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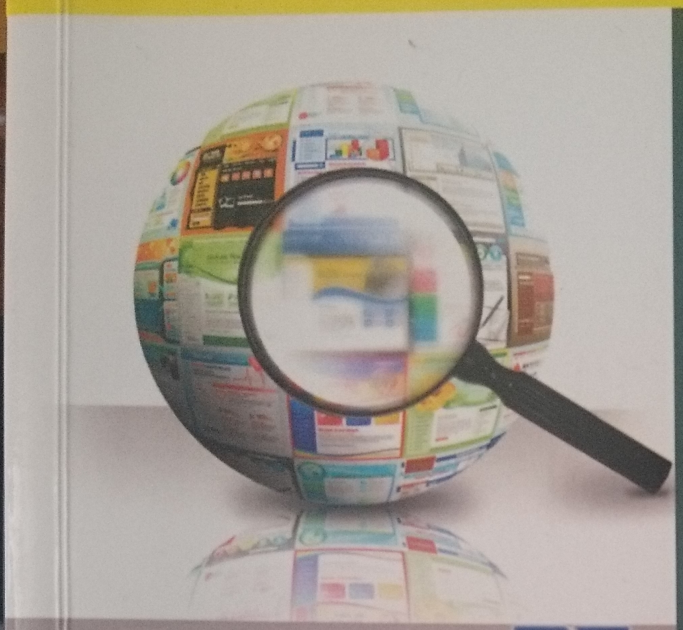

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MATHEMATICAL SCIENCES

Invited talks

NONCOMMUTATIVE INTEGRATION AND QUANTUM MARTINGALES

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The noncommutative extension of Lebesgue integration theory \arose partly from specific analytical situations encountered in the theory of groups,in quantum field theory, and elsewhere." Concentrating on probability measures, many of the stochastic concepts were extended to the von Neumann algebra framework (by Gross, Umegaki, Cuculescu, and Dixmier, to name few). These extensions throw more light on operators, for example, on the structure of von Neumann algebras. For our part, we extend the very fundamental notions of stopping times and discrete-time quantum martingales. We introduce a new ordering for self-adjoint operators which is more applicable than the standard ordering, and establish a maximal lemma for the set of all bounded stopping times. We introduce the discrete time quantum martingales and establish the optional sampling theorem for quantum martingales. Indeed, we also provide some properties of noncommutative conditional expectations. Asymptotic martigales (abbreviated as amarts) did not yet attract the attention of the quantum probability experts. We introduce them and establish some of their standard properties.

FORENSICS OF SOFTWARE COPYRIGHT INFRINGEMENT IN THE GLOBAL CONTEXT: THE VITAL NEED FOR IMPROVED RESEARCH

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Software piracy and copyright infringement can be established either by way of authorship identification or by proving copyright infringement or both. Authorship identification methods aim at identifying the author of the pirated. These methods assume that when a set of writings of a number of authors is 'known', any given new piece of writing can be attributed to one of them through similarity of profiles and then a statistical hypothesis test can be performed to confirm or disprove this attribution. Most authorship identification methods remain as academic products in the sense that they are not officially accepted by investigating agencies. Unlike authorship identification methods, copyright infringement investigation methods check whether there is so-called "substantial similarity" between the defendant's work and the protectable elements of the plaintiff's work. Abstraction-Filtration-Comparison (AFC) test, a copyright infringement investigation method, has an excellent

track record of usage in US judiciary since 1992, but it does not mean that the infallibility of AFC has not been questioned. Finally, POSAR, an extended form of AFC, is a silver line along this dimension.

The ultimate forensic success of any authorship identification or copyright infringement investigation method is its successful application / use in criminal investigation to establish culpability and in a judiciary-friendly manner. This paper contends that the future research should target at making all such methods non-esoteric and judiciary-friendly and suggests some directions and means towards achieving such an objective. In addition, it also reinforces the notion that it is the duty of computer experts to update the software piracy / copyright forensic tools, processes and procedures to make them fit for performing the forensics of modern software products so that the investigating officers and legal professionals are properly supported to deal with the crime sophistication

FORMAL VERIFICATION OF CYBER-PHYSICAL SYSTEMS

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The term "cyber-physical systems" refers to any network of digital and analog systems whose performance crucially depends on both the continuous dynamics of the analog parts and the real-time switching decisions made by the digital system. A typical cyber-physical system may consist of several processors connected with a set of physical systems via sensors and actuators over wired or wireless communication networks. Such systems are increasingly playing safety-critical role in modern life, where a fault in their design can be catastrophic.

Formal modelling and verification of systems is the set of techniques that employ rigorous mathematical reasoning to verify properties of a system. In this talk we concentrate on a celebrated [1, 2] formal verification framework known as *model checking*. Model Checking—pioneered by Clarke, Sifakis and Emerson [2]—is a widely used automated technique that, given a formal description of a system and a property, systematically checks whether this property holds for a given state of the system model. The success of the model checking framework in formal verification of systems is largely due to it being highly automatic—a push-button technology—in comparison to other competing approaches like theorem proving.

Early research on formal modeling and verification of systems concentrated on simplified models of the systems as finite state-transition graphs. Since these models are finite in nature, it is—in theory—possible to exhaustively explore the state space of the system to verify the properties of interest. These graphs,

however, often do not satisfactorily model cyber-physical systems as they disregard the continuous dynamics of the physical environment. The framework of *Hybrid automata [3]*—introduced by Alur, Courcoubetis, Henzinger, and Ho—provides a formal modeling and specification environment to analyze the interaction between the discrete and continuous parts of a cyber-physical system. Hybrid automata can be considered as generalizations of finite state automata augmented with a finite set of real-valued variables whose dynamics in each state is governed by a system of ordinary differential equations. Moreover, the discrete transitions of hybrid automata are guarded by constraints over the values of these real-valued variables, and enable discontinuous jumps in the evolution of these variables. Considering the richness of the dynamics in a hybrid automaton, it is perhaps not surprising that the fundamental verification questions, like reachability and schedulability, for the general model are undecidable. In this talk we present a review of key ideas behind model-checking with emphasis on hybrid automata as modeling and verification framework for cyber-physical systems.

CREDIT RATINGS : A DYNAMICAL MODEL

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Commercial banks have devoted many resources to developing models to better quantify their financial risk and assign economic capital. These efforts have been recognized and encouraged by bank regulators. Over the years, banks have extended these efforts into the field of credit risk modeling.

A credit rating is a risk indicator, telling an investor how likely or unlikely an entity's bankruptcy is. The investor will use this information to decide which return he wants to receive.

To this end, to differentiating credit quality, a heterogeneous population of identical firms are divided into a finite number of classes. In order to have a dynamical model, the partition can change during the time. A suitable exchangeability assumption is made, to preserve the property to be identical items with different credit level.

Given the cardinality of the class of the firms already defaulted, the aim is to recover informations about the time to the default of each firm.

CREDIT RISK MODELLING FOR A SET OF FIRMS

Prof. Silvia Centanni, *Department of Economics***,** *University of Verona, Italy*

Modelling credit risk in a coherent yet applicable manner is challenging problem. An important issue is the proper modelling of the correlations between firms default behaviour and the default clustering. The literature discusses several potential sources for the clustering of corporate defaults. First, firms are exposed to common macroeconomic variables, whose movements cause correlated changes in firms conditional default rates. Second, defaults may be contagious, and have a direct impact on the conditional default rates of other firms. Early credit risk models focus on the prediction of the default probabilities (credit scoring) to distinguish 'good' from 'bad' companies using, for example, logit and probit models, or neural networks. These models usually emphasize the cross-sectional rather than the time series dimension of the sample. The binomial mixed model assumes conditional independence between firms so that the number of defaults in a portfolio is described by a binomial distribution given the fluctuation of macroeconomic fundamentals. Examples include, the models used by KMV, J.P. Morgan , etc. This approach underestimates the eûects of correlations and the default clustering, and consequently the degree of loss fluctuation to be expected. Other approach make use of use copula functions to quantify correlations in default dynamics, or consider the theory of interacting particle systems, such as the voter model. Also, continuous time Markov models are used to describe the dynamics of transitions of the indicator variables describing rating classes of the obligors in a portfolio. In this paper an heterogeneous population of identical ûrms is investigated inspired by models coming from the biological literature, in discrete time setting. The model takes into account that new firms can appear in the market in time, so that the cardinality of the population is time varying. To model credit quality, the population is divided into a ûnite number of classes and

the partition is supposed to change during the time, due to defaults and changes in credit quality, following a class of Markov processes. Under suitable assumptions, only the number of firms in the various classes, together with the class changing process, is relevant to analyze some conditional probabilities related to default times. The model admits a huge variety of specifications, among which we underline the inclusion of dependency upon macroeconomic variables and self exciting behaviour, to properly include correlations. The model is presented together with some simulation result.

Oral presentations

NUMERICAL METHODOLOGIES FOR HIGHER INDEX DIFFERENTIAL-ALGEBRAIC EQUATIONS

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This paper focuses mainly on the numerical methodologies for solving Differential-Algebraic Equations (abbreviated as DAEs). An overview for the existing numerical techniques is also given. Here, various forms of Backward Differentiation Formulas (BDFs) are considered in order to solve the DAEs of higher indices. In the beginning of the work, DAE of index zero was considered. The solution of the test example was computed using BDF methods of order one, two and three respectively. Then we moved on to index one and then to index two DAEs. In all these cases, the computed solutions were found to be in good agreement with exact solutions.

To validate the efficiency of the proposed method, various numerical experiments are done and the results of these experiments are tabulated and plotted in the form of graphs. The plotted graphs reveal the fact that the computed solutions generated by BDF are almost the same as the exact solutions obtained from analytical methods.

A MODULAR EXPONENTIATION ALGORITHM AND A MODULAR MULTIPLICATION ALGORITHM IN PUBLIC KEY CRYPTOSYTEMS

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Modular exponentiation is a basic operation in many Public key cryptosystems like the RSA cryptosystem ,El Gamal cryptosystem and Rabin cryptosystem . In this paper we present an improvised algorithm to compute b^n mod p when p does not divide b ,wherein large exponents are generated from smaller ones. Modular exponentiation is achieved by repeated modular multiplications. In many algorithms modulo n multiplication is constructed from remainders with modulus (n + 1) and (n+2) , (2 n+1) and (2n +2) , (2n) and (2n + 2) etc using Chinese Remainder theorem. In this paper we also make an attempt with modified modular components in the remainder and arrive at an improvised algorithm for modular multiplication.

MSC (2010) : 11T71

FUZZY SOFT CONGRUENCES ON RIGHT TERNARY NEAR-RINGS

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Fuzzy soft sets over a set X are generalization of soft sets which are parameterized family of subsets of X. Fuzzy soft relations over X are defined as fuzzy soft sets over X×X. In this paper fuzzy soft congruences on a right ternary near-ring (RTNR) are defined and their basic algebraic properties are derived. Theorems on obtaining a normal fuzzy soft ideal from a fuzzy soft congruence relation and vice versa are proved. Lattice structure of the set of all fuzzy soft congruence relations on an RTNR is given. Homomorphism theorems on RTNR with fuzzy soft congruence relation are also proved.

AMS Classification : 08A72 , 06B10, 20N10,16Y30,06C05

A FUZZY APPROACH TO FINITE DIMENSIONAL LIE ALGEBRAS

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The theory of Lie algebras has been developing rapidly in recent years , mainly due to its connections and applications to various fields of Mathematics and Mathematical Physics. On the other hand, Fuzzy sets first originated in a seminar paper by Lotfi A.Zadeh in 1965. The fuzzy theory has been applied to almost all topics of Mathematics and finds interesting applications to Mathematical and real life problems as well. In this paper, finite dimensional Lie algebras are considered. Fuzzy sets are defined on the root system of finite dimensional Lie algebras. Basic properties of these fuzzy sets are studied; The fundamental nature of these fuzzy sets on the Lie algebraic structure has been studied; fuzzy decomposition in terms of the α **– cuts** are obtained for the finite dimensional Lie algebras.

