluding Techno park), and refixed unilaterally after first year by University.
8. Rental for all equipments like PC, Printer etc shall be at mutually agreed rates.
9. Any running expense incurred other than routine expenditure (like installation of heavy loads etc) shall be reported to the IIC and shall be charged as per actuals.
10. If the company makes working profit from third year of its existence, it shall payback twice the amount of subsidy in rentals or 25% of its net profit which ever is higher.
11. Any utilization of services of faculty/facilities of Departments/Centres shall be as per existing consultancy guidelines of University, and any variation shall be with express permission of Advisory Board of IIC.
12. The Company shall ensure that their activities do not disrupt any of the activities of the Departments in the Campus. They shall also abide by the general rules and guidelines of conduct of the campus, in so far as it is applicable to them. The University shall, subject to the above, ensure smooth operational environment to the company.
13. Any dispute arising out of the MoU shall be attempted to be settled by mutual discussions between the advisory board and the representatives of the company, before recourse to legal action with Trivandrum Jurisdiction.
14. Any interaction between University and the company which involves IPR, shall be based on a written agreement, in the absence of which the concerned IPR shall vest with the University.

The undersigned have read and agreed to all the terms above.

**For SooryaKiran Bioinformatics**

15/9/07

**Director** GOPAKUMAR G

**For University of Kerala**

15/9/07

**Registrar**

***Witnesses:***

1. 15/9/07
SRIJITH V.M.
CHIEF EXECUTIVE OFFICER
SOORYAKIRAN BIOINFORMATICS
UNIVERSITY INCUBATION CENTRE
UNIVERSITY OF KERALA,
TRIVANDRUM

2. 17/9/07
Dr Achuthsankar S Nair
Head, Centre for Bioinformatics
Univ of Kerala

## A 5.4 Communication of Successful Completion of first Incubation

for IIC file

**DEPARTMENT OF ZOOLOGY**
**UNIVERSITY OF KERALA**

**Dr. OOMMEN V. OOMMEN Ph.D.**
F. R. E, F. A. S, F. N. A. Sc.
**CEO, Industry Incubation Centre**

KARIAVATTOM
THIRUVANANTHAPURAM 695 581
Phone: Off: 0471-2418906
Bioinformatics: 0471-2412759
Res: 0471-2598940
Fax: 0471-2307158
Email: oommen@bigfoot.com

09/05/2008

To
The Director,
Planning and Development.

Sir,
Sub : Report on Industry Incubation Centre, University of Kerala
Ref : Letter No: PLA/ 418/ IIC/ 06 dated 11-04-2008

As directed in letter cited, I am forwarding herewith a report on the IIC for further consideration.
I may also point out that the company now incubated by University of Kerala, SooryaKiran Bioinformatics (P) Ltd, has given notice to move out of the incubation scheme. (This is being forwarded separately). **This signals the successful completion of the first incubation. I request that the rentals may be fixed at the earliest and collected.**

A new batch of students has now approached the IIC for incubation of their company, GeneLocuz Bioinformatics. **I request that fresh guidelines for IIC may be evolved in light of the operations so far and the new applications may be entertained on the basis of the same only.**

Thanking You,

Yours Faithfully,

o/c

CEO, IIC

# Appendix : A6
## Institutions Related to Innovation
### (Extracts from their respective websites)
### A6.1 National Innovation Foundation – India (NIF)


**National Innovation Foundation – India (NIF)** is an autonomous body under the Department of Science and Technology (India), Government of India. It was set up in February 2000 at Ahmedabad, Gujarat, India to provide institutional support for scouting, spawning, sustaining and scaling up the grassroots innovations across the country. NIF conducts a biennial national competition for grassroots green technologies developed by farmers, mechanics, artisans and - others through their own genius without any recourse to professional help. NIF validates these innovations with the help of experts, and, ascertains the novelty in these innovations by doing prior art search. If the innovation is deemed novel, NIF files a patent on behalf of the innovator. NIF also funds value addition initiatives in these innovations to upscale them and make them more useful for a larger segment of people. A Micro Venture Innovation Fund (MVIF), sponsored by Small Industries Development Bank of India in 2003, supports the activities of prototype development, test marketing and pilot production. IGNITE is an annual competition for student's ideas and innovations conducted by NIF in partnership with the Central Board of Secondary Education (CBSE). Some State Education Boards also partner in the same. All students up to the 12th class from any school (and of the same age group but out of school also) in India are eligible to participate in IGNITE. The IGNITE awards are announced on October 15, the birthday of Bharat Ratna, Dr APJ Abdul Kalam, Former President of India, which is celebrated as the children's creativity and Innovation Day by NIF. NIF is mandated to build a national register of ideas, innovations and Traditional Knowledge (TK) practices related to agriculture, plants, animal health, and human health. With the help of the Honey Bee Network, NIF has been able to scout and document over 2, 10,000 examples of technological ideas, innovations and traditional practices. It has also set up a Fabrication Laboratory (Fab Lab) with the help of MIT, Boston, for product development apart from strengthening in-house research and development facilities for the initial validation of herbal technologies.

