Research Thrust Areas

SRM Institute of Science and Technology

Engineering and Technology

Kattankulathur Campus

1. School of Computing

Cyber Security

Over the decades, the fact that is undeniably a point of concern is, there has been ONLY an exponential increase in cyberspace threats and attacks, especially now as we witness the world shifting to a remote work model in response to the COVID-19 pandemic.

- The SRMIST School of Computing has had quite a strong foot in the Cyber Security domain for a long time. We work on developing thrust models and secured frameworks for communication over wired, wireless, heterogeneous networks and hybrid cloud infrastructures to identify from normal to sophisticated attacks. Our research in this domain has been very often funded by DRDO, Govt of India.
- Pilot studies are being made for developing an analytics platform to profile cyber criminals The aim is empirical data analysis on the user profiles obtained from the social media platforms like Twitter, Facebook, Instagram.
- Currently automated techniques are being tried to identify and handle the spamming of unwanted mails in our google accounts.

Though we are into integrating efficient methodologies and techniques to handle cyber security attacks and vulnerabilities, we are also researching to analyse the same through advanced artificial intelligence techniques.

Artificial Intelligence

Today's increased urge towards automation and digitalization has just been leading us to the emerging technologies and competitive models in each and every domain. Our research focus is on Artificial intelligence also for statistical computation methods, pre and post analyses

techniques for handling structured and unstructured data. We are trying our hands at developing an analysis tool to try our cross-department/faculty research problem statements in cyber security, agriculture, Industry 4.0, pharmacy and mental health domains.

- Study trials are made to enhance the audio signals over secured communication using advanced deep learning techniques like generative adversarial analysis
- We are currently working on the plans to propose an interdisciplinary prototype for secured surveillance using mixed images captured by unmanned bots which can be helpful for defence purposes embracing high level AI techniques
- The School extends its hand to SRM-Wabco Center of Excellence for Smart Factory Initiatives in conducting exclusive sessions on Industry 4.0 nine technical pillars by developing prototypes and sensitizing multi-disciplinary research opportunities.
- Likewise in the Agriculture domain, Automated plant watering, Soil health monitoring and recommendation system for the farmers- suggesting suitable fertilizer components to the relevant soil type and crops. We had been working on one of the related problem statements funded by DST, Govt of India.
- Jointly we are developing a mobile app for the patients visiting SRM hospital with SRM College of Pharmacy, under the SRM Excellence for Research Initiatives (SERI), to sensitize the users regarding the food-drug interactions
- Since the outbreak of pandemic in 2020, we are extensively researching on analysing mental health problems.

---- We are developing a mobile application for Royal Brisbane and Women's Hospital, Melbourne recording their mental health counselling sessions.

---- We are into joint research publication work with the University of Southern Queensland team, addressing the severity of dementia problem from the brain MRI dataset using deep learning imaging techniques.

---- We are implementing federated learning techniques for Sensor based Mood profiling, which is to develop a network by taking input from multiple sensors and predict user mood while they are exposed to video clips, images, music files for a specific time period. The objective revolves around Robert Plutchik's 8 primary emotion dimensions

--- We have recently teamed up with the SRM Dept of Public Health to analyze and develop an AI based recommendation system for smokers in order to help and support them in reducing their smoking habits.

Computer Vision - Security and Surveillance Systems

Computer vision is a promising approach and plays an important role in facial recognition applications, self-driving cars, augmented and mixed reality, and health care applications. Computer Vision is engaged in the generation, processing and analysis of digital images. Computer Vision in applied research is proposed to develop innovative solutions in the field of Vision Systems, Interactive Information visualization and Immersive Technology.

Surveillance systems have received much attention in recent years due to the increasing demand for safety and security. Long-Range Terrestrial Surveillance (LRTS) has a diverse range of applications such as border security, long-distance photography, identification & detection of distant objects. Surveillance systems are susceptible to environmental variations like change in light, motion in the background, fluctuation or reflection of light, presence of shadows and so on. Hence, there is a need to create an efficient algorithm that compensates for distortions and blurriness caused by

atmospheric turbulence in complex or dynamically changing backgrounds; while effectively detecting and tracking the set of moving objects which may be partially or completely occluded.

Augmented Reality in Education

In Education, AI based automation on administrative activities will allow the teachers to spend more time on teaching learning process by shrinking their time spent on duties such as, grading assessments, marking attendance etc. The use of immersive technology and AI in the teaching learning process will help us to overcome the geographical barriers in learning which one of the major drawbacks is in the currently prevailing pandemic scenario.

Augmented Reality (AR) provides huge likelihoods for online teaching in science and engineering, as these disciplines require more practical training. During this COVID-19 pandemic, remote education has forced teachers to use every tool in their toolbox. But AR, which allows both visual and hands-on instruction from any setting that remains out of reach for most educators.