A FUZZY APPROACH ON THE ROOT SYSTEM OF FINITE TYPE OF KAC-MOODY ALGEBRA

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The theory of Kac-Moody algebra is one of the modern fields of Mathematical research that has been developing rapidly, mainly due to its interesting connections and applications to various fields of Mathematics and Mathematical Physics. The subject was introduced in 1968, developed simultaneously and independently by Kac and Moody. On the other hand, Fuzzy sets first originated in a seminar paper by Lotfi A.Zadeh in 1965. The development of fuzzy set has also been very fast and finds significant applications not only to all branches of Mathematics but also acts as a tool for solving real life problems.

Fuzzy approach on Kac-Moody algebra was initiated by Uma Maheswari [4], in which Fuzzy sets were defined on the Cartesian product of the root system of Kac-Moody algebras using an invariant, non degenerate, symmetric, bilinear form $< \ . \ , \ . \ >$.

$A_l^{(1)}$

Some of the fuzzy properties were studied for the finite type of Kac-Moody algebras A_l, B_l,C_l,D_l in[4], for affine type of Kac-Moody algebra in [5] , [6] and for hyperbolic type in [8]. For the finite type of Kac-Moody algebra G_2 another fuzzy approach was attempted in [9]. In this paper, the affine type of Kac-Moody algebra $A_l^{(1)}$ is considered; Fuzzy sets are defined on the Cartesian product of root system of, using an invariant, non degenerate, symmetric, bilinear form; Basic properties of these fuzzy sets are studied; The fundamental structural components and measure of fuzziness of these sets are obtained.

AMS MSC 2010 Code 17B67

EXACT SOLUTION OF AN OSCILLATORY FREE CONVECTIVE MHD FLOW IN A ROTATING VERTICAL CHANNEL

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An analysis of an oscillatory free convective flow of a viscous incompressible and electrically conducting fluid in a vertical channel is carried out. The two plates are subjected to a constant injection and suction. A uniform magnetic field is applied in the direction normal to the plates. The entire system rotates about the axis normal to the plates with uniform angular velocity. For small and large rotations the dependence of the steady and unsteady resultant velocities and their phase differences on various parameters are discussed in detail.

AN (*a; b*) POLICY DISCRETE TIME BULK SERVICE QUEUE WITH ACCESSIBLE AND NON-ACCESSIBLE BATCHES UNDER CUSTOMER'S CHOICE

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In this article we consider a discrete time bulk service queue under the policy (*a; b*), incorporating accessibility to the batches of ongoing service. The inter-arrival times are assumed to be independent and geometrically distributed. The customers are served by a single server under the policy (*a; b*). Here the server begins service only if the number of customers in the queue is at least *a* and serves a maximum of *b* customers in a batch with or without accessibility to the batches of ongoing service. If the batch size is less than *d*(*a _ d _ b*), the arriving customer can join the ongoing service depending on the customer's choice. That is, the arriving customer decides either to join the ongoing service (accessible batch) or waits till the next service batch starts. The service times are also assumed to be independent and geometrically distributed. The analysis of the model is considered and explicit expressions are obtained for the steady state probabilities of the system states, expected queue length and expected cost function.

MATCHING PRECLUSION NUMBER FOR HEXAGONAL MESH PYRAMID

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The matching preclusion number of graph G, denoted by mp(G), is the minimum number of edges whose deletion leaves the resulting graph without a perfect matching. In this paper we use the concepts of matching, perfect matching and matching preclusion number. A hexagonal mesh pyramid of n levels denoted as HXP_n consists of a set of vertices arranged in n levels of a hexagonal mesh. A vertex with

address (k,(x,y,z)) placed at level k, of HX_n network is connected to all its adjacent vertices. This vertex is also connected to all the vertices of the hexagon with center (k+1,(x,y,z)). The matching preclusion number of HXP_n (mp(HXP_n)) is 4 and the perfect matching in HXP_n is trivial.

AMS Classification Number: 05C70

(l,w) -DOMINATING NUMBER OF SILICATE NETWORKS

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The *(l,w)*-dominating number is a direct generalization of dominating number. It is used to characterize more precisely the reliability of resource sharing in a network than the wide diameter. In this paper we study *(l,w)*-dominating number of n-dimensional Silicate network *SL(n)*.The Silicate networks was introduced recently by Paul Manuel et al. A silicate network can be constructed in different ways but in this paper we consider a silicate network constructed from honeycomb network.

A FUZZY OPTIMAL EOQ MODEL FOR DETERIORATING ITEMS WITH STOCK DEPENDENT DEMAND UNDER INFLATION EFFECTS

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This paper discusses a Deterministic EOQ (Economic Order Quantity) model for Deteriorating items under inflation in a Fuzzy environment. The supplier gives some credit period to the retailer if the retailer orders a large quantity. This paper considers the stock dependent demand in which shortages are not allowed. We study the effects of inflation rate, deterioration rate and trade credit period on the optimal cyclic length, optimal order quantity and the total relevant cost by taking costs involved in this paper as

triangular fuzzy numbers. A deep study of Sensitivity analysis is made to elucidate the fuzzy model better than crisp model. A graded mean representation method is used to de-fuzzify the model.

Fuzzy Congruences And Green's Relations

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This paper focuses on the concept of fuzzyness on Green's relations. This necessitates describing in fuzzy compatibility by redefining more precisely the definition of Kim and Bae. Then fuzzy congruence is introduced with the help of the definition of Samhan. The condition for composition of fuzzy congruence relations to be a fuzzy congruence is found out. There by Green's ***L***, ***R***, *D* and ***H*** relations are defined by characterizing these notions using fuzzy property and introducing partial order relations on inverse semi groups.

Paper concludes by arriving at the conditions of getting a fuzzy congruence ***D*** and ***H*** relation.

MULTI-OPTIMIZATION TECHNIQUES FOR VENDOR-BUYER INTEGRATED INVENTORY SYSTEM IN A FUZZY ENVIRONMENT

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In this paper, multi-item inventory model with constraints are developed in both crisp and fuzzy environment. This model considers an inventory vendor-buyer integrated system by allowing shortages in a fuzzy situation by employing the type of fuzzy numbers which are trapezoidal. A fully fuzzy model is developed by using different optimization methods. The proposed methods find the optimal lot size for both the vendor and buyer in an integrated two stage supply chain. Graded mean integration representation method is used for defuzzification the values of input parameters and decision variables. A detailed study of numerical example has been carried out by using different optimization techniques

ANALYSIS OF HASHING WITH SL_2 USING NEW GENERATORS

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J.P Tillich and G. Zemor proposed a family of hash functions based on computations over a finite field of characteristic 2. We generated a family of hash functions by replacing the generators with new generators. In this paper we analysis the hash function.

A STUDY ON A RANDOM MOTION GOVERENED BY A M/M/1/1QUEUING SYSTEM

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In this paper, we study on random motion related to queuing system has not been given due to attention in the literature .In this paper an attempt is make to study a random motion which arise by the consideration of the costs associated with the simple queuing processes M/M/1/1 model .This queuing system is very simple in nature to obtain the busy and idle time distributions and the time dependent state probabilities .The study of some random motions related to it leads to parabolic type partial differential equations which require sophisticated techniques to yield solutions .In this papers we provide the transient behavior of the state probabilities of the queuing model M/M/1/1.An elaborate procedure is used to drive partial differential equations governed the joining probability density function associated with the random motion.

A SURVEY ON VARIES ROBUST STATISTICS EDGE DETECTION TECHNIQUE IN BLURRED AND NOISY IMAGE

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Edge detection plays a vital role in image analysis.It is a basic tool for image processing and segmentation. In this paper the most widely used edge detection technique is used to determine the best and better edge detectorin blurred and noisy image. The blurred and noisy image is subjected to various stages of processing to detect the edges.The detector operates at nearOptimum level for the underlying noise distributions, and maintains its robustness in theChanging intrinsic noise environments. In addition, the detector is applied to retrieveEdges from noisy images corrupted by Gaussian noise and

salt-and-pepper noise. This procedure is quite simple, moderateand more flexible. The experimental results show a good performance of the proposed model in segmenting blurred and noisy image. All the propositions have been made using the MATLAB Software.

AN EPQ MODEL FOR AN IMPERFECT PRODUCTION PROCESS WITH THE EFFECT OF INFLATION AND RELIABILITY IN A FUZZY ENVIRONMENT

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This paper explores a fuzzy EMQ model with reliability and inflation effect for an imperfect production process. If the machine goes through a long-run process, it may shift from in-control state to out-of-control state. As a result, the system produces imperfect items. The imperfect items are reworked at a cost to make it as new. The production of imperfect quality items increases with time. To reduce the production of imperfect items, the systems have to more reliable and the produced items depend on the reliability of the machinery system. In this direction, the author considered that the development cost, production cost, material cost is dependent on reliability parameter in a Fuzzy environment. They are taken as Fuzzy triangular cost. A deep study is carried out to illustrate the model.

CHARACTERIZATIONS OF INFLATED PARAMETER DISTRIBUTIONS BASED ON ñ-TYPE LACK OF MEMORY PROPERTY

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In this paper we establish a characterization of the inflated-parameter geometric distribution in terms of ñ- type lack of memory property and this is extended to the characterization of inflated-parameter extended geometric distribution. Also the measure of memory of these classes of distributions discussed. We discuss zero-inflated distributions and measure of memory, inflated parameter geometric distribution in the introduction. The characterization theorem of the inflated parameter geometric distribution is presented in the light of ñ-type lack of memory property. We also have a look at the extended distributions inflated at the point 'a' and their measure of memory, inflated-parameter extended geometric distribution, ñ-type lack of memory property for the extended random variable 'Z'.

AN APPROACH FOR SOLVING AN INVENTORY PROBLEM USING OCTAGONAL FUZZY NUMBERS

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In this paper, a general fuzzy inventory problem is discussed. There are several approaches by different authors to solve such an inventory problem. We introduce octagonal fuzzy numbers by which we develop a new model to solve the problem. Ordering cost, holding cost, order quantity are taken as octagonal fuzzy numbers. Graded mean integration representation method is used for defuzzification. The proposed model is illustrated through numerical examples.

HARRIS DISCRETE UNIFORM DISTRIBUTION

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We introduce and characterize a new family of distribution- Harris discrete uniform distribution. Characteristic properties of the extended models are investigated. That is the natures of hazard rate, entropy, distribution of minimum of sequence of i.i.d random variables are derived. An AR (1) model with this distribution for marginals is considered. Then establish the connection between Harris discrete uniform distribution with Marshall-Olkin discrete uniform distribution and Marshall-Olkin extended geometric uniform distribution.

Characteristic properties of the extended models are investigated

A BRIEF STUDY SURVEY ON ASSOCIATION RULE HIDING IN QUANTITATIVE DATA

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Data mining is the procedure of extracting hiddenpatterns from data. With the explosion of data at anincredible rate, data mining is necessary to mine useful information. Association rule mining is a process of finding correlation relationships among large set of data items. A rule is characterized as sensitive if its disclosure risk is above a certain confidence value. Sensitive rules should not be disclosed to the public, as they can be used to infer sensitive data and provide an advantage for the business competitors. However, data mining also positions a threat to privacy and information protection if not done or used correctly. Therefore, researchers need to investigate data mining algorithm from a new point of view that is of private privacy. Many algorithms have been developed to hide association rules discovered from a binary database. But in real applications, data mostly consists of quantitative values. In this paper a survey of privacy preservation hiding both in binary and quantitative data has been completed.Also this paper suggests a hybrid algorithm with automated generated membership function for PPDM.

Poster presentations

ANALYSIS OF EXPANDED RANK-SIZE MODEL IN TAMILNADU CITY SIZE DISTRIBUTION

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The objective of this paper is to analyze the structure of city size in TamilNadu state from 1991 to 2011 census Population by using expanded rank-size model. The former studies related to rank size model in Tamilnadu have pointed up rank-size relationships. In these studies changes in city- size distributions over time observed makes a note of differences in slope and intercept at the different points in time and results are inferred to indicate growth or decline in entire system of cities and the relative rates of growth or decline of large and small areas. In this paper, the expanded rank-size model is applied in all of cities of Tamilnadu and region wise.