### A6.2 The Department of Scientific and Industrial Research (DSIR)

The Department of Scientific and Industrial Research (DSIR) is a part of the Ministry of Science and Technology, which was announced through a Presidential Notification, dated January 4, 1985 (74/2/1/8 Cab.) contained in the 164$^{th}$ Amendment of the Government of India (Allocation of Business) Rules, 1961. The Department of Scientific and Industrial

Research (DSIR) has a mandate to carry out the activities relating to indigenous technology promotion, development, utilization and transfer. The Department has two public sector enterprises, viz., Central Electronics Limited and National Research Development Corporation, apart from two autonomous organizations, viz., Council of Scientific and Industrial Research and Consultancy Development Centre, under its ambit. The present focus on innovation, highlighted by the President during her speech to Parliament during the Budget Session in 2009, followed by the Prime Minister during his address at the Science Congress in January, 2010, has important implications for the Department and its future planning. DSIR has been supporting innovative projects directed towards improving the technological and industrial competitiveness of the industry during the tenth and eleventh five year plans. The DSIR programmes in the 12th five year plan focus on building an innovation ecosystem in the country. DSIR aspires to be - an agency that influences policy formulation leading to industrial competitiveness; a one-stop agency in the country for all matters related to industrial research and development; and an agency that is looked at by anybody in the country, as one that nurtures and supports innovations having industrial applications.

**Vision:** Enabling India to emerge as global industrial research and innovation hub.

**Mission**

- Invigorating industrial research in the country through industry and institution centric motivational measures and incentives.
- Creating an enabling environment for development and utilization of new innovations.
- Enhance innovations through its resources and channelize benefits thereof to the people

## A6.3 Technology Development Board (TDB)

The Technology Development Board is the first organization of its kind within the Government framework with the sole objective of translating the fruits of indigenous research into commercial products or services. The Board plays a pro-active role by encouraging commercial enterprises to take up technology oriented projects.

**Aims:** Technology Development Board Aims at accelerating the development and commercialization of indigenous technology or adapting imported technology to wider domestic application. The board provides financial assistance in the form of Equity, Soft loans, or Grants. **TDB's Objectives:** The objective of Technology Development Board is to assist the industrial concerns and other agencies which attempt development and commercial application of indigenous technology or adapt imported technology to wider domestic applications.

**Features of TDB Services:** Technology Development Board provides equity capital or loans to industrial concerns and financial assistance to research and development institutions. The Board reduced the rate of simple interest from 6 to 5 percent per annum with effect from 13 May 2002. The loan carries a simple interest rate of 5% per annum.

With its proactive stance the Board:

- Emphasis on technology driven project in any sector
- Unique evaluation procedure through acknowledged experts.
- Full opportunity to the applicant to present the project proposal.
- Confidentiality as regards project documents / processes.
- Transparency in processing of project proposals.
- Handholding and trouble shooting.
- Encouraging industry to enter into hi- tech, hi- risk areas.
- Motivating industry to have firmer linkages with the R&D.
- Leveraging other similar funds of financial institutions and banks
- creates new job opportunities

**Financial Assistance by TDB**

- Loan Assistance
- Equity Subscription
- Grants by Technology Development Board

## A6.4 Technology Business Incubators (TBI)

Department of Science and Technology has set up many Technology Business incubators (TBI) and Science and Technology parks across the country in premier academic institution to nurture entrepreneurs in varied knowledge and technology domains. Incubators are a capital efficient method for stimulating technology innovation and job creation. Technology Business Incubators are an effective tool for technology transfer, innovation, generating skill-based jobs creation. Technology transfer, innovation, generation skill-based jobs and for local economic development. Incubators are a critical component of the entrepreneurial support infrastructure that has proven themselves to be significant generators of new jobs.