2. Department of Biotechnology Engineering

1. Utilization of industrial waste for value addition
2. Phytochemicals / small molecules for the management of chronic diseases
3. Fabrication of biomaterials in tissue engineering

3. Department of Bio-Medical Engineering

Thrust area of research 1: Biomedical Instrumentation

Biomedical Instrumentation is an area of research that paves way for easy diagnosis and treatment of medical conditions. Non-invasive technology has a great scope in theranostics.

Infrastructure and Expertise available

Labs are equipped with equipment of clinical standard including real time ECG monitor, Patient monitoring system, Spirometer, Body composition analysers, Peripheral dual X-ray absorptiometry and ultrasound imaging system. We also have high end data acquisition device from AD Instruments Power Lab for recording all kinds of bio signals and perform analysis in real time. We have well-resourced National Instruments products ELVIS-Bundle (with 708A to E NI –USB/6008 KIT & WINDOWS), NI compact RIO Based design platform for design porotype and Deployment of biomedical application, Custom Bundle: FPGA& RT DAQ, USB DAQ.

Other facilities include real time Audiometer for evaluating hearing acuity, NI make Biomedical Sensor and Instrumental Hardware Platform Bundle, Nerve conduction velocity measurement equipment, EMG monitor, Blood pressure measuring Apparatus (Digital- Fully automated, Manual), Ultrasound Diathermy equipment, Electro surgical therapy equipment, Real time EEG monitor incorporated with Stimulus study such as audio, Visual etc., Automated AB Index Peripheral Vascular Doppler machine incorporated with Photo Plethysmography (PPG) Toe sensor for measuring Automated Ankle Brachial Index and Toe Brachial Index, Segmental BP which can be used for study as well as research purpose.

Faculty have published articles in indexed journals in the research areas of non invasive and hand-held instruments for diagnosis of various medical conditions.

Scope and multidisciplinary nature of the research area:

Ever existing demand for Noninvasive, cheap, faster and accurate methods of diagnosis that leads to early screening of ailments is the greatest scope of this area of research.

A multidisciplinary scope with Computer science in the area of Artificial Intelligence and Machine learning and Chemical Engineering in the area of point of care diagnosis is welcome.

Thrust area of research 2: Biomechanics

Biomechanics focuses on the assessment of basic descriptions of motion to complex analysis of forces and torques produced at specific joints to understand the loading condition of soft tissues and their mechanical responses. The human movement analysis is one of the disciplines which focuses on qualitative analysis and quantitative analysis of motion.

Infrastructure and Expertise available

HUMA (Human Movement Analysis Lab) with basic setup for motion analysis and software like MIMICS for 3D Modeling.

Faculty have published articles in indexed journals in the research area of human movement analysis, rehabilitation engineering, orthotics, prosthetics, 3D modelling and analysis of bones.

Scope and multidisciplinary nature of the research area:

Rehabilitation and injury prevention for persons with different disability and elderly, sports application where the experts can train the athletes to improve the performance.

This thrust area of research has multidisciplinary scope involving mechanical engineering in the areas of finite element analysis on dental implants, upper extremity and lower extremity bones with help of Software's like Ansys and solid works etc.

We collaborate with department of occupational therapy and physiotherapy for different student projects related to autism and stroke to improve rehabilitation interventions. There is huge scope to work with Mechanical,Mechatronics engineering departments, medical sciences and sports department based on the application.

Thrust area of research 3: Bio signal and Medical Image Processing

Biomedical signal processing involves engineering principles on signal denoising, pattern recognition of signal models, feature extraction and dimension reduction for decisive function or dysfunction, machine learning and deep learning techniques in earlier prediction of future pathological conditions.

Medical image processing involves with the usage and investigation of human images in three-dimensional domain, to diagnose diseases and thereby guide clinicians for treatment, surgical planning and clinical research purposes.

Infrastructure and Expertise available

Our current research expertise in Biomedical signal processing includes data acquisition of biosignals using labview for various applications such as breath signal analysis in diabetes detection, chronic kidney diseases, monitoring asthma, blood alcohol concentration. Further the acquired signal are pre-processed, feature extracted and classification is performed using machine learning algorithms.

We have focussed researchers in the area of acquisition of thermal imaging for various applications such as rheumatoid arthritis, child obesity detection, diabetes mellitus, breast cancer, varicose vein detection etc.

Faculty have published articles in indexed journals in the research areas of imaging modalities such as X-ray, CT, MRI, ultrasound, OCT and fundus images for various applications. 3D modeling of CT/MRI images have been carried out and further analysis performed for patient specific implant design.

Scope and multidisciplinary nature of the research area:

The scope of bio signal and medical image processing includes development of computer aided diagnostic system based on Artificial intelligence for cost effective prediction of various disease at earlier stage.

Collaborative work which involves multi-disciplinary projects can be implemented in association with Computer science Engineering department, SRM Medical College and Research Centre.

Thrust area of research 4: Biomaterials for Bio imaging and Tissue engineering

Bio-imaging relates to the detection and diagnosis of diseases via non-invasive techniques. Imaging systems like X-rays, Optical, Ultrasound, Magnetic Resonance and

Positron Emission Tomography (PET) used in both clinical, pre-clinical and in-vitro evaluation of drugs. Biomaterials based contrast agents and their innate properties aid in imaging systems to identify diseases at early stage.