Keywords: Rank-Size Model, Expanded Rank Size Model, City Size, Logarithmic Rank size, Regression.

PREPROCESSED IMAGE STEGANOGRAPHY THROUGH SMQT TRANSFORM

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The available powerful steganalyzers can find out the presence of secret information in images with high accuracy. Increasing the hiding capacity of cover images minimises the detection risk of stego images. In view of this, we propose an enhanced image steganography scheme with preprocessed steganography through SMQT that has a preprocessing stage called successive mean quantization transform before embedding. The goal of this proposed scheme is increasing the undetectability of stego images. Due to the dependence of embedding capacity of images to their content, we used an ensemble steganalyzer to estimate the embedding capacity of each cover image. Since the content of cover image has less significance in steganography, in order to achieve more security, the steganographer can select a cover image from a database to attain higher security and satisfactory embedding capacity. We present several experiments that show the effectiveness of this steganography scheme in improving the security of stego images. The experimental results demonstrate that considering a preprocessing stage can significantly improve the security.

CHEMICAL AND PHYSICAL SCIENCES

Invited talks

ELECTRON AND ENERGY TRANSFER PROCESSES IN SEMICONDUCTOR QUANTUM DOTS

K. George Thomas, *Indian Institute of Science Education and Research, Thiruvananthapuram (IISER-TVM)*

The presentation will highlight our recent efforts on the design of semiconductor quantum dots (QDs) based hybrid systems for light harvesting and conversion. Rate and efficiency of energy transfer between the QDs of various dimensions to donors/acceptors will be discussed.

ORGANIC SOLAR CELLS: PROBLEMS AND PROMISES

P. Predeep, *Laboratory for Molecular Photonics and Electronics(LAMP), Department of Physics, National Institute of Technology Calicut*

Fast depleting fossil fuels and environmental concerns have generated a massive drive in research and development on renewable energy sources with solar photovoltaics (PV) at the centre stage. However the current solar cell technology is not at all a match to the available energy form the sun. A significant fraction of the cost of solar panels comes from the photoactive materials and sophisticated, energy-intensive processing technologies. Recently, it has been shown that the inorganic components can be replaced by semiconducting polymers capable of achieving reasonably high power conversion efficiencies. The current PV energy is far from cost effective and cannot be considered as a viable alternative unless large area printable devices with low temperature processing methods are developed. Even though silicon is the most abundant materials in the earth's crust, turning essentially sand into pure silicon is very energy intensive. Organic and polymer photovoltaics hold forth the promise of an alternative in this context. In spite of the serious concerns about the capability of organic PV as a cost effective alternative to inorganic ones, especially silicon cells, in the light of recent reports of setbacks to the high- hyped OPV companies compounded by the rapid fall in the prices of Si panels, organics still hold forth a lot of hope for the future.

The poor single digit efficiencies of OPVs had been projected as the major drawback for its implementation. However the projected 10% efficiency threshold for commercial viability of OPV has already been breached at least in the laboratory scale. With multilayer tandem cells a 15 % efficiency may not be a far dream. However it has now been accepted that it is not the efficiency but the extremely short shelf life of organic solar cell is going to be the real barrier that restricts OPV emerging as a low cost alternative to conventional silicon solar panels.

In this context an attempt will be made in this talk to discuss the various issues in the OPV development. Basic operational principles of organic solar cells will be presented followed by an overview of recent developments in cell architecture and design concepts.

NATURE INSPIRED CHIRAL CATALYSTS FOR NON-ENZYMATIC KINETIC RESOLUTION

G. Sekar, *Department of Chemistry, IIT Madras, Chennai, Tamil Nadu, India*

Galactose Oxidase (GO) is a copper containing metaloenzyme that oxidizes the primary alcohol of galactose to corresponding aldehyde with concomitant reduction of molecular oxygen.[1] The GO enzyme has so far inspired several research groups to design a variety of synthetic analogues. However, all the ligands in GO models reported so far are either achiral[2] or racemic.[3] For the first time, we have developed an enantiopure model of Galactose Oxidase enzyme from commercially available (*R*)-BINAM and $Cu(OTf)_2$ in a single step. This *in-situ* prepared GO model is directly used as an efficient catalyst for the oxidation of primary alcohols to corresponding aldehydes using molecular oxygen as the sole oxidant and water being only by-product.

In this talk, I will present our recent results concerning the application of enantiopure GO model as a catalyst for the aerobic oxidative kinetic resolution (AOKR) to synthesize highly enantiomerically enriched benzoins.[4] Later on, the efficiency of the AOKR was further improved by developing a new chiral Co catalyst where the reaction can be performed even at room temperature with very high selectivity.[5] In continuation to find out more efficient and environmental friendly catalytic system, we have also developed new chiral iron catalyst for AOKR.[6] Other than benzoins, amino alcohols,[7a] ?-hydroxy esters[7b] and several other racemic alcohols were successfully resolved to yield corresponding optically active compound in highly enantiomerically enriched form.

SYNTHESIS AND SURFACE MODIFICATION OF CALCIUM PHOSPHATE BASED BIOCERAMICS AND IT COMPOSITES

Dr. S. Narayana Kalkura, *Crystal Growth Centre, Anna University, Chennai.*

Calcium phosphates are the main constituent of the bones and teeth of vertebrates as well as almost all hard tissues of humans. Hydroxyapatite (HAp, $Ca_{10}(PO_4)_6(OH)_2$) is one of the phases of calcium phosphate and attracted attention due to its similarity to the natural bone and teeth in its composition. It also has been an attractive material for chromatographic separation, catalysis and ion exchange apart from their use as bone and teeth implants. Study of finding a substitution for the bone parts and repairing seriously

damaged portions of the human body is a challenging area of multidisciplinary research. Some of the outstanding properties of HAp are biocompatibility and osteoconductivity. It has been widely used to reconstruct or substitute spoiled bone tissues. Despite these advantages it has poor mechanical strength that limits its application in the load bearing areas. Another disadvantage of HAp is its low reactivity, which leads to slow integration with bone. When applied as coating on metallic surfaces the dissolution rate in the body environment is high that results in the disappearance of the coating at an early stage after implantation. Conventional high temperature sintering of HAp may reduce its reactivity and also result in the conversion to its á-phase and calcium oxide, which is undesirable as it increases the dissolution rate in vivo. To tolerate the corrosive environment of the human body and to control the dissolution rate, surface modifications of the implant materials is being employed. The ion implantation and irradiation of the implant can change the properties of the surface in a controllable way without impairing the bulk characteristics. The nano-scale changes in surface like grain size distribution, charge distribution is known to influence the biological performance of the biomaterial. Further, the porosities produced would help in the flow body fluids, bone tissue growth coupled with good biocompatibility.

The low temperature synthesis of HAP and its composites by various techniques along with the effect of metallic ions(Fe, Co,Ni, Mg, Sr, La) on the physico chemical properties of the samples will be discussed. Further, the low temperature technique employed provides non toxic, versatile and cost effective biodegradable scaffolds which could be used for various biomedical applications. The samples were characterized by XRD, IR, RAMAN, SEM, DLS, and Thermal Analyses. The samples exhibited enhanced drug delivering and bioactive properties. In addition, discussion on the irradiation studies using oxygen, sliver ions and silicon ions and nitrogen ion implantation on HAp bioceramic will be presented. It was seen that the method of preparation of the samples influenced the surface modification in a significant way. The surface was modified in most of the cases leading to considerable changes in surface properties. The irradiated surfaces showed unique bioactivity, forming spherical macro-porous apatite layer which can enhance osteointegration and osteoconduction. The nitrogen implantation significantly enhanced permittivity, ac conductivity, photoluminescence and average pore size (50%) and *in vitro* bioactivity. The porosity of the samples could be engineered by implantation of Nitrogen ions. The implantation of the bioceramics with low energy ions could be used to modify the surface and tailor the properties such as electrical, photoluminescence, protein absorption and bioactivity of the biomedical implants.

GREEN MESOSTRUCTURED CATALYSTS

M. Selvaraj, *School of Chemical and Biomolecular Engineering, PNU, Busan*

The discovery of highly ordered mesoporous silicate materials with high surface area, large uniform pore size, and large pore volume has attracted great interest for their potentially wide catalytic applications. Particularly, the mesoporous SBA-15 is synthesized using Pluronic P123 triblock copolymer as a structure

directing agent under strong acidic hydrothermal method. However, the introduction of higher heteroatomic species into SBA-15 under the similar method is very difficult because the formation of metal-oxo species in the mesoporous material is much less whereas ~75% heteroatoms can be leached out during filtration, and the poisoned-catalytic products are easily formed by certain metal oxides on the surface of SBA-15. To overcome the above problems, using the pH-adjusting direct hydrothermal (pH-aDH) method introduced, for the first time, by Selvaraj and his research group, several heteroatoms, such as Al, Ga, Mn, Sn, Cr, Nb, Ce, Cu, V and Ti, have been successfully incorporated in the framework of SBA-15 with very high metal species loadings. On the basis of characteristic results obtained for the synthesized mesoporous materials, the incorporation of higher heteroatomtic species into SBA-15 materials is found to create the higher mild Brÿnsted and Lewis active sites on their surface pore walls with enhanced hydrothermal stabilities. These materials have been successfully used as the green catalysts in the production of fine chemicals / petrochemicals with 90-100% selectivity under novel green catalytic methods, and the mesoporous catalysts have been also recycled in these catalytic reactions to find their catalytic stabilities.

Oral Presentations

CHARACTERISTICS OF MONSOON ORGANISED CONVECTIONS : VIEWED AS MULTIPLE ONSETS OF INDIAN SUMMER MONSOON

C A Babu[1], P. N. Sreelekha[1] and Hamza Varikoden[2]

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Indian summer monsoon exhibits evolution of intermittent monsoon organized convections in the equatorial Indian Ocean. These organized convections are treated as multiple onsets or surges embedded in the monsoon system as they produce monsoon rainfall in the region they pass during their northward propagation until they dissipate in the foot hill of Himalaya. Characteristics of the monsoon surges are studied in detail utilising OLR, GPI, wind and humidity data. Prominent organized convections move beyond 25^{o} N while feeble surges dissipate before 15^{o}N. One surge is formed before monsoon season (bogus onset) and 7 to 12 surges are formed during the season. A comparison of bogus onset, normal onset and second onset is made. The analysis helps for a better understanding of the processes behind evolution of the surges and hence the factors responsible for different epochs of the Indian summer monsoon.

DYNAMIC FEATURES ASSOCIATED WITH DEFICIT MONSOON DURING 2009 : A COMPARATIVE STUDY

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Indian summer monsoon plays vital role in the agricultural based Indian economy as farmers depend mainly on rain-fed irrigation. During monsoon season, intermittent monsoon organized convections are formed in the equatorial Indian Ocean and move to the north producing monsoon rainfall over the region they pass. A better understanding of factors responsible for deficit monsoon rainfall during 2009 is useful for proper assessment of monsoon activity especially in the climate change scenario. Thus an analysis is carried out to assess the features of Indian summer monsoon during 2009 to bring out the factors responsible for the deficit monsoon. The analysis is carried out utilizing mainly NOAA OLR, NCEP wind and humidity

at different levels and GPI rainfall. The cross equatorial flow strength during 2009 was relatively weak. The westerly in the lower atmosphere was feeble and shallow during 2009 in comparison with normal monsoon year, leading to less moisture pumping from Arabian Sea. The number of monsoon organized convections formed during 2009 was less and moved north quickly, producing less rain. In addition, the intensity of organized convection and its northward extension were less during 2009. Furthermore, the vorticity, convergence, vertical extension of cyclonic circulation and vertical velocity associated with the monsoon organized convection were relatively small during 2009. The analysis provides an insight into the mechanisms responsible for deficit monsoon 2009.