# Appendix: A7
# UNIVERSITY OF KERALA
**(Abstract)**

Student Entrepreneurship Scheme for the University and colleges affiliated to the University – Implementation – Sanction modified – Orders issued.

**ADMINISTRATION 'MISC.' SECTION**

No.Ad.Misc./3/H.Edn/2013 Dated, Thiruvananthapuram 21.10.2014.

*Read:-* 1. G.O.(MS)No.499/2012 H.Edn.dated 11.10.2012
2. U.O.No.Ad.Misc./3/H.Edn./2013 dated 31.01.2013
3. U.O. of even no dated 26.08.2014
4. Letter dated 17.09.2014 from Dr.J. Rajan, Entrepreneurship Co-ordinator of the University
5. Minutes of the meeting on SES held on 14.10.2014

**O R D E R**

The Student Entrepreneurship Scheme, as approved by the Government of Kerala was implemented in the University and colleges affiliated to University vide U.O. read as (2) above.

Dr.J. Rajan, Head, Institute of Management of Kerala was nominated as the Entrepreneurship Co-ordinator of the University vide U.O. read as(3) above.

Dr. J. Rajan, vide letter read as (3) above has requested to modify the U.O. implementing SES in the University, incorporating the full contents of the G.O. read as (1) above for its smooth implementation. Accordingly, sanction has been accorded by the Vice-Chancellor to modify the U.O. read as (2) above incorporating the following details of the Scheme of 'SES'.

**Introduction**

Over a lakh of students in both engineering and non-engineering discipline, graduate every year in Kerala. There are a significant number of students who have valuable entrepreneurial ideas which do not germinate and grow to completion, for want of the necessary environment and support. Allowing students both engineering and non-engineering, to start working on innovative ideas even while in universities, colleges and polytechnics, could contribute significantly to the growth a robust entrepreneurial eco-system in the State. Government of Kerala recognises that it is imperative for growth of Kerala to support home grown companies through a specific incentive for student start-up companies.

**Technology Business Incubators (TBI)**

Department of Science and Technology has set up many Technology Business incubators (TBI) and Science and Technology parks across the country in premier academic institution to nurture entrepreneurs in varied knowledge and technology domains.

Incubators are a capital efficient method for stimulating technology innovation and job creation. Technology Business Incubators are an effective tool for technology transfer, innovation, generating skill-based jobs creation. Technology transfer, innovation, generation skill-based

jobs and for local economic development. Incubators are a critical component of the entrepreneurial support infrastructure that have proven themselves to be significant generators of new jobs.

Under the Student Entrepreneurship Initiative, three stages will be recognised in the incubation process.

**Stage 1. Ideation Stage**

Ideation Stage is the process of generating, exploring, and evaluation new technology/business ideas that can give the business proposed by the student entrepreneur a competitive advantage. The expert committee formed for the evaluation of the ideas should interview each entrepreneur and analyse the business potential and feasibility.

**Stage 2. Teaming & Company formation**

Team Formation is the key for an entrepreneur in commencing his journey before starting his own company. The team should ideally have a mix of co-founder with complementary skill sets. Having complementary set of experience is very important for a well-rounded team from the inception. The team has to register it as private limited company/Limited Liability partnership (LLP)/Partnership of any legally recognized entity.

**Stage 3. Prototype developed/Business started**

The working model or the prototype of the Technology Idea to be developed and this to be certified by the experts for commercialisation or Technology Transfer.

**OR**

If it is a business service idea, the company or legally recognised entity should start the business operation as per the business plan and start generating Income.

**TBI in Kerala approved by NSTEDB, Department of Science and Technology, Govt of India**

1. Technopark TBI, Thiruvananthapuram
2. NITK-TBI, Kozhikode
3. ITIH TBI (Start-up Village), Kochi
4. College of Engineering TBI, Thiruvananthapuram
5. Amritha TBI, Kollam
6. Central Institute for Fisheries Technology TBI, Kochi
7. NRI TBI, Kollam, Kochi & Kozhikode

All Government Engineering Colleges and Government Aided Engineering Colleges in the State will be encouraged to apply for the status of Technology Business Incubators (TBI) with Department of Science & Technology, Government of India and to obtain the same within 6 months.