Biomaterials in tissue engineering have applications that include the treatment of injuries to the skin, sensory organs, nervous system tissues, the musculoskeletal system, circulatory/pulmonary tissues and genitals/testicles and of acute radiation syndrome and the development of novel biosensors.

Infrastructure and Expertise available

The current facility available in the Biomaterial laboratory are Spray coater, Electrophoretic Deposition (EPD), Temperature controlled magnetic stirrer, Muffle furnace, Hot-air oven, Light microscope, Weighing balance, pH meter, Centrifuge, UV-Lamp, Bath sonicator, Rotary shaker.

The faculty have done research work in the area of Hybrid Nanoprobe for Bioimaging Applications, Microfluidics for large scale synthesis of nanomaterials, Development of Pre-clinical imaging systems, Design and development of 3D printing for Dental implants, New novel biomaterials for degradable cardiac stent application,Development of Nano composite in Hip implants

Scope and multidisciplinary nature of the research area:

Collaboration perspective of Biomaterials for Bio imaging and Tissue engineering is multidisciplinary areas including Biotechnology, Genetic engineering, Chemical, Food Technology and SRM hospital.

4. Department of Genetic Engineering

i. Genomics

Genomics is an interdisciplinary field of science that focuses on the genome and transcriptome sequencing, structure, function, evolution, mapping, and genome editing. Genomics research is an integral part of the Department of Genetic Engineering, SRM IST. With strategic investments in infrastructure, Big data analytical tools and globally trained faculty, the department has become the leading centre for genomics research in India. The department's principal aim is to serve as an incubator to bring together faculties across the University to promote cutting-edge interdisciplinary research. The core technology that links all genomics, and the heart of the revolution, is DNA sequencing. The new high-throughput sequencing technologies available in the department have enabled us to reach new horizons evidenced by externally funded grants and high impact publications. Department faculty pursue research on genome-assisted breeding, mining of genes for stress tolerance in plants, human & microbe's whole genome sequencing, single nucleotide polymorphism, genome-wide association studies etc. Overall, the genomics research facility in the department has facilitated several collaborations with national and international institutes like CSIR-IGIB, DBT-ILS, TNAU-CPMB, Kansas State University, West Virgina State University many more.

ii. Genome engineering tools for disease diagnosis and product development

Genome engineering approaches allow us to analyze and perform editing of genomes of microbes, plants and humans. We do translational research to develop affordable disease diagnostics tools and therapeutics to improve human health. We also promote research to increase crop production, climate-resilient crops using genome engineering tools. The Genetic Engineering Department at SRMIST has an infrastructure and highly experienced team of faculty members who are undertaking exciting research projects on various aspects of genome engineering. Some exciting ongoing research projects include RNA interference mediated low nicotine content in tobacco, abiotic stress-tolerant rice varieties using engineered stress responsive promoters, and enhanced solvent production by overexpression of target gene(s). Similarly, mutations and the

obtained mutants have been used to identify genes involved in plant root colonization. Whole-genome data of bacterial genomes has been used to produce industrially important enzymes and therapeutic proteins using bacterial expression system. Cancer models in Zebrafish using CRISPR genome engineering tool have been developed to gain novel insights on tumor onset and progression to utilize the research outcomes for drug discovery.

5. Department of Electronics and Communication Engineering

Major Thrust Areas:

- **RF & MICROWAVE / OPTICAL COMMUNICATION**
- **VLSI and Nano Technology**
- **SIGNAL & IMAGE PROCESSING, MACHINE PERCEPTION**

Thrust Area: RF & MICROWAVE / OPTICAL COMMUNIATION

- **Antenna Design**
- **Waveguides**
- **Optical Devices & Networks**

On-going Research:

Terahertz for Wireless Communications

Photonics is the generation, detection and manipulation (amplification, modulation, processing, switching, steering) of photons. RF Photonics are expected to make an impact in future communications engineering by replacing or enhancing conventional electrical approaches by reducing the size, weight, power, or performance. RF /

Microwave photonics are being developed to offer new functionality and performances for the New Generation Communications.

Terahertz Photoconductive Antenna

In recent years, terahertz receiving a lot of attention due to its potential in several significant fields of application. The major difficulty in the terahertz domain is the availability of the efficient source compared to the microwave and infrared regimes. The photoconductive antenna (PCA) is one of the sources of Terahertz technology which has the advantages from both electronic and optical sides can be widely used for spectroscopy, characterization, imaging of biological objects, deep space studies, scanning of surfaces, and detection of potentially hazardous substances. These antennas are the compact, tuneable, continuous or pulsed wave terahertz signals at room temperatures, capable of producing moderate electric field terahertz radiation with no need for high-power optical sources. Plasmonic nano-structures and 2D-nanomaterials within the PCA can be employed to manipulate the optical wave and enhance the efficiency of THz PCAs compared to conventional dipole PCA.