DEPENDENCE OF SOLAR ACTIVITY CYCLE ON GENERATION OF LUNAR X-RAY FLUORESCENCE

Smart Kundassery*[1], C. A. Babu[1] and Anil Bhardwaj[2]

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Photons of the electromagnetic spectrum interact with the surfaces and atmospheres of planetary system objects thereby generating various physical processes which are detectable from either ground-based or a space-borne satellite mission. Photons having energy greater than the binding energy of the elemental composition can cause excitation, and on de-excitation generates fluorescence. X-ray photons generated from the solar atmosphere are capable for the generation of fluorescence in the X-ray region. Being endowed with an exosphere, lunar regolith is exposed fully to the impinging X-ray radiation, which generates fluorescence from the sun-lit side. The solar coronal X-rays interact with the elemental composition and the intensity of the resulting fluorescence spectrum is highly dependent upon the phase of the solar activity cycle. A model is developed to estimate the continuum X-ray emission by considering free-free emission during representative phases of solar activity cycle, and this X-ray spectrum is further utilized to determine the X-ray fluorescence spectrum emanating from KREEP Basalt, of the lunar regolith.

DIFFERENTIATION BETWEEN SENSITIVE AND INSENSITIVE SALINITY ZONES OF COASTAL AQUIFERS OF THE CENTRAL KERALA, SOUTH INDIA USING THE QDI TECHNOLOGY.

***Pious Joseph K**, Associate Professor of Physics, Christ College, Irinjalakuda*

***A V George**, Vice-Chancellor, Mahatma Gandhi University, Kottayam*

Detailed investigations and critical evaluation of the aquifer conditions of the Central Kerala Coastal Tracts extending from Azhikkode in Thrissur district to Ponnani of Malappuram district of Kerala, South India is carried out during pre monsoon, monsoon and post monsoon seasons. Detailed analysis of physico–chemical parameters of the water samples collected from various sample stations of the different zones of the entire study area, during every month, at a specific date during the three seasons. Using each depth

of the monthly water table data of the sample stations during the three seasons and corresponding physico-chemical parameters, 'QDI' (Quality Depth Index) is found out. This index will indicate the amount of rise or drop of the salinity per unit lowering or rising of the water table. Higher values of QDI indicate the higher sensitivity of the fresh water towards the change in depth to the water table. Using the plots between the QDI values of each sample station and the distance of that sample station from the nearest salt water body, the entire coastal aquifers of Central Kerala are differentiated in to Sensitive and Insensitive Salinity Zones.

A STUDY OF CLIMATE VARIABILITY OF TRIVANDRUM CITY USING LONG PERIOD METEOROLOGICAL NORMALS

Sunil Kumar Morais.C , Sony.K.S and T.E.Girish

Department of Physics,University College

We have studied long period meteorological normals of Trivandrum city during 1837-2010 AD to understand the climate change scenario. The cloud cover and rainfall of Trivandrum city is found to exhibit long term decreasing trend for most months of study while a decreasing trend is observed for wind speed. An unusual warming (surface temperature increase) is observed during 1865-1882 due to deficient rainfall. The importance of the present results are discussed using urban climate variability models with applications to diverse fields such as agriculture, hydrology and solar energy utilisation.

EFFECT OF POST DEPOSITION THERMAL TREATMENT ON THE PROPERTIES OF ZNSE THIN FILMS

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Polycrystalline zinc selenide thin films have been deposited on glass substrates via chemical bath deposition. Effects of annealing temperature on optical, structural and photo luminescence properties of the deposited ZnSe films have been investigated. Structural examination revealed a transition from purely cubic phase to a mixed cubic and hexagonal phase at an annealing temperature of 200 ^{0}C. The optical transmittance has improved with increase of annealing temperature. The band gap energy was estimated by Tauc's method and found to be 2.88 eV at room temperature. The optical band gap energy has decreased with increasing annealing temperature. The photoluminescence (PL) intensity increased with annealing temperature up to 200^{0}C and decreased at 300^{0}C.

A NOVEL METHOD TO PREDICT THE PERFORMANCE OF A DYE IN DSSC

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In the field of Dye Sensitized Solar Cell (DSSC) various efforts are made to replace the Ruthenium based photosensitiser with other organic complexes and even natural dyes. Though the reported efficiency of natural dye based solar cells is less, it is an area of research with immense possibilities for appreciable results. In this paper, based on theoretical requirement of a good dye, an attempt is made to predict the performance of a natural dye. Quinone dyes contained in the natural extract of Teak leaf is selected for the study. HOMO and LUMO energy level of this natural dye is evaluated using absorption spectra and cyclic voltammetry. With these results we have made predictions on cell efficiency in comparison with Ruthenium dye N-719. This would mean the possibility of predicting cell performance of any given dye, even without fabricating a solar cell. We have also made attempts to correlate this prediction with the actual cell performance.

EFFECT OF UV ILLUMINATION ON CHEMICAL BATH DEPOSITED TIN SULFIDE THIN FILMS

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Tin sulfide thin films have been grown on glass substrates by chemical bath deposition technique (CBD) at room temperature and irradiated with UV light source of wavelength 355nm. The effect of UV illumination on the physical properties of the films was compared with that of the as prepared film. Though the thickness of the films unaltered after illumination, the properties like structural, optical and electrical were changed considerably. The structural studies showed the polycrystalline nature of the UV illuminated sample whereas the as prepared film was mono crystalline. Both films were orthorhombic structure with Sn_2S_3 phase. The optical properties of the films were systematically studied using the optical absorbance and reflection spectra. The irradiated film exhibited lower band gap of 1.74 eV than the value of as prepared film ie.1.77eV. The measured resistivity of the tin sulfide thin films was found to be of the order of 10^9 and 10^8Ùcm for as prepared and UV illuminated films. The SEM images showed the presence of worm like nanostructures with almost similar appearance in both the films.

SYNTHESIS, GROWTH, AND CHARACTERIZATION OF L-ALANINIUM TARTRATE SINGLE CRYSTAL

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Organic non-linear optical materials are potential candidates for frequency mixing, electro-optic modulation, optical parametric oscillation optical by stability *etc*., due to the large optical non-linearity, low cutoff wavelength, short response time and high thresholds for laser power. In the present investigation, bulk crystal of L-alaninium tartrate, an organic adduct of L-tataric acid was grown by slow solvent evaporation technique. The grown crystal was subjected to single crystal X-ray diffractometry (XRD) to estimate the crystal structure and space group and its morphology was also studied. The optical property of the crystal was investigated using UV-vis-NIR. The functional groups were identified by the FTIR spectral analysis.

STUDIES ON THE TREATMENT OF AMMONIACAL NITROGEN CONTAINING WASTE WATER BY STRUVITE PRECIPITATION WITH THE DESTRUTION OF DISSOLVED ORGANICS

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This study was conducted to treat the high ammoniacal-nitrogen containing waste water through struvite precipitation techniques followed by Fenton oxidation. In this study, $Cu^{+/}H_2O_2$ were selected as Fenton reagent and Nonporous Activated Carbon (NAC) as catalyst for the destruction organic compounds in wastewater. The struvite chemicals MgO, H_3PO_4 were optimized for the removal of ammoniacal-nitrogen from hetero Fenton oxidized wastewater. The percentage removal of ammoniacal-nitrogen was increased from 87.9% to 95% and the purity of the struvite also increased after the destruction of organics in wastewater by $Cu^{+/}H_2O_2$ oxidation. The molar ratio (NH^{4+}-N: Mg^{2+}:PO_4^{3-}) for the maximum amount of struvite precipitation was optimized at pH, 9.0 and the temperature at 25 !. Further, the struvite reaction time and the precipitate settling time were also optimized. The FT-IR analysis, TGA-DTA and DSC analysis of the struvite precipitate shows difference between the precipitations followed by HFO process and without following HFO process. The recovery of the struvite chemicals is also optimized and it was used for the further struvite precipitation process.

MAGNETIC FIELD EFFECTS ON SIGNAL TRANSMISSION IN A NANOSTRIP HIGH TEMPERATURE SUPERCONDUCTING COPLANAR WAVEGUIDE

Jolly Andrews

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The vortex dynamical effects on the microwave signal transmission through a High Temperature Superconducting (HTS) Coplanar Waveguide (CPW) is reported for a wide range of magnetic field and strip thickness in nanometer scale. The numerical analysis is carried out by Spectral Domain Method (SDM) using Galerkin's procedure. The dyadic Green's functions formulated in the Fourier space are modified by using the resistive boundary condition obtained by the self consistent phenomenological model proposed by Coffey and Clem (CC). The complex penetration depth derived by CC model takes into account the thermal and field effects in a self consistent manner. Numerical results are presented for the propagation constant and unloaded quality factor. It is found that the microwave signal is gradually attenuated as the superconducting strip thickness is slowly decreased whereas the signal dispersion is more or less constant with the strip thickness variation. The impact of the varying magnetic field on signal transmission is explained using vortex effects. The higher field will create greater dissipation of the signal. The study relates the influence of vortex motion on the electromagnetic signal propagation through a nanometer scaled High Temperature Coplanar Waveguide.

NOVEL FEATURE OF CUO AS AN EFFECTIVE BIOMATERIAL FOR TREATING URINARY TRACT INFECTIONS

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Urinary tract infection is the second most common clinical disease and possesses a healthcare burden. This infectious disease can alter the urinary system either structurally or completely and it remains as one of the greatest challenges to global health. Out of all the trace elements, Copper shows a pronounced antibacterial activity. A number of papers report that Copper exhibits a good anti microbial activity. The present work reports the novel feature of copper oxide as a biomaterial in the treatment of Urinary tract infections. Copper Oxide was prepared by "Precipitation method" with Copper Chloride and sodium hydroxide as precursors. A polymer Poly Ethylene Glycol was incorporated along with Copper Oxide in

the molar concentrations of 200,400,600 to enhance the anti microbial activity. Using Poly Ethylene Glycol the size and shape of the synthesized copper oxide was successfully altered. The prepared samples were subjected to X-Ray diffraction analysis using CuKá radiation with a scanning rate of 0.02 s^{-1} in the angles of 10º to 75º. The major peak located at 39º corresponds to the diffraction pattern of CuO. The sharpness of the peaks indicates that the samples are crystalline and pure. SEM studies of as synthesized sample gives the average grain size and the surface morphology of the particles. By "Well Diffusion Method", the samples were tested for its antibacterial activities against *E.coli, Pseudomonas sps, Staphylococcus* and *Klebsiella sps* which are the main causal agents for Urinary Tract Infections (UTI). It was found that PEG incorporated Copper Oxide has a pronounced anti bacterial activity. Hence it can be concluded that Copper Oxide can be used as an effective novel material for treating "Urinary Tract Infections".

EXPLORATION OF SUPPORT-FREE VISIBLE LIGHT SENSITIVE CETIO4 CATALYST FOR PHOTOCATALYTIC WATER SPLITTING WITHOUT ANY SACRIFICIAL AGENTS / SCAVENGERS

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The importance of Hydrogen as a fuel is increasing day by day, especially when the scenario of the fossil fuels in the world does not look bright. Hydrogen is also a very important industrial chemical, as it is used widely in large scale processes like the Haber's Process. Even for such requirements, hydrogen is obtained by using up fossil fuels in barrels. To make a change to this scenario, it is very essential to look at methods by which we can produce hydrogen efficiently, without putting the non-renewable sources of energy at stake. The economic feasibility and non-toxic nature are other important features we have to focus on. This is where the photocatalysts gain importance. Our work focusses on exploring the scope of CeTiO4 as a photocatalyst to perform water splitting. CeTiO4 was produced in the laboratory, and characterized by various methods. Evaluation of the photocatalytic activity is also included in this work.

LIFE SCIENCES

Invited talks

INNOVATIONS IN BIOLOGICAL WASTE TREATMENT PROCESSES

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Waste generation is an inevitable outcome of industrial development. Waste minimization and eco-friendly waste treatment methodologies have to be prioritized to make the development sustainable. The problem can be addressed by minimizing waste generation and by treating the waste through advanced process technologies which reduce the environmental impact. Different treatment technologies are in use for treating the wastes, which can be broadly classified into four groups: physical, chemical, physico-chemical and biological processes. Among these processes, biological processes are most favoured because they are economical and eco-friendly.