**Measure for Promotion of student Entrepreneurship in Kerala**

To encourage entrepreneurship among the students in Kerala, Government have announced a landmark Student Entrepreneurship Initiative. The policy provides for 20 % attendance relaxation and 4% grace marks in academic courses for students who pursue entrepreneurship and innovation during their studies.

**Distribution of Grace Marks and Attendance**

**Duty Leave**

Duty Leave will be given to student entrepreneur who has taken prior permission from the Head of Institution to attend EACS/Seminars/ Workshop/Competitions, in-house training by TBIs, Techno Business training programme etc.

This shall be applicable to faculty also if they are accompanying the student/student teams as the mentor or guide.

**Grace Marks and attendance**

Grace marks and attendance will be provide by the University to Student Entrepreneurs who are incubated in TBIs approved by the National Science and Technology Entrepreneurship Development Board, Department of Science and Technology, Govt. of India based on the following board guidelines. Accordingly a student entrepreneur (or group) will be rated at different stages.

| **Sl. No.** | **Stages** | **Grace Marks** | **Attendance (Max 20% )** |
|---|---|---|---|
| | | Marks (Max 4%) | |
| 1 | Ideation Stage | 1% | 5.00% |
| 2 | Teaming & Company formation | 1% | 5.00% |
| 3A | Prototype (Working Models) for **Technology based firms*** | 2% | 10% |
| **OR** | | | |
| 3B | Business Services of **Service based firms*** | 2% | 10% |

*** The student company (Arts/Science/Business School/Engineering College/Polytechnic) should have made a working model (proto type) which is commercially viable (for technology based companies) and has started generating sufficient cash flow towards attaining self-sustainability and have as sound workable business plan validated by a DST approved Incubator (for service based companies)**

1. For students to be eligible to receive the special attendance under the Student Entrepreneurship Scheme, they should have secured a minimum of 75 % attendance including the special attendance for which the student is eligible under the scheme.

2. Students shall not be allowed to avail this special this special attendance to skip any of the examinations fixed by the college/university/Directorate of Technical Education as applicable.
3. Each University should have a mechanism to consolidate and recommend award of marks/ attendance based on the letters from the TBIs.

4. Students should be encouraged to participate in nationally reputed idea competitions/business plan contexts/entrepreneurship seminars etc. to gain maximum exposure. Duty leave may be given for this purpose. Students who win prizes at university/state/national level idea competitions/ business plan contexts may also be given up to 2% grace marks in the semester in which price was won. The list of TBI approved

competitions may be maintained by the Universities for this purpose and may be uploaded in the University website within 15 days of this order.

It was resolved to include the following clauses regarding the guidelines and distribution of grace marks also, while modifying the U.O., vide minutes read as (4) above.

1. 4 % Grace marks can be distributed to any (3) semesters on the basis of the stages noted in the G.O. or to one semester, as a candidate completes the stages of incubation.
2. Maximum grace marks to be awarded for professional courses shall not exceed 5 % , including SES/sports/NSS/Arts etc.
3. Guidelines specified for award of grace marks as per U.Os. No. Ad.DI.1.1276 /Sports/Grace marks/2007 dated 07.09.2007, No.Ad.DI.1. 1276/Mod./2007 dated 30.11.2007 & No. Ad.DI.1./Mod./Extn./09 dated 02.11.2009 will be applicable to SES also.

The U.O. read (2) above stands modified to this extent.

Sd/-
**Rema M.**
Deputy Registrar (Acad.II)
For **Registrar**

Copy to:-

1. Dr.J. Rajan
   Entrepreneurship Co-ordinator .
2. The Principals of all Colleges, affiliated to the University
3. PS to VC/PVC
4. PA to Registrar/FO/CE
5. The Stock file / File Copy.

Forwarded/By Order

**Section Officer**

# Appendix : A8

**DEPARTMENT OF COMPUTATIONAL BIOLOGY AND BIOINFORMATICS**
**UNIVERSITY OF KERALA**

**Course Code: COB 201**
**Course Title: CREATIVITY, RESEARCH & KNOWLEDGE MANAGEMENT**
**Credits : 4**
**Semester : 2**
**Pre-requisite: Nil**
**AIM:**

- To trigger creativity
- To temper research attitudes and skills
- To create awareness about current issues related to research management and ethics.

**COURSE DESCRIPTION:** This course will be a combination of lectures and directed activities aimed at developing an in-depth understanding of the scientific method and research process management. Activities in creativity and creative thinking, development of hypothesis, design of experiments, scientific research writing and critical reviewing will form the central part of the course. Finally the whole course will be contextualized with specific reference to the bioinformatics field.