Optical Wireless Communication

- Optical Wireless Channel Modelling – FSO, UOWC, IsOWC, VLC
- **Hybrid optical and RF system** as the next frontier in optical communications for substantially increasing the higher transmission throughput in today's optical systems

Photonic devices and Sensors

Accelerating the use of optics, optical devices, and optical signals through **photonic device modelling**

- Optical Beam Forming (For 5G applications)
- Photonics in 5G (mmW generation)
- Optical Sensors for underwater measurements

Thrust Area : VLSI and Nano Technology

Ongoing Work

Computational Intensive Array processor architecture

Array Processors Optimal mapping of algorithms onto various architectures is studied. Techniques that have been proposed, allow the automatic composition of a finite number of application-specific processors onto arrays that optimally implement the parallel execution of algorithm fragments.

Computer Arithmetic Research focuses on the properties of number systems and their potential use in designing high-performance processors for computationally intensive tasks. Techniques for performance improvement in speed, hardware complexity, and power dissipation through the exploitation of number system properties are developed. VLSI Neural Networks Study of computational structures that mimic neural networks with application in pattern recognition.

Flexible Electronics

Organic materials could supersede their inorganic cousins in many applications due to some unique and intriguing properties. From lasers, lighting and Li-Fi (light fidelity) to OLED TVs and solar cells, flexible electronics offers a thin, flexible and easy-to-manufacture substance that is carving out new niches in some highly competitive markets. Materials composed of organic electronics are inexpensive, have low environmental impact and can be solution-processed, offering fast, simple and cheap manufacturing onto flexible, even wearable substrates.

CNT based Super-capacitor

In recent years, nanomaterials for supercapacitors have been extensively studied and reports are available for their preparation methods, physical and chemical properties and their characterization techniques. Because of their potential applications, carbon nanotubes are recently major area of research. Carbon nanotubes owing to their novel properties of high electrical conductivity, high specific surface area, high charge transport capability and High mesoporosity, CNT are excellent electrode materials for developing high performance super capacitors.

Ultrafast 2μm Fiber Laser using 2D-nanomaterial based saturable absorber

2D-nanomaterial exhibit exciting optical properties, which opens up a new pathway to generate ultra short pulses from fiber lasers. Layered 2D materials display distinct saturable absorption properties due to excited state absorption, as compared to their bulk structures. Moreover, the electronic structures of the films depend on the thickness of the films due to the quantum confinement of the electrons. By virtue of this, nanoparticles play a key role in all-fiber mode locked lasers. By tweaking the crystal structures, it is possible to generate ultra short pulses across the visible, near-infrared and mid-infrared wavelengths. Our research is the current state-of-art of 2D-nanomaterial based saturable absorbers and their applications in different regimes of mode locked fiber lasers.

Thrust Area : SIGNAL & IMAGE PROCESSING, MACHINE PERCEPTION

- **Image Processing & Deep learning**
- **Machine Learning**

Ongoing Work

Computational Intelligence in Medical Image Analysis

Description: The presence of plaque in the carotid artery can help accurately predict cardiovascular infirmities like strokes and heart attacks in people despite having no history of cardiovascular disease. To avoid the use of an invasive method and to determine the amount of plaque in the carotid artery also to predict the heart risk, we are working on machine learning and deep learning techniques to perform computational image analysis on ultrasound images to accurately predict the presence of plaque in the artery and to increase the accuracy in computer-aided diagnosis.

OPTICAL IMAGING, IMAGE PROCESSING, DEEP LEARNING

By integrating Optical Imaging Parameters from the camera raw format stages and Deep Learning for parameter optimization and selection, Digital Image Processing, which occurs on stored image data with many tunable parameters, may be substantially advanced to next generative level technology. As a result, Optical and Intelligent Computation can now back Digital Computation, which can revolutionize imaging systems.

6. Department of Electrical and Electronics Engineering- Mobility

To align with the national mission and to provide a platform for learning, research and development, a multidisciplinary research on the area E-Mobility sector is being carried out. The e-mobility research work focus mainly on the following thrust areas like:

Power Electronics Converters of Electrical Vehicles

Charging Systems Infrastructure: Design and Modelling

Battery Management and Energy Management Systems

Electric Motor Design and Modelling

Electric mobility will also contribute to balancing energy demand, energy storage and environmental sustainability. Electric vehicles could help diversify the energy needed to move people and goods thanks to their reliance on the wide mix of primary energy sources used in power generation, greatly improving energy security.

7. Department of Chemical Engineering

Thrust areas:

1) Sustainable environmental solutions
2) Process engineering

The department faculty membes are involved in projects with focus on:

- Methodology for treatment of wastewater and recovering valuable products such as heavy metals, organics, from e-wastes and process industries through synergism of conventional unit operations and developing techniques such as photocatalysis and membrane-based technologies
- Techniques for the detection of the contaminants in spent aqueous streams through the development of sensors and extending the same to biomolecular sensing, theranostics and drug delivery systems
- Biomaterial synthesis from agro-biomass, extraction of valuable products from natural resources and proteomics
- Towards replacing the cost intensive technologies with simple cost beneficial technologies for environmental protection
- Development of techniques for conversion of waste to societally utilisable eco-friendly products.
- Electro-catalytic techniques for CO_2 redemption, clean energy production using fuel cells, algal fuels, etc.