Anaerobic biological processes are attractive for treatment of waste waters due to the possible recovery of energy in the form of methane. However, they suffer from very low reaction rates, which is an inherent property of all methanogenic microorganisms. The solution to overcome this problem lies in building up a high concentration of the anaerobic biomass inside the reactors. Reactors such as anaerobic filters and anaerobic fluidized bed reactors work on this principle. So does the up-flow anaerobic sludge blanket reactor, though without any inert carrier particle. However, all these reactors suffer from some operational problems which make their field application very difficult, if not impossible. To overcome these problems, some novel anaerobic reactors have been developed at the Department of Biochemical Engineering and Biotechnology, IIT Delhi. One such reactor, called the hybrid anaerobic reactor (HAR), has self-immobilized anaerobic biomass granules which are in a fluidized state. Bacterial surface charges, presence of divalent cations in the aqueous phase as well as ability of the bacteria to produce extra-cellular polymeric substances play an important role in the production of the biomass granules. While the fluidized-bed style of operation eliminates bulk liquid phase transport limitations, the absence of any carrier particle eliminates particle carry-over problem and the associated reactor operational instability. This reactor, initially operated under lab scale, has now been scaled up to pilot plant level and has been shown to operate satisfactorily, treating waste waters generated by the diary industry at a rate of 10,000 litres per day at a hydraulic retention time of only 2.5 hours. The entire process of granule formation, organic uptake and wastewater treatment occurring within the reactor has been modeled mathematically and shown to predict reactor performance close to actual experimental data. The model consists of the following elements:

a. A biofilm model which describes the rate of substrate conversion per individual granule

b. A bed fluidisation model which describes the number of biogranules per unit fluidised bed volume

c. A reactor flow model, which links biofilm, and bed fluidisation models to yield substrate concentration as function of axial position within the reactor.

The performance of these reactors depends on the activity of the microbes present inside the reactors. For designing such reactors, engineers consider the reactor like a 'convertor box' or 'black box' where influents enter, get converted and come out as treated effluents. In designing such reactors mostly effluent characteristics, hydrodynamic conditions, chemical kinetics (rate of conversion) are considered and chemical reactor design parameters are considered as guidelines. These black boxes generally work and degrade waste to the satisfactory level. But sometimes they fail. Failure of such reactors affects not only the industry but the environment and ecosystem severely. Often, corrective measures are adopted too late and almost the entire reactor has reached a total failure state. Mostly this is due to lack of any advance warning or indicators of what is happening to the microbial community inside the reactor. In such cases, the only option left is to restart the entire reactor(s). Shutdown and restart of process trains involves huge physical effort as well as financial loss. But such disasters can easily be prevented by using metagenomic tools like Polymerase Chain Reaction (PCR), Denaturing Gradient Gel Electrophoresis (DGGE), Real-Time PCR (RT-PCR), and Fluorescence *in situ* Hybridization (FISH) to map the community profile of the microbes present in the reactor. A proper understanding of the microbial community present in the reactors can helps in preventing such failures. The mixed microbial consortia present in the reactor involves different groups of microbes responsible for degrading the waste. Stability of the reactor performance depends on the stability of the community profile achieved at steady state operation. Knowledge of abundance and diversity of the desired microbes present in the community leads to best performance from the reactor. Whenever some disturbance occurs in the system, it reflects on the microbial community profile and the community gets changed from its stable profile. Frequent monitoring of community profile helps in taking preventive actions well in advance which restricts the sudden failure of the reactors. Diversity and abundance of the desired microbes in the community profile also helps in choosing the best operating conditions to be maintained.

The metagenomic tools are based on identification of 16s rRNA present in the microbes which is known as molecular evolutionary markers or 'biomarkers'. First, the DNA from the mixed microbial consortia is extracted and then amplified with specific pre-designed primers of microbes of interest in a PCR thermo cycler. The amplified DNAs are segregated based on their GC content in a DGGE apparatus. Different bands obtained in the DGGE gel are cut and eluted separately and the eluted DNA molecules are sequenced. Using the sequence data, BLAST search is carried out to identify the species and their diversity in the mixed culture. This helps in preparing the community profile map of a mixed microbial consortia. Deviation of profile map from the stable profile obtained at steady state operation indicates the occurrence of disturbance in the reactor. RT-PCR is also used to determine the quantitative profile. FISH is used to determine the abundance of the desired microbes in the mixed microbial population. In FISH,

rRNA selective fluorescent-labelled oligonucleotide probes are used. The bio-film or microbes are permeabilized or fixed using aldehydes. Then the probes are added which enters the cell with hybridization buffer and are hybridized with selective rRNA present in the ribosome of the cell. After hybridization, excess probes are washed and viewed under Confocal Laser Scanning Microscope (CLSM). Presence of desired microbes gives fluorescence and ensures their presence in the mixed culture. 3D configuration obtained from the CLSM gives the idea of the abundance of the desired microbes in the mixed microbial consortia. Change in abundance of the desired microbes in the mixed consortia indicates perturbation to the system.

VECTORIAL CAPACITY AND PATHOGENIC ADAPTATIONS IN MOSQUITO TRANSMITTED DISEASES

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Among various Arthropod vectors, mosquitoes have the maximum capacity to transmit debilitating and deadly diseases such as malaria, Japanese encephalitis, lymphatic filariasis, yellow fever, dengue and chikungunya. Their vectorial capacity involves the prolific breeding in preferred water bodies, flight range, swarming ability, anthropophilic feeding habits, ability to maintain the pathogens to complete the life cycle, wide distribution, development of insecticide resistance, highly engineered blood feeding technique, perfectly evolved saliva constitution etc. However, out of over 3500 mosquito species described in the world, only about 350 are vectors. Remaining species are called refractory.

The pathogens too travelled along with the mosquito vectors to various continents and evaded their immune system to complete the life cycles, thereby widely spreading the communicable diseases . For example , to protect itself the Plasmodium gamete surface protein PfGAP50 binds to the host compliment regulator Factor H to inactivate the complement protein **C3b.** In the human host, the malarial parasite modifies the erythrocyte by exporting proteins into the host cell. Development of drug resistance is another evolved adaptation of Plasmodium. These pathogens including the retroviruses such as JE, YF, DEN and CHIK have adapted to survive in alternate hosts by adjusting to altered temperature conditions, by evading the immune systems both in the vector and the vertebrate hosts. For example, DEN and CHIK viruses survive in the infected macrophages, thereby hoodwinking the immune system and transported across various tissues. They even get amplified in certain vertebrate host asymptomatically (JE). Further,pPathogenic adaptations involve proliferation with complex life cycles and virulence. Their appearance in the peripheral blood stream usually coincides with the biting rhythm/habit of the vector concerned which will ensure the onward transmission.

ROLE OF BIOMATERIALS IN TISSUE ENGINEERING & REGENERATIVE MEDICINE

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Diseases, injury and trauma are increasing day by day leading to damage and degeneration of tissues in the human body. This will require treatments to facilitate repair, replacement or regeneration. Auto grafts (tissue from one site to another in the same patient) and allograft (one individual to another) were used for transplantation. Even though both are lifesaving, auto grafts are painful, limited and associated with donor site morbidity. Allograft and transplantations are also having problems like availability, risk of rejection and possibility of acquiring infection. In this context, Tissue engineering (TE) strategies become significant. Tissue Engineering was defined as "application of principles and methods of engineering and life sciences toward the fundamental understanding of structure function relationships in normal and pathological mammalian tissues and the development of biological tissues to restore, maintain or improve tissue function." Tissue engineering is a multidisciplinary field requiring the expertise of clinical medicine, materials science, mechanical engineering, genetics and other related disciplines from Engineering and Science disciplines. For creation of biological tissues, porous 3D scaffolds are normally used to simulate the natural environment. TE consists of a triad of main elements cells, biomaterial/scaffold and growth factors.

Tissue regeneration therapy is a third therapy based on the natural induction of tissue regeneration through cell transplantation and tissue engineering following reconstructive surgery and organ transplantation. Tissue engineering requires substantial collaborative research between material, pharmaceutical, biological and clinical scientists. Even if superior stem cells can be practically obtained, it is impossible to therapeutically treat patients only by transplanting the cells alone, unless a local environment of cells suitable to promote the proliferation and differentiation is created properly. In turn, creation of this environment requires biomaterials and the biomaterial technology.

Biomaterial was first defined as "a nonviable material used in a medical device intended to interact with biological systems". Later the definition was changed as "a material intended to interface with biological systems to evaluate, treat or augment or replace any tissue, organ or function of the body". This gives a more prominent role for biomaterials in regeneration or tissue repair. Metals, Ceramics and Polymers (both natural & synthetic) are the main groups of biomaterials. Previously biomaterials were used simply to fill the void space during surgery, whereas current biomaterials are intended to mimic the natural extra cellular matrix (ECM). Selection of biomaterial is an important criterion to mimic ECM. Suitable biomaterial should be selected for specific application. Biomaterial scaffolds may require highly open porous structure with good interconnectivity and possessing sufficient mechanical strength for cellular in or outgrowth. Surface of fabricated scaffolds must support cellular attachment, proliferation, and differentiation. , Drug or cytokine releasing scaffolds are ideal for modulating tissue regeneration as

cytokines, growth factors and other small molecules play fundamental roles on growing functional living tissues.

Natural biomaterials have been extensively used for tissue engineering as they have advantages over synthetic materials like similarity with natural ECM. Alginate, chitosan, collagen, fibrin, and hyaluronic acid (HA) have been used for the fabrication of three-dimensional scaffolds Main drawbacks are adjustment of the properties of natural biomaterials and the source-related immunogenicity. Synthetic biomaterials being man-made can be modified to provide precise control of the properties of synthetic materials and even can give better performance than naturally occurring biomaterials. However, biocompatibility issues have to be looked into. Aliphatic polyesters and polyanhydrides are commonly used synthetic polymers for tissue engineering and drug delivery systems, as they have distinct biodegradability and biocompatibility. By combining hydrophilic and hydrophobic segments in the structure, a variety of synthetic biomaterials with different mechanical properties and degradation behaviors can be generated.

Native ECM normally brings cells together into tissue, controls the tissue structure, and regulates the cell phenotype. Biomaterials can act as ECM and give biologic and mechanical functions. Biomaterials can also facilitate the localization and delivery of cells and/or bioactive factors like cell-adhesion peptides and growth factors to desired sites in the body. Biomaterials can also provide a three-dimensional space for the formation of new tissues with appropriate architecture and function. Even though direct injection of cell suspensions without biomaterial matrices has been used in some cases, but it is difficult to control the localization of transplanted cells. However, many of the mammalian cell types are anchorage-dependent and require a substrate for adhesion. Biomaterials can be a means of cell delivery with high loading efficiency to specific sites in the body. The configuration of the biomaterials can guide the structure of an engineered tissue by providing mechanical support against in vivo forces. The biomaterials loaded with bioactive signals, such as cell-adhesion peptides and growth factors, can also regulate cellular function.

The creation of new materials by combining the advantages of both synthetic materials and naturally derived materials is an emerging area of tissue engineering. The hybrid materials should have the specific biologic activities of naturally derived materials as well as the favorable properties of synthetic materials, including widely controllable mechanical properties and good processability. Traditional synthetic biomaterials lack biologic signals that regulate cellular functions. One of the interactions that direct cell behavior is the cellular interaction with adhesion domains in biomaterials. The synthetic materials promote cell adhesion via indirect nonspecific recognition through proteins fibronectin and vitronectin from the body fluids. A direct approach will be the incorporation of cell-adhesion peptides found in natural ECM growth factors and DNA into synthetic materials.