**COURSE CONTENT:**

**Module 1:** ***Creativity & Thinking Skills:*** Various views on creativity; stimulating creativity; obstructions to creativity; creativity & innovation, creativity & craft; critical thinking; logical thinking – inductive & deductive logic – common logical fallacies; problem solving strategies.

**Module 2:*****Research and Research Reporting:*** Various outlooks on research: pure versus applied, incremental versus innovative, qualitative versus quantitative; Philosophy of science; the scientific method, the research process –creative question – hypothesis – planning and designing of experiments – critical analysis – sources of errors and minimization. Format of a science research paper – the IMRAD format – objectives of each section – reference citing styles; Proof reading & editing; Publishing Science: Authorship; Publication process -Peer review – single/double blind and open; fabrication, falsification and plagiarism – Turnitin; Open Access Publications and other emerging trends in scientific communication; case study of paper writing and peer review; popular journals in Computational Biology & Bioinformatics (brief overview of their scope).

**Module 3:** ***Knowledge Management Skills:*** Active reading, listening and comprehension skills; Learning about Learning- multiple intelligences- learning styles; Advanced internet search skills – specialized academic search; Google scholar and scopus; Bibliometrics and

webometrics – impact factors –h, h-b and g indices – pitfalls in interpreting impact; Reference managment tools: diigo, zotero, mind manager, endnote; Academic search engine optimisation; Current awareness: RSS feeds, TOC alerts, DB alerts.

**Module 4: *IPR awareness***: Copylefts, copyrights and patents; IPR of software and life forms; Brief overview of IPR laws in India - Protection of traditional knowledge; Patent amendment of 2005 and its impact; Overview of International treatise – GATT, TRIPS; India as an emerging Knowledge power; Ethics – its role in scientific research and academics, conflict of interests; academia-industry collaborations.

**Module 5 *(Flexi module- Only for Internal Assessment. Lecturers may expand and/ or interpret the syllabus to update it or suit the particular cohort in any way)***: Allied Topics: Profile of key Bioinformatics/CB/ pharmaceutical institutions and industries in India& abroad. Overview of Bioinformatics policy of Govt. of India; Job opportunities in CB/BI & skill profiles; Quality – basic concepts – popular certifications; Making effective multi-media and poster presentations; Professional Societies in the field – their role in research and knowledge dissemination.

**ASSESSMENT:**

**Continuous Assessment (40%):**

- 5% for Attendance
- 20% for Assignment (i) A research paper writing workshop based on a toy experiment done by the cohort. (ii) Distributed tasks: A set of 10 minor tasks covering selected skills/concepts spread over the syllabus. AND/OR (iii) Students are required to successfully complete a course in MOOC, related to the syllabus.
- 15% for 2 class test in the form of MCQs.

**End-Semester Assessment (60%):**

- 3 hour written exam consisting of 40% short answer questions and 20% long essay questions.

**READING LIST:**

**Core**


1. Lee, J. A. (2000). *The scientific endeavor: A primer on scientific principles and practice*. Benjamin Cummings.
2. Katz, M. J. (2009). *From Research to Manuscript: A Guide to Scientific Writing*. Springer.
3. Day, R., Gastel, B. (2012). *How to write and publish a scientific paper*. Cambridge University Press.

4. Rao, R.A., Rao, B.(2008). *Intellectual Property Rights: A Primer*. Eastern Book Company.
5. Lester, J.D.(2005).*Research Paper Handbook: Your Complete Guide*. Good Year Books.
6. Murray, R. (2010). *How to Write a Thesis*. McGraw-Hill Education.
7. Lowe, P. (1995). *Creativity and problem solving*. McGraw-Hill.
8. Ruxton, G., & Colegrave, N. (2011). *Experimental design for the life sciences*. Oxford University Press.
9. Trochim, P. D. W. M. (2003). *Research methods*. Dreamtech Press.