Our efforts are directed towards digitalization for design of equipment and processes in chemical, biochemical and allied areas using:

- Computational fluid dynamics
- Modeling and simulation
- Multi-media modeling of contaminants
- Computer-aided process optimization

8. Department of Civil Engineering

Sustainable Green Concrete

One of the disadvantages of conventional concrete is the high self-weight of concrete. By using suitable aggregates the density of concrete can be reduced. This green concrete results in reducing dead weights on structure, and also has a better insulation against heat and sound. Now a days, use of natural resources are need to be

restricted to save them. Hence, finding the alternate materials are become essential. The use of alternative aggregate has become necessity for the construction industry because of the economic, environmental and technological benefits derived from their use. In developing countries where abundant agricultural and industrial wastes are discharged, these wastes can be used as potential material or replacement material in the construction industry. The new and alternative building construction materials developed using agro-industrial wastes have ample scope for introducing new building components that will reduce to an extent the cost of building materials. Coconut shell, one of the agricultural wastes, produced in abundance and has the potential to be used as aggregate in concrete. Use of coconut shell as an alternate material for the production of green concrete. Coconut shell concrete gives more ductility compared to conventional concrete which is more benefit and useful for earthquake resistant and blast resistant structures. Building units like tiles, pipes, manhole cover, dust bin, coconut husk door were prepared using the coconut shell concrete.

Progressive collapse of structures subjected to multistoried frames subjected to thermo mechanical loads

The study on progressive collapse in multistoried buildings in two or three dimensional is significant considering the devastation it can create in terms of loss of life and property. This kind of failure is caused by the disproportionate effect of failure of few elements on the collapse behavior of entire building, For example the Pathetic collapse of WTC building in 2001.The existing studies or inadequate to a major understanding of this phenomenon worldwide, hence investigations are carried out in the department of civil engineering to conduct analytical and experimental studies on 2D planar frames and 3D multi-storey frames by simulating failure of corner column by overloading. In the case of 2D multibay multi storeyed frames effect of temperature on columns has been studied through experiments on one fifth scale models. These studies have revealed the typical mode of failures possible alternate load paths to save the structures against catastrophic failure etc: The major conclusions resulted from the experiments is that the provision of partition wall for function purpose save the entire building.

Feasibility studies on development of efficient structural systems through Bio mimics

Bio mimicry is the examination of nature, its model, systems, process and element to solve human problems. Anew ideology of combining biology and architecture is seen in today's scenario. As time went on, many different styles of architecture were introduced and forms began to imitate elements from nature and the natural environment. For reducing pollution associated with production, structure need to modify concurrently with ecological trends. Such kind of resiliency standard was achieved focusing on structural design concept inspired by the performance and geometry efficiency of a static model. A bio structure human skeleton particularly Femur and Humerus bones are considered to produce structural elements driven by the natural flow of force. Human bone is efficient in resisting compressive and tensile force. Analytical and experimental studies have been carried out imitating the shape of human leg and hand bones which can be a substitute for the strut and tie members of bio mimicked truss for carrying loads. The final conclusion is that the bio mimicked members can be used in structural applications and that will lead to both economic and energy efficient structures.

Geopolymer Concrete

The major area of our research is on developments of Geopolymer concrete. The novelty of our developed geopolymer concrete is that it doesn't need any external curing like oven curing, steam curing and water curing. It can be curing in ambient temperature itself. The major products which we developed were geopolymer toilet blocks, utility building, paver blocks, hollow blocks, geopolymer bricks and railway sleepers. The researches undergoing were textile reinforced geopolymer concrete, bendable geopolymer concrete, lightweight geopolymer aggregates, durability studies on geopolymer concrete, carbonation studies on geopolymer concrete.

9. DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

The faculty in the Department of Electronics and Instrumentation Engineering has been working in the following **FIVE THRUST AREAS** under the following Research Centre's

1. **Thrust area : Industrial Automation**

To develop an operator training simulators for carrying out dynamic simulation studies and analyses operational problems in a process and power generation plants using AI&ML based automation technology.

IIoT connects automation devices such as sensors, actuators, and PLCs (programmable logic controllers) to the Internet as well as to each other which is known as machine-to-machine communication. IoT based Automation finds application in smart factories, smart buildings and process industries This Research Centre innovations are patented and converted into products which are ready for commercialization.