Electro spinning allows the production of polymer fibers with diameters from 3 nm Electro spinning is applied more and more in tissue engineering scaffolds as it can mimic native ECM. Electro spinning provides a simpler and more cost-effective means to produce scaffolds with an inter-connected pore

structure and fiber diameters in the sub-micron range. Electro spinning has been utilized to form Synthetic polymer scaffolds, Natural polymer scaffolds, Composite scaffolds and Functionalized scaffolds. The tissue engineers have stared to utilize the inherent nanoscale nature of electrospun polymeric fibers as potential scaffolds to mimic native ECM. Electrospun matrices are able to support the attachment and proliferation of a wide variety of cell types; as the cells are able to maintain their phenotypes on these nanofiber scaffolds

Cell sheet engineering is another important strategy for Tissue Engineering for Regenerative medicine. Poly (N-isopropylacrylamide) (PNIPAAm) is a well-known stimuli- responsive polymer, which responds to temperature by changing its hydrophilicity and swelling. Properties of PNIPAAm make it favorable to fabricate dynamic platforms to overcome the static features of previous technologies. Thermoresponsive substrates overcome static properties of previous cell-culture surfaces by providing the ability to form geometrically controlled and retrievable biomimetic tissue constructs in a temperature-dependent manner without the use of digestive enzymes. Two-dimensional thermoresponsive templates are useful to obtain intact monolayers of tissues with high cell-cell interactions. This can also be used for different regenerative therapies by creating thick tissues or prevascularized tissue constructs by stacking cell sheets. Three-dimensional thermoresponsive platforms give the opportunity to control tissue geometries in a 3-D manner by mimicking the native tissue architecture and enable their further retrieval. However, creating shapes of native tissues and organs with preserved functionalities will be a challenge.

DEVELOPING DRUGS USING BIOINFORMATIC TOOLS

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Research into the biochemistry of diseases has led to much understanding about the molecules involved in the disease causation as well as the mechanisms involved during the onset and establishment of the diseases which triggered the quest for the search of effective drugs that can prevent, block or revert the molecular events leading to the diseases.

The booming of bioinformatics has made possible the development of drugs at a much faster rate and the study of its efficacy using *in silico* approaches even before it is taken up for clinical trials. The rigorous screening methods available also make it possible to bypass the first two stages of clinical trials involving *in vitro* testing and laboratory animals, and move straight to the human clinical trials in several instances.

Drugs play an integral part of our well being, especially as the number of ailments that afflict the human beings is constantly increasing. Day after day, new disorders and ailments are also on the raise due to

increasing pollution levels, mutant forms of microorganisms and development of resistance to existing pathogens (organisms responsible for causing diseases). Additionally, the efficacy of the existing drugs can be improved and side effects (if any) can be minimized by re-designing the drugs. Thus, the need for new drugs is a constantly increasing process.

In recent years, the process of drug design and development has been influenced by computers and information and technology, leading to the process of computer-aided drug design (CADD). This process has significantly improved the speed, accuracy and efficacy of the drug development process and has drastically decreased the testing phase, as it permits *in silico* high throughput screening.

The "ideal" drug candidate (lead compound) should satisfy several criteria, the most important of which are as follows:

1. Safety
2. Effectiveness for intended use
3. Chemical stability
4. Metabolic stability
5. Ideal solubility profile
6. Synthetic feasibility
7. Novelty.

The field of Computer-aided Drug Design (CADD for the biologists, though for the computer specialists CADD is something else) encompasses a wide variety of subjects, with biology and computer science in the forefront. CADD takes heavy input from mathematics, statistics, physics, chemistry, mechanics, thermodynamics, combinatorial chemistry, and also several engineering disciplines, besides computer science and biology. Apart from this, the product designed ultimately needs to be mass produced by scaling up, and marketed, which requires the input from economics, commerce, financial analysis, etc. Then there is also the process of obtaining the intellectual property rights like patents, where the lawyers are involved. Thus, CADD turns out to be a truly interdisciplinary field, which can utilize the skills of scientists and individuals from varied disciplines.

The process of drug development starts with the identification of the target, that is, the molecule that is responsible for the disease. With the precise identification of such a target molecule, the process of CADD becomes much easier. Now, we decide on how we need to tackle this molecule with the drug. The trick is to design the drug molecule to modulate the target molecule in the desired way. Several biochemical and systems biology approaches make it possible to identify the exact area in the target molecule that we need to hit. Once we decide this *modus operandi*, we start the design process. This involves the design and synthesis of the candidate drug and testing it for pharmaceutical activity.

Now, we "dock" the possible drug molecule. By docking, we mean making an exact fit of a ligand molecule in the identified hit area (referred to as the active site) of the target molecule. Then comes the screening step. This is once again done effectively with the help of computers. Software programs or modules have been developed that can calculate, based on several mathematical, statistical, physicochemical and other characteristics, the exact extent of the drug action (efficacy or activity) in relation to each structure generated. This process is called Quantitative Structure Activity Relationship (QSAR).

Once this is done, we would have narrowed down the candidate list drastically. The next step is to move from the dry laboratory to the wet laboratory, to chemically synthesize the ligands. These candidates are then subjected to high throughput screening, where once again the computers help. Once the candidate drug is through all the tests, it is ready for the testing on the experimental animals and move on to clinical studies. Only then can it be cleared by the FDA (Food and Drug Administration) for marketing as a drug.

All these are fine when we know the structure of the target molecule that we start with. But often it turns out that the biochemists have not worked out the exact structure of the target molecule that is responsible for the disease process. Now let us consider how a drug is designed when we do not know the structure of the target molecule. Here, a process called "Homology modeling" comes into play. Using homology modeling, we can compare the target molecule with a molecule that is highly similar in sequence with the target and shares a common "ancestor". There are software programs to do this too. Using the structure of this second molecule, we can "model" the most probable structure of the target molecule and follow it up with confirmatory tests. The rest of the design and testing processes then follow.

To conclude, computer-aided drug design has developed as the "rational" drug design and development process. It saves time, energy, money and manpower to a large extent and also helps in the development of not only more drugs, but also more efficient drugs, in a much shorter time. Computer professionals have a lot of role to play in this process, in developing better software programs to improve all the steps in the process, so that we can look forward to a disease-free future.

STEM CELLS: NEURAL FATE SPECIFICATION AND THERAPEUTIC APPLICATIONS

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Stem cells are unique totipotent cells that distinguish themselves from other cells in the body by having the capacity to proliferate indefinitely under *in vitro* conditions and can be differentiated into any cell type in the body under appropriate experimental conditions, i.e., neurons, muscle cells etc. Currently, a lot of research is being carried out globally to treat Parkinson's and Alzheimer's diseases, spinal cord injury, stroke, burns, heart disease, diabetes, osteoarthritis and rheumatoid arthritis etc using embryonic

stem (ES) cells and adult stem cells. But the most challenging task is obtaining a homogenous population of fate specified cells for cell replacement therapy. A number of signaling pathways such as Notch, Wnt etc. and growth factors are involved in fate specification of stem cells into a particular lineage. During this talk we will discuss the biology of neural stem cells with an objective to understand the mechanisms underlying cell fate specifications in the retina and brain and to utilize these cells for cell replacement therapy.

BIOREFINERIES FOR THE FUTURE TRANSPORTATION FUELS AND MORE

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Plant biomass is the most abundant renewable resource currently available in the world and the only raw material that can herald the sustainable production of fuels and chemicals for the future. Among the biologically produced transportation fuels, lignocellulosic ethanol is probably the most feasible one for near future production. Though the technology for bioethanol from lignocellulosic raw materials is mature and is ready for implementation, the cost of production is still high and the commercial feasibility of this transportation fuel largely depends on co-production of several chemicals or materials from the biomass feedstock which helps in negating the current high cost of lignocellulosic ethanol production.

An operation of lignocellulosic ethanol plant based on biorefinery concept is therefore essential for commercially viable plants for this fuel. More importantly, environmentally benign replacements or substitutes for several chemicals and materials would be needed from the biomass feedstock for future scenarios of eco-friendly and sustainable production, which now is poised to happen based on carbohydrates as raw materials. This also underlines the importance of a biorefinery, where analogous to a petroleum refinery – the fuels as well as chemicals are produced from the same raw material; in this case – biomass. Centre for Biofuels at CSIR-NIIST has recently commissioned a Bioethanol Pilot plant where we are working towards a biorefinery which will produce bioethanol as the main product and the byproduct streams will be utilized for production of high value chemicals and building blocks. The concept, and the initiatives at the Centre for Biofuels shall be discussed.

Oral Presentations

BIOCHEMICAL MECHANISMS INVOLVED IN TOLERANCE DEVELOPMENT OF LABORATORY COLONIZED CARBOFURAN RESISTANT *CULEX QUINQUEFASCIATUS* SAY THE FILARIASIS VECTOR

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Carbofuran is a systemic insecticide/nematicide used extensively in modern agriculture to combat various major insect pests and vectors. Selection experiments for analyzing carbofuran resistance development were carried out for ten generations at Mysore with *Culex quinquefasciatus*, a widely dispersed domestic mosquito and the vector of lymphatic filariasis. The mosquito populations were continuously exposed to different carbofuran concentrations following the WHO method. Simultaneously detoxifying enzymes such as alpha esterase, Beta esterase and glucose-6 phosphate dehydrogenase (G6PD) have been assayed qualitatively and quantitatively to relate the biochemical mechanisms involved in tolerance development. The selection experiments and enzyme assay have revealed a steady increase in tolerance build up and the target enzyme level. The results of larval selection test up to F10 revealed a significant increase in tolerance development in every generation compared to the susceptible F1. The results revealed up to 16.22 times tolerance after 10 generations

BIODIVERSITY OF ANTI-DIABETIC MEDICINAL PLANTS IN IRINJALAKUDA LOCALITY

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Identification and selection of appropriate plant species for a specific disease is very important in herbal treatments. The present study concentrates on the survey of medicinal herbs growing wild in our locality which are useful as immunity giving, health promoting and anti-diabetic varieties. Our locality has an enormous variety of medicinal plants and their organized, sustainable cultivation, preservation and processing, marketing to meet the growing internal and external demands can create employment opportunities for thousands of our youth. The medicinal plants were collected from their natural habitat of the locality Irinjalakuda municipality of Thrissur District- especially from a) St. Joseph's College Campus and nearby places b) random areas of Irinjalakuda municipality.The habit, habitat, and the morphology of the plants were recorded along with the family, genera and species. The details of useful parts and therapeutical uses were noted with the help of literature collected using authentic sources. The aspect of correct identification of botanical source and spot verification is of prime importance in the efficacy of

herbal cure of disease. A large number of compounds isolated from plants that have anti-diabetic effects, such as alkaloids, phenolics, proteins, terpenes, aminoacid derivatives and other compounds. A number of potentially anti-diabetic plants bioactive have been shown to inhibit particular enzymes *in vitro* including á-amylases (inhibition of starch breakdown), á-glycosidase (inhibition of glucose release and intestinal absorption) aldolase reductase (inhibition of cellular sorbitol accumulation which is thought to promote diabetic complications) and lipoxygenase (inhibition of diabetes- associated vascular complications).The anti-oxidant á-tocopherol (vitamin E) is currently being clinically trialed for therapy against diabetic retinopathy. Considering the biochemical basis of blood glucose control plant derived compounds are found to be useful in pharmacological approaches to the treatment of diabetes.

PROTEASE PRODUCTION BY A THERMOPHILIC FUNGUS

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Microbial enzymes of thermophilic fungi have several advantages as they are thermo stable. Among them proteases are the most important industrial enzymes with considerable applications in food, medicine & pharmacy. Fungi elaborate a wide variety of proteolytic enzymes than bacteria and also offer an advantage as the mycelium can be grown on cheaper substrate, broad range of pH and the mycelium can also be easily removed from the final product. Hence the present study was aimed to study the protease produced by a thermophilic fungus, Aspergillus flavus, isolated from the goat dung. The protease production was evaluated in solid state fermentation (SSF) with different substrates and also under the influence of different activators and inhibitors. The most satisfactory results were obtained when wheat bran is used as substrate in SSF. Results will be discussed at length.