**Additional**

1. Mak, D.K., Mak, A.T., Mak, A.B.(2009). *Solving Everyday Problems with the Scientific Method: Thinking Like a Scientist*. World Scientific.
2. Kitchin, R., *Fuller, D. (*2005). *The academic's guide to publishing. Vistaar Publications*.
3. Caroselli,M.(2004). *Quick Wits: 50 Activities for Developing Critical Thinking Skills*. Human Resource Development Press.
4. Bassham, G., Irwin, W., Nardone, H., Wallace, J. (2005). *Critical Thinking: A Student's Introduction*. Tata McGraw Hill education Pvt. Ltd.
5. Osborn, A. F. (1953). *Applied Imagination: Principles and Procedures of Creative Thinking*. Charles Scribner's Sons, New York.
6. Oech, R.V. (1983).*A Whack on the Side of the Head: How to Unlock Your Mind for Innovation*. Warner Books.
7. Sternberg, R. J., & Lubart, T. I. (1999). The concept of creativity: Prospects and paradigms. *Handbook of creativity*, *1*, 3-15.
8. Weisberg, R. (1993). *Creativity - Beyond the Myth of Genius*. W.H. Freeman and Company.
9. Allen, R. (2005). *Boost Your Creativity: Exercises and Advice for Great Creative Thinking*. Anova Books
10. Ramkumar, M. (2008). *Intellectual Property Rights Demystified*. New India Publishing.
11. Khader, F. A. (2007). *The Law of Patents: With a Special Focus on Pharmaceuticals in India*. LexisNexis Butterworths

**OTHER RESOURCES:**

**Online courses**

1. Creative problem solving, conducted by University of Minnesota. https://www. coursera. org/course/cps
2. Creativity, innovation, and change, conducted by Pennsylvania State University. https:// www.coursera.org/course/cic
3. Understanding research methods by University of London. https://www.coursera.org /course/research methods.

## Appendix: A9

## Profile of a Kerala University Graduate who holds 284 US Patents

**Ajith K Kumar** graduated from Model High School Trivandrum in 1965. He later attended Intermediate College, University College and Engineering College (all in Trivandrum) and in 1972 obtained a Bachelor's degree in electrical engineering (Kerala University first rank). After graduation he worked as a lecturer in CET till 1973. (He worked for few months as a technical officer in syndicate bank and joined the R&D of Keltron).

In 1977 he got a Master's degree from Stanford University in Electrical Engineering using a Rotary Foundation Scholarship awarded through Trivandrum Rotary Club. He has been working at General Electric Company at its Transportation Division since 1977 and currently holds consulting engineering position in GE Transportation at its Innovation Group. In addition he holds Master's Degree in engineering and an MBA both from Gannon University, USA. His interests include application of power conversion equipment, optimization and energy storage systems for locomotive and mining propulsion and auxiliary equipment.

During his work at GE, he has been instrumental in the development of propulsion systems for Transit vehicles, Freight Locomotives, Passenger Locomotives, Off-highway vehicles and underground Mining vehicles, as well as for Battery & Applications and Track Inspections like Broken Rail Detection. Some highlights include drive/power control systems for AC/DC motors, AC propulsion systems using GTOs and IGBTs, adhesion control systems, individual axle control, C4 locomotive including dynamic weight management, drive systems for auxiliaries, energy storage systems, and hybrid vehicles. Due to this effort most of the freight railroads have switched from traditional DC propulsion systems to AC propulsion systems. Ajith has further contributed to the Trip Optimizer systems, and has advanced technologies for fuel savings dealing with auto propulsion, automatic dynamic braking, and auto-independent distributed power, and airbrake advisement and have saved over 60 million gallons of diesel fuel. Ajith is a recipient of GE Edison Award and GE Dushman Award. Ajith considers the solid foundational education obtained in Model school capped with the technical education at CET to be a main contributor for this achievement.

In 2015 he became the most decorated patent holders among over 300,000 GE employees worldwide. He holds **284 US patents** and numerous international patents and has published many articles. His patents span all the above technologies across multiple GE Transportation products. He was recently recognized by GE Chief Executive Jeff Immelt for that distinction at a special company function. GE recently won the order to develop 1000 locomotives for Indian Railways and some of the technologies Ajith developed will be used in those.

Ajith is married to Meera Kumar (daughter of Late Mr. CPN Nair) from Trivandrum, Ajith Kumar is the son of Prof P.K. Kuttan Nair who retired as the Professor and head of the department of Mathematics in CET (and Honorary Director of State Observatory, Trivandrum) and Smt. C Madhavi Amma, mathematics teacher, Headmistress and retired as Educational officer. Ajith used his Edison Award to fund a scholarship for CET graduate to study and get a Master's degree in engineering at USA.