No. of Patents Granted: 01

No. of Indian Patents Filed &Published:15

No. of International Patents Filed &Published:1(Japan)

No. of Publications: 20

No. of Funded Projects: 03

Venue : Center for ACCES
Domain Expert : Dr. G. Joselin Retna Kumar & Team

2. **Thrust Area : Non Destructive Testing and Health Care-Instrumentation**

1. To develop various strategic measurement/diagnostic systems using multimodal Imaging techniques
a. Thermal Vision research,
b. Terahertz Imaging,

c. Digital imaging that can be applied in Multi-disciplinary domains

2. To Design and develop various Robotic systems for various Instrumentation applications

3. To develop Wearable, Assisting Technologies related to health care Instrumentation

Non-contact security screening of humans and objects and non-destructive evaluation of a variety of materials is one of the key objectives.This team is been working from last 5 years in the above areas of interest in collaboration with IGCAR, CSIR, BRNS,SRM Hospital ,SRM Dental Hospital, Adhi Parashakti Dental Hospital with funding and other support. There were one international patent grant, one National Patent Grant, 24 patent publishing and 15 collaborative publications in referred journals

Centre for Instrument Design and Measurement system

Domain Expert : Dr. K. A.Sunitha & Team

3. Thrust area : Instrumentation for Diagnostics and Rehabilitation

a) To design techniques to investigate the human movement physiology for various applications in Virtual reality.

b) To develop techniques to measure the human gait, hand tremor, muscle movements, and other properties of biomechanics for various disorders such as Parkinson's Disease and the rehabilitation post-diagnosis.

c) To investigate human physiology by analyzing the biosignal properties using **multiarray** sensors for diagnosis and rehabilitation

d) To investigate the multi-spectral characteristics to understand the human skin morphology for diabetic foot ulcers.

This team is in active collaboration with RMIT University, IIT Madras, University of Melbourne, Monash Neurology, SRM Physiotherapy with good number of joint publications and fund up to one crore.

Venue : CHMRA Lab

Domain Expert: Dr. P. A. Sridhar & Team

Thrust area : Simulation and fabrication of micro and Nano sensors

(a) Biomedical application:

1. To design and develop microfluidic particle separation techniques for biomedical application essential for cancerous cell detection and isolation
2. To devise a food pathogen model and implement using self-powered, portable devices for detention, isolation, and separation of harmful food pathogen in food particles

(b) Ambient parameter monitoring:

1. To monitor and analyze the measurement of ambient parameters inclusive of Temperature, Pressure, and harmful gas concentration with help of micro and nanosensors suitable for meteorological, application and air pollution control
2. To design and develop wearable multisensor arrays that could help in tracking the environmental parameters of specific users including space astronauts from the ground station

(c) Energy harvesting

1. To investigate the potential nanomaterials suited for the design of low weight wearable biomedical applications which could be powered using regenerative body heat and solar power sources
2. To optimize and enhance the performance of fuel cells used in electric vehicles by measuring. Controlling and moderating optimal humidity levels within the fuel cell.

This team has published numerous papers in this field

Venue : Center for Microelectromechanical devices (MEMS)

Domain Expert: Mr. C. Likith Kumar & Team

5. Thrust area : Cyber-Physical Power systems

Objectives:

a) To develop the cyber-physical system testbed for critical infrastructure protection such as electric power grid with power generation, transmission, and distribution domains.

b) To learn the complex interactions between the cyber and physical systems and quantify the impact of cyberattacks on the physical system in terms of power system transient stability.

c) To develop the indigenous cyber-physical attack resilient control algorithms for Indian power systems with the realistic communication imperfection and computation limitations and to get the real-time experiences of power system control during the cyberattacks than the simulated

ones.

d) To validate the control algorithm for stability enhancement of the Indian electric power grid.

e) Promoting the developed tools, techniques, results and its analysis reports to NCIIPC and support for smart city projects with the help of this CPS testbed.

This team in a short period had good impact factor publications

Domain Expert :Dr. G. Y. Rajaa Vikhram & Team

10. Department of Mechanical Engineering

I. Thermal Engineering

1. Solar Energy:

Active research work is going on in solar photovoltaic and solar thermal energy. Already four faculty members have completed Ph.D and many other faculty members and full time research scholars are pursuing Ph.D in the area of solar thermal energy and PCM thermal storage. Few researchers are pursuing research in solar photovoltaic systems. Many papers have been published in high impact factor journals. One patent has been awarded and few patents have been published in this area of research.

The research range across fundamental and applied research, focusing on the development of new designs, materials for solar components and systems. At present more focus is on the research in concentrated solar power for process heating applications. In future, we like to extend the research for power generation. With respect to solar photovoltaics, the research on Bi-facial and Mono-facial solar PV modules, Solar PV with different cooling technologies (PV/T) are being carried out.

2. Thermal Energy storage:

PCM thermal Energy storage is another area of research where one faculty member has completed Ph.D work, many of the faculty members and research scholars are pursuing research in cool thermal energy storage along with Refrigeration systems. Many papers have been published in peer reviewed high impact factor journals. It is proposed to start a separate research lab facility on Thermal storage.

3. Bio-fuels:

Bio-diesels as alternate fuel in IC engines, additives for bio-diesel to reduce exhaust emissions, pre and post combustion treatment processes for emission reduction in IC engines are the areas where active research work is going on. Three faculty members have completed Ph.D work, many other faculty members and full time research scholars are pursuing research in this. Many papers have been published in high impact factor journals and few patents have been published.