A NUMERICAL STUDY INTO MINIMAL CONDITIONS OF ARTERIAL VASOMOTION

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The occlusion of arteries during ischaemia causes a state of insufficient blood supply and hypoperfusion downstream to keep the brain functioning. Hypoperfusion in the human brain is a critical event which leads to cerebral hypoxia with a high risk of developing impairment. Vasomotion can be induced in the situation of reduced perfusion. This might increase the blood flow by decreasing the effective vascular resistance and lead to enhanced perfusion. Therefore, one could assume that vasomotion is a regulating mechanism associated with hypoperfusion to control vascular resistance, blood flow and

tissue perfusion. It is therefore important to explore the underlying mechanisms and the factors affecting the initiation and spread of vasomotion. In future, this study could help the early diagnosis and treatment of previously mentioned pathological conditions. The study analyses the minimum condition required to initiate vasomotion. It is shown that a minimum number of cells need to be stimulated with a sufficient amount of depolarization to initiate the conduction of contraction.

CHARACTERIZATION OF NOVEL LIPASE PRODUCING BACTERIA FROM THE WINDROW COMPOST AND CLASSIFICATION USING PHYLOGENIC ANALYSIS

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Lipases (members of the á/â hydrolase fold super-family) play an important role in lipid metabolism and are produced by a variety of species. Their activities rely mainly on a catalytic triad usually formed by Ser, His and Asp residues. In the present study we have characterized Lipase producing bacterial species from the windrow compost using Tributyrin agar medium containing 1 %(w/w) olive oil. The bacterial strains like *Staphylococcus sp., Streptococci sp., Pseudomonas sp., Brevibacteriumsp., Bacillus sp., Lactobacillus* spp. Aeromonas sp., and Bifidobacterium sp. were characterized . Representative lipase gene sequences of the above bacteria were collected from the ExPASy and the National Center for Biotechnology Information (NCBI) server. Multiple sequence alignment was done using the *Clustal X 2.0.11*. Phylogenetic analysis was performed with Phylodraw (1.0.0.3) and phylogram was created by NJplot software (version 4.32.0). Gene predictions on retrieved sequences were carried out using genscan software and using the predicted translated protein sequences , functional motifs were compared using Motif search software. Conserved domain search was carried out on the lipase gene sequences using CDD tool. The study also revealed that distantly related members of the á/â hydrolase superfamily share similar conserved motifs with the isolated bacterial lipase genes from the compost sample. Therefore, there is a lot of scope to search for newer lipases with desired selectivity and substrate tolerance. To widen the usage level of lipases, there is an urgent need to understand the mechanisms behind the lipase-catalysed reactions. Comparison of some of the lipases produced by microorganisms from the windrow compost is better than the well-known commercially available imported lipases. Thus, utilizing these lipases will greatly boost many biotechnology-based industries with the ushering of the 21st century.

BIOMAGNIFICATIONS OF PRODIGIOSIN BY EARTHWORM *EISENIA FETIDA* GUT *PONTIBACTER SP* USING TANNERY SOLID WASTE

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Animal fleshing (ANFL), the proteinaceous solid waste generated from the leather industry was fermented, using *pontibactersp*., isolated from the gastrointestinal tract of fish. The hydrolyzed ANFL was introduced to the vermin reactor containing *Eiseniafetida*species and it had been incubated for 35 days. During the vermicompost, the earthworm gut wall associated *pontibactersp* synthesis prodigiosin using the amino acids from fermented ANFL. The prodiogiosin extracted from vermin reactor was characterized by UV-Vis, Fluorescence, FT-IR, H^1-NMR and GC-MS spectroscopy. This study concluded that the *Eiseniafetida*utilized the fermented ANFL and converted it into amino acids that were utilized for biosynthesis of prodigiosin by the gut bacteria, *pontibacter*sp.

MITOCHONDRIAL ACTIVITY IN EPITHELIAL TUMOR CELL INVASIVENESS

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GRIM-19, Genes associated with Retinoid (RA)-IFN-induced Mortality-19, was originally identified as a death-related gene in cancer cells and was found to interact with Stat3. Previous work has already confirmed that GRIM-19 is localized in mitochondria. By gene targeting in mice, it is demonstrated that GRIM-19 is essential for assembly and electron transfer activity of mitochondrial electron transport chain (ETC) complex I. The functional domains of GRIM-19 were further defined and found that the mitochondrial localization sequences are localized at the N-terminus and co-localized with a domain responsible for the complex I assembly. And the middle portion plays a pivotal role in the maintenance of mitochondrial transmembrane potential. As the protein expression was found to be decrease or even lost in certain carcinoma, we were interested to further pursue the importance of GRIM-19 in tumorigenesis. We used the shRNA knockdown methodology to inhibit the protein expression of GRIM-19 in epithelial tumor cells. The knock down of GRIM-19 could decrease the protein expression of some other ETC-CI subunit such as NDUFS3 (p30) and p39 and vice versa indicating a common control mechanism for the expression level of these complex I proteins. More over the loss of complex I proteins were correlating with the metastatic potential of breast cancer cell line under study. Further studies are underway to find out the involvement of GRIM-19 in transdifferentiation of normal cell to acquire tumorigenic properties.

PRODUCTION, PURIFICATION AND CHARACTERIZATION OF EXTRACELLULAR PECTINASE FROM *ASPERGILLUS IBERICUS* ISOLATED FROM FRUIT PROCESSING INDUSTRY

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The present study investigates the production of extracellular pectinase from fruit processing industry waste. Among the twenty identified species *Aspergillus ibericus* species showed high pectinolytic activity on pectinase screening agar medium. The isolated *A. ibericus* was used for the pectinase production. The optimum conditions for the production of pectinase was characterized for the selected parameters such as time, pH, temperature, carbon sources, nitrogen sources, substrate concentration, and metal ions. The extracellular pectinase was precipitated by ammonium sulfate method and purified by dialysis. The optimum conditions for the maximum pectinase (70 U/ml) production was found to be temperature, 40°C; pH, 5; pectin (carbon source), 2%; peptone (nitrogen source), 1% and incubation period, 120 h. Among the addition of metal ions, calcium chloride 1mM enhanced the pectinase (85 U/ml) production. The molecular weight of purified pectinase was found to be 41kDa. Further, the storage of the pectinase was evaluated to be stable for the pH range from 3.0 to 9.0 and temperature upto 50°C.

ISOLATION AND CHARACTERIZATION OF WITHAFERINE A FROM *IN VITRO* AND *IN VIVO* TISSUSES OF *WITHANIA SOMNIFERA*(L.)POSHITA VARIETY

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Withania somnifera (L.) Dunal commonly known as 'ashwagandha' or 'asgandh' has a high repute in Indian traditional medicine, and is one of the most extensively used plant in Ayurveda and Unani medicines. *Withania somnifera* is one of the most important sources of commercial production of withanolides as its root and leaf contain comparatively high content of important secondary metabolites and used as drugs. The plant roots are a major source of alkaloids and possess other secondary metabolites, viz. withaferin-A, withanolides, flavonol glycosides, glycowithanolides, sterols and phenolics. Non standardized herbal preparations have not found acceptance in the global market and therefore need to be chemically standardized on the basis of isolated constituents, preferably bioactive ones. The objective of the study was to isolate and extract the withaferine A from *W. somnifera*. The extracts of samples were prepared using the powdered samples of root, stem and leaf of *in vitro* and field grown *Withania sominfera*- Poshita were serially extracted into solvents of increasing polarity. TLC of the various extracts of plant parts collected from 3months and 5 months old grown plants were conducted. *Comparison of the R_f value of the compounds in 5 months old leaf and stem of in vivo and in vitro with that of the standards (Withaferine A and Withanolide A) showed that withaferine A and withanolide A were present in all the three extracts. The dried in vitro leaf material powder was extracted with methanol and loaded on a silica gel column and eluted with* Toluene: Ethyl acetate, toluene: Ethyl acetate and chloroform: methanol. *The fractions were tested by TLC, and fractions with matching profiles were pooled, concentrated, and further purified*

by column. The purified phyto chemicals were subjected to structural determination based on UV, IR, HPLC and LC MS. The results supports that the purified compound from methanol fraction can be withaferine A.

CHARACTERISATION OF A BIOACTIVE COMPOUND FROM THE SUBMERGED CULTURE OF A BASIDIOMYCETE, *LEUCOCOPRINUS BRESADOLAE*

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The basidiocarps of *Leucocprinus bresadolae* (Schulzer) were collected from TBGRI campus, Palode, Thiruvananthapuram. The pure mycelium of the macro fungus was cultured at 30° C on malt extract agar in 9 cm diameter Petri plates. After 7-10 days, mycelial discs were punched out with a cork borer of 9mm. diameter and transferred aseptically into 250 ml Erlenmeyer flask containing 100ml potato dextrose broth (pH 6.5). The cultures were incubated at room temperature for 10-15 days by shaking on a rotary shaker (ORBITEK) at 120 rpm as well as in static condition for studying the growth and production of metabolites. After 10 days of inoculation, the crude culture filtrate, its ethyl acetate fractions as well as the aqueous fractions were evaporated to dryness *in vacuo* and subjected to *in vitro* antimicrobial assay. *In vitro* antibacterial activity was tested against *Bacillus substilis* (MTCC 441], *Escherichia coli* [MTCC 443], *Klebsiella pneumoniae* [MTCC 109], *Proteus vulgaris* [MTCC 426], *Pseudomonas aeruginosa* [MTCC 741], *Salmonella typhii* [MTCC 733], *Serratia marcescens* [MTCC 97] and *Staphylococcus aureus* [MTCC 2940]. The *in vitro* antifungal activity was tested against *Candida albicans* [MTCC 1637]. Oxford agar cup plate method was followed. The bioactive compound from the ethyl acetate fraction was separated by column chromatography. ^{1}H NMR / ^{13}C NMR spectroscopic data of the compound were recorded at room temperature in DMSO at 300 MH3 for ^{1}H and 95 MH3 for ^{13}C NMR when tetra methylsilane was used. Mass spectral graph was recorded in Joel JM 600 model Mass spectrometer. From the Mass spectrum the molecular weight of the compound was 315. From the data, the compound was found to be phenolic having an α , β unsaturated carbonyl group, an aldehydic and carboxylic groups.

A STUDY ON THE LIPID PROFILE, LEVELS OF TRACE ELEMENTS AND IDENTIFICATION OF C/T, G/C GENETIC MARKER IN AUTOSOMAL POLYCYSTIC KIDENY DISEASE AMONG SOUTH INDIAN (MADURAI) POPULATION

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Autosomal dominant polycystic kideny disease (ADPKD) is a common disease among different population in worldwide. Mutations in the PKD1 and PKD2 genes on 16p13.3, 4q 13-23 are responsible for ~85%, ~15% of cases of ADPKD. The study aimed to analyze the levels of lipids, trace elements and identification of PKD1 (C/T) and PKD2 (G/C) polymorphism as genetic markers. Three hundred South Indian patients with clinically proven ADPKD were selected for the study. The lipid profile and trace elements were estimated using Kit, AAS and Flame photometer. The genetic markers (C/T (PKD1 gene, PKD2 (G/C) gene polymorphism) were identified with PCR, RFLP. The study showed to be highly significant changes (at $p<0.001$) in lipid profile and the trace elements levels. The C/T and G/C polymorphism with ADPKD revealed that the frequency of mutant allele "T" "C" is found to be significantly (at $p<0.001$) higher in ADPKD subjects compare to control subjects among South Indian (Madurai) population. The mutant allelic frequencies were found to be higher in ADPKD (0.58) than in control subjects (0.18). The study concludes that the C/T and G/C polymorphism among South Indians is described. It is a single nucleotide polymorphism, which are identified as genetic markers and autosomal dominant mutation, which is the major cause of ADPKD.