4. Fluid flow and Heat transfer

Computational Fluid Dynamics is yet another area which mainly involves usage of computational science and numerical analysis to simulate various flow problems. Some of the ongoing work are study of flow in internal ducts, aerodynamics problems etc. Water tunnel to study fluid dynamics and turbulence characteristics with visualization is going on. The research work also includes experimental and numerical investigation of flow boiling inside micro-channel. Studies on electronics cooling are also being conducted on various methods, like utilization of phase change material, to remove heat from the chips are being undertaken.

II Materials

1. Composites and Advanced Materials

Under this broad thrust area the faculty members in our department is working on fiber reinforced composites, nano and hybrid composites, biomaterials and bio-composites, friction materials, Electroactive polymers, sensor materials, light alloys and composites, metallic foams, high entropy alloys etc. In addition to experimental research, the faculty members are also working in the domain of computational materials design with emphasis on numerical simulations of microstructure and component and materials design using AI & ML.

Several research scholars have already received their PhD degree with their research in this domain. Several PhD scholars are working presently. The department have several ongoing industrial consultancy projects on composites and other materials. The department organized the first International Conference on Recent Advances in Composite Materials in February 2020. To augment both experimental and computational research in the domain of composite and advanced materials, including advanced manufacturing processes, a Centre for Composites and Advanced Materials has been created within the department. The Centre has three different laboratories, namely

1. Composite and Advanced Materials Manufacturing Lab

2. Materials Modelling and Simulation Lab

3. Functional and Biomaterials Engineering Lab

III. Design Engineering

1. Tribology

Air Foil Journal Bearing:

Air Foil Bearing is the technology which is using air as lubricant for high-speed bearing rotors. Because of its simplicity in design and manufacturing, it is recommended for high-speed applications like Turbomachines, Turbojets, Turbo expanders, Turbo-

compressors, etc. Texture profile modification and addition of functionally Graded Materials (FGM) is ongoing work to determine the dynamic performance of the rotor system. Analytical model for limiting load and limiting stiffness is derived for various bump-recess foil bearing configuration. The development of experimental set up is in progress. Experimental set up is being developed to validate the analytical solution. Tribology tests will be conducted on the specimens with different texture profiles. Mechanical properties of different FGM will be determined in Strength of Materials Lab.

2. **Bio-Mechanics**

The thrust areas in the Bio-Mechanics area are given below:

Biomechanics of Spine:

- Biomechanical analysis of cervical, lumbar and thoracic region
- Effects of intervertebral discs on loading
- Generic modeling of spine
- 15 SCI / Scopus indexed papers have been published.

Biomechanics of foot:

- Finite element modeling and analysis of human foot.
- Gait analysis
- Ergonomic studies on subjects with and without disability
- Twelve Scopus indexed papers have been published.

Tissue Engineering:

- Design and development of scaffolds structure for human defects
- Modeling of longitudinal elastic modulus of bovine femur
- Ten Scopus indexed papers were published.

Dental Biomechanics:

- Modeling and analysis of mechanical behaviour of orthodontic brackets, implants.
- Craniofacial research, Dental materials.
- Published 25 SCI / Scopus papers
- MoU with clinicians
- Received grant under Selective Excellence Initiative Scheme at SRM IST.
- Two Indian patents were published

IV. Manufacturing Engineering

1. Machining Process

- Micromachining of composite materials
- Ball and Roller burnishing
- Unconventional machining, Nanomachining
- Magnetorheological abrasive machining
- High Speed Machining, Nano Fluid machining

2. Welding

- Friction Welding
- Friction Stir Welding
- Welding Metallurgy, Cold Spray

Salient Features:

The department of Mechanical Engineering, SRMIST, Kattankulathur have well established Machine shop with latest state-of-art facilities such as

- 5-axis and 3-axis milling centres and turning centres and several CNC machines along with their conventional counterparts to perform various machining operations required for research with high accuracy and precision,
- a Friction welding machine, a wire cut EDM machine, Kristler make tool dynamometer for force measurement and a Zoller Tool Management centre of excellence facility to cater the needs of the researchers in the above thrust areas.
- Many full time and part time scholars are pursuing their research in the above thrust areas and few scholars have completed their Ph.D. in these areas.

3. Metal Forming

- Severe plastic deformation, Incremental Forming, Tube forming

Salient Features:

- The department has a 150 Ton Hydraulic press installed in Foundry Lab and an Incremental forming set up installed in CNC machine in Machine shop to perform research in the metal forming area.

- Finite element analysis software's such as Deform 2D and 3D, Abaqus and Ansys are available in the department to perform the numerical studies in metal forming area.
- Few patents have been published in die design on Severe plastic deformation process.
- An MoU is signed between RANE NSK steering systems and SRMIST to carry out the collaborative real time research in the Metal Forming area.
- Few full time and part time scholars are pursuing their research in the above thrust areas.