DIVERSITY OF SPIDERS IN CHRIST COLLEGE CAMPUS, KERALA

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Biodiversity is often used as a measure of the health of biological systems. Spiders are clearly an integral part of global biodiversity as an important indicator in biodiversity assessment studies. Christ College campus, Irinjalakuda, Thrissur, Kerala is a green patch of land with many microhabitat associations. It is well known for its diverse flora. This study is a pioneering attempt to reveal the diversity of spiders in Christ College campus. The study was conducted over a period of 10 months from November 2011 to August 2012. The study area covered approximately 64 acres of land with varied vegetation. A total of 101 species of spiders coming under 62 genera under 21 families were collected from the study area. During this work attempts were made to study the guild structure of spiders distributed here. Of the 21 families sampled, the family Salticidae was found rich in number of species. This family was represented by 22 species. The next dominated family was Araneidae, possessed 19 species. Theridiidae and Oxyopidae were the others with higher diversity having 12 and 9 species respectively. An important outcome of the study is the discovery of two new species of spiders, *Matidiachlorosi* sp. nov.of family Clubionidae and *Tetragnathaherbarum* sp. nov.of family Tetragnathidae. This study revealed that spider fauna in the study area is qualitatively rich. A total of seven feeding guilds were identified by the analysis of feeding behaviour of collected spiders.

Keywords: Spider, Diversity, New species, Christ college campus, Guild structure

BIOLOGICAL SYNTHESIS OF SILVER NANOPARTICLES USING MANGROVE *BRUGUIERA CYLINDRICA*

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Biomolecular synthesis of metal nanoparticles is an intensifying research area due to its impending applications for the development of advanced novel technologies which includes therapeutics and diagnostic devices. In this paper, we report a novel biological protocol for the synthesis of silver nanoparticles using aqueous extract of mangrove, *Bruguiera cylindrica*. The newly synthesized silver nanoparticles were characterized using physic-chemical techniques UV, XRD, SEM, and TEM analysis. UV spectrum exhibited an absorption peak at 426 nm. X-ray diffraction pattern displayed typical peak of crystalline silver at (111), (200), and (220). The transmission electron microscopy results indicated that the silver nanoparticles were spherical in structure. Further the antiviral activity of newly synthesized silver nanoparticles was demonstrated.

ISOLATION OF A BACTERIUM CAPABLE OF DEGRADING BOTH ALIPHATIC AND AROMATIC HYDROCARBONS AND POTENTIAL FOR ACCUMULATING HEAVY METALS FROM 2004 TSUNAMI

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A bacterium was isolated from the deposits in the beach of Munakkal, immediately after Tsunami in 2004 . It was identified by molecular ribotyping as *Lysinibacillus fusiformis* . Growth studies indicated that the bacterium was alkaliphilic organic solvent tolerant and thermo tolerant . The bacterium has significant level of tolerance to the various metals & accumulated cadmium, mercury and arsenic as confirmed by ICP- AES analysis and fluorescence microscopic studies utilising fluorescent nanoparticles .GC,GCMS and FTIR studies showed that the bacterium degraded both aromatic and aliphatic hydrocarbons . This bacterium is potential remedy to abate both hydrocarbon and heavy metal pollution.

Poster presentations

PRELIMINARY STUDY ON IDENTIFICATION OF SPIDERS USING MITOCHONDRIAL DNA

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Taxonomy provides us with basic understanding about the components of biodiversity which is necessary for effective decision making about conservation and sustainable use. Taxonomy is a vital component of biodiversity management, as the first step towards protecting and benefiting from biodiversity is sampling, identifying and studying biological specimens. DNA barcoding offers taxonomists the opportunity to greatly expand and eventually complete a global inventory of life's diversity. The utility of DNA barcoding in identifying spider species was revealed in this study. The study established that the mitochondrial gene cytochrome c oxidase I (COI) can serve as the core of a global bioidentification system for animals. The study also demonstrated that COI identification system will provide a reliable, cost-effective and accessible solution to the current problem of species identification. A comparative study of CO1 sequence of nine families of spiders and their phylogenetic analysis was performed and it showed their relationship with evolution of web building behaviour. Thus this study revealed the relationship between molecular and morphological taxonomy.

COMPARATIVE STUDY OF SOIL OF SACRED GROVES AND NORMAL FIELD

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Sacred groves are tracts of virgin forest with rich biodiversity, which have been protected by local people for centuries for their cultural and religious beliefs. They serve as repositories of genetic diversity and are provided with comprehensive and rich ecological niche. Sacred groves play a crucial role in soil and water conservation. With a rapid litter decomposition rate, nutrient release in the soil of these groves is very high. The present study was carried out to compare the physico chemical parameters of soil of Sacred Groves and Normal field. The P^H of the soil of Sacred Groves was found to be slightly alkaline (6.4-6.8), where as the P^H of the normal field was more acidic (6.3). The percentage of organic carbon was found to be higher (0.8-1.9) than that of normal field (0.6.) The Phosphorous content of the soil of Sacred grove in Kg/ha was in between 24—36 , while that of normal field was 22. The Potassium content was also found to be higher (275-396 kg/ha), than the normal field (187 kg/ha). The cropping and

tillage practiced in the agricultural field considerably lowers the nitrogen. Total soluble salt (TSS) of both areas are not much varied. The results indicate that soil of, sacred groves are nutrient rich than the normal field.

ANTIBACTERIAL ACTIVITY OF LAGENANDRA TOXICARIA -A LOCAL BIOREMEDIAL PLANT

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The use of medicinal plants is increasing day by day to cure the non-communicable diseases as well as infectious diseases. Very often studies on the antibacterial activity of medicinal plants are done by subjecting the tested organisms to the medium consisting of a specific concentration of plant extract, for fixed exposure duration. The sensitivity of the bacteria towards the antibacterial agent are mainly determined by using agar disk diffusion assay, minimum concentration assay, and minimum bactericidal concentration assay. The objective of the present study was to evaluate the antibacterial activity of Lagenandra toxicaria a local bioremedial plant against gram positive and gram negative bacteria. This was determined by the above mentioned assay systems. When we analyze the results from agar disk diffusion assay, minimum concentration assay, and minimum bactericidal concentration assay, 70% methanol extract of Lagenandra toxicaria has strong antibacterial action against Gram-positive bacteria, Staphylococcus aureus while negligible to no inhibitory activity against Gram-negative bacteria, E. coli. The lowest inhibitory concentration (MIC) of the plant extract that, under defined in-vitro conditions, prevents the appearance of visible growth of the Staphylococcus bacteria with in a defined period of time was found to be 250ìg. Further studies are in progress to assess the antibacterial activity of Lagenandra toxicaria against other gram positive bacteria and to find out the phytochemical responsible for the bactericidal activity.

A COST EFFECTIVE HERBAL MOSQUITO LARVAE DESTROYER USING NANO TECHNOLOGY

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One of the major problems faced by human society is mosquito menace. Mosquitoes cause so many diseases like malaria, filaria, chikungunya, Dengue, bullae formation etc. The population of mosquitoes is booming day-by-day due to various reasons. The tropical climate of South India poses a

favourable breeding place for mosquitoes. There are at present many remedies for mosquito menace such as coils, repellent creams, liquidator etc. But they lead to many harmful side-effects on human health, especially respiratory problems such as asthma, allergies etc, our paper is aimed at discovering a herbal remedy to prevent the mosquito problem and also destruction of mosquito larvae at the place of their generation.

The neem seed is used as the raw material. It allows for extraction, filtration, and evaporation and drying after which we obtain the neem powder (Azadirachtin). Further by using nano technology the final product is converted to nano size using size reduction technique which is confirmed by PSA (Particle size analyser) analysis. Then nano particles are mixed with suitable solvent to slurry form then it is formed into nano coated balls. These balls are thrown to the stagnant water after that Azadirachtin content will cover the stagnant water bodies and it will absorb and destroy the mosquito larvae.

INTEGRATED NUTRIENT MANAGEMENT FOR HIGH VALUE (I.E. SWEET CORN-RAJMA – ONION) CROPS

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A field experiment was conducted at AICRP on Integrated Farming Systems Research, Dr. P.D.K.V., Akola during 2003-04 to 2011-12 with an object to evaluate organic farming package for system based high value crop. The experiment on sweet corn-rajma-onion crop sequence was test with eight treatment combinations. The pooled results revealed that the application of recommended dose of NPK recorded highest weight of green cobs (98.51 q ha^{-1}), grain yield of rajma (8.25 q ha^{-1}) and onion bulb yield (94.92 q ha^{-1}). Significantly highest sweet corn equivalent yield (221.61q ha^{-1}),GMR (Rs. 132966 ha^{-1}) and B:C ratio (2:27) were also recorded by treatment T7 (100 % NPK + secondary and micronutrient based on soil test).

Highest net gain of N and P were recorded with application of 100% recommended dose of fertilizer except in rajma crop. Whereas highest gain of K were noticed in treatment T3 where 1/3rd recommended N each through FYM, *leucaena lopping* and neem cake + intercropping of green gram in sweet corn, fenugreek in rajma and cluster bean in onion.

DUNG BEETLE DIVERSITY ACROSS DIFFERENT ELEVATIONAL AND DISTURBANCE GRADIENTS OF A WET EVERGREEN FOREST IN WESTERN GHATS, kerala

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The local distribution of dung beetles is strongly governed by vegetation cover and soil type. It was generally believed that the species diversity decreases with increasing elevations. Reduction in habitat area, primary productivity, resource diversity and increasing unfavorable environmental conditions were pointed out to be the reasons for the decrease in species richness in higher elevations. Approximately half the studies so far demonstrated that the species richness peaks at middle elevations and it is now widely recognized that both environmental conditions and historical factors play an important role in explaining such variations The Dung beetles were collected from ten sampling locations of varying elevations from 130 to 2750 feet above sea level. The Species diversity was found random along the elevational gradients where as species abundance was higher both in lower and higher elevations compared to mid elevations. Sample sites at lower elevations were disturbed more by anthropogenic interactions than mid and higher elevations.

INNOVATIONS

Invited talks

GRASS ROOT INNOVATIONS-INDIAN WAYS

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Invention is the search for a solution for a problem that is understood well. Thus necessity is the mother of invention. Innovation is an activity that is a culture both academic and non-academic. Innovation needs more of an idea and spark with lot of presence of mind.

There are at least a few knowledge rich people who may not have been educated and economically poor; but still have the ability to create solution that will make their day to day life simpler. There are at least a few knowledge rich people who may not have been educated and economically poor; but still have the ability to create solution that will make their day to day life simpler. This is what we call as Grass Root Innovation.

The objective of this paper is to invite the academic-scientific-technical brains to look around and create a vision towards solutions for the day-to-day problems and think out of box solutions. It is also equally important to know the work in place in our country in these directions by the government and volunteers supporting such innovators. Some examples in these directions in Education (Youth) encouragement, Professions / Workers – supportive system, Business / Entrepreneurs initiatives are given in brief. Most of the materials are drawn as information from the given references.

ADVANCEMENTS AND APPLICATIONS OF FLUIDIZED BED SYSTEMS

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Fluidization is a process by which fine solids are transformed into a fluid-like state through contact with gas or liquid that is blown upwards evenly through a bed of these solid particles with sufficient force to

cause the particles to rise up and move around inside the bed. Solids are transformed into a fluidized bed (FB) by the lifting action and the velocity of gas passing through it. On the basis of the increasing velocity of fluid, there are different stages in the process of fluidization such as fixed bed, minimum fluidization, bubbling bed, turbulent bed and pneumatic conveying. This method of contacting has a number of unusual characteristics and applications.

There are different types of Fluidized Bed systems based on the characteristics of the particles and the fluid velocity. Bubbling Fluidized Bed, Turbulent Fluidized Bed and Circulating Fluidized Bed (CFB) systems are usually used for Geldart B particles (sand-like particles). For Geldart D particles (heavy, coarse particles), Spouted Bed, Spout-Fluid Bed and Recirculating Fluidized Bed (RCFB) are usually used.

The Fluidized Beds are now in use for various industrial, environmental applications like coal combustion, waste incineration, coal / biomass gasification, drying, tablet coating, Pyrolysis, calcination of alumina/ phosphate rock, reduction of iron ore, cement production, fluid catalytic cracking (FCC), Chemical Looping, immobilization of enzymes/mammalian cell fermentation, aerobic / anaerobic biological treatment of waste waters, etc.

This invited talk concentrate on the advancements of fluidized bed systems for environmental applications.