4. Additive Manufacturing

- Fused deposition modelling

Salient Features:

To update with the latest technologies, lot of research works are carried out in Additive Manufacturing. Few companies such as Kemmpi India Ltd., and Fronius India Limited have signed MoUs with our department to do collaborative research in the above field.

5. Composites, Foundry & Stir casting

Salient Features:

The department has well established composite centre of excellence to carry out the research works in the area of materials science. It enables the students and faculty members to do the project and research works related to polymer and metal matrix composites. It consists of many equipment's which is given below

- Microwave furnace
- Tube furnace
- Planetary mono classic line PULVERISETTE 6 ball mill
- **Compression moulding machine**

- **Acoustic Emission Sensor**
- **Stir casting machine**

6. **Measurement and Testing**
   - Optical Metrology, Digital Image Correlation
   - Vision Measurement System
   - Condition Monitoring and signal processing

- The department has well established Metrology Lab with precision metrological equipment's such as surface roughness tester, machine vision system to cater the needs of the researchers.
- Many full time and part time scholars are pursuing their research in the above thrust areas

7. **Robotics, Mechatronics and Artificial Intelligence and Automation**

   Some of the facilities available in the department, which are being used for research are Industrial, Robots (ABB IRB1410), Robotic sensor, Drives and control of robotics using micro controller. The above facilities are extensively used to pursue research in the above thrust areas.

11. Department of Automobile Engineering

Objective

Development of Eco-Friendly Copper-Free Brake Friction Materials for Catering E-Mobility Global Braking Scenario

Description

Electric Vehicles (EV) have recently gained increased worldwide interest since they result in far less climate pollution caused by the non-emission of greenhouse gases than their gas-powered counterparts. EVs make less noise, involve simple operation,

and reduce the fuel costs associated with conventional vehicles. Making India an all EV market by 2040 also ushers the development of EVs like the Faster Adoption & Manufacturing of Electric Vehicles (FAME) Scheme in 2015 to incentivize manufacturing of Eco-friendly vehicles, including Hybrid Electric Vehicles (HEV). Vehicle propulsion and deceleration play an essential role in the smooth functioning of the vehicle. Batteries and fuel cells do propulsion in EV while the brake does the deceleration. A brake is a mechanical member used for converting kinetic energy into mechanical energy by friction. This friction is generated by brake friction materials when it comes in contact with the counter surface. Brake friction materials should generally have characteristics like the stable coefficient of friction with lesser wear rate, low NVH, eco-friendly, rotor friendliness, long life, most minor sensitivity to all environmental conditions, no surface thermal cracks, etc. These properties can be achieved when a cocktail of 10-15 ingredients is used in the formulation. The resin bonded organic brake friction materials are widely used for automotive applications withstanding working temperature range.

12. Department of Physics and Nanotechnology

The department strength is the broad coverage of topics of materials science, condensed matter physics, materials science and engineering, computational physics. and atmospheric physics This broadness allows the faculty members to perform original and collaborative research on key multidisciplinary topics as given below.

Materials Development and Functional Properties

Development of Electronic nanostructures with High Carrier Mobility Thin-Film Applications

Understanding Size-Microstructure-Mechanical Property Correlations in Hard-Yet-Tough Nanostructured Coatings and High-Temperature Structural Alloys

Development of Ferromagnetic Thin Film Heterostructure and Nanocomposite for Magnetic Memory Devices.

Understand and Tune the Interaction of Light and Plasmons with 2D and 3D Photonic Materials

Energy Harvesting, Storage and Devices

High-performance thermoelectric materials and devices based on nanostructures for energy harvesting applications

Development of novel materials for highly efficient hydrogen production and light weight hydrogen storage solid state materials with high storage capacity.

design and development of new material for hydrogen production based on photoelectrochemical and photocatalytic water splitting techniques.

Investigation of photoanode with multilayers of nanostructured semiconductors for high efficiency dye-sensitized solar cells

Design and development of all-Solid Thin Film Li Ion Batteries for Energy Storage Application

Electronic Devices and Sensors

Design and development of new nanoscale devices and ultra-sensitive strain, temperature sensors

Study of carrier dynamics in 2D layered materials and development of large scale vertical heterostructure photodetectors

Development of Chemoresistive type based chemical sensors and Organic Molecules Functionalized 1D Metal Oxides, 2D Transition Metal Dichalcogenide (TMDC) Hybrid Nanostructures based Electronic Nose for Exhaled Breath Analysis

Material Informatics & Computational Physics

Design and high throughput screening of functional materials from first principles and machine learning.

Investigation of magnetic and magnetoelectric properties of reduced dimensional antiferromagnets: ab-initio approach.

Molecular electronics Electron transport in Nano electronic and spintronic devicesQuantum Transport in Nanoelectronic Devices-First principle approach

Atmospheric Sciences

Atmospheric science is a multidisciplinary study on the optical, electrical, mechanical and dynamical processes manifesting the entire earth’s atmosphere**.** A strong group of researchers involved in the following activities:

Studies on moisture recycling and atmospheric residence times over India and its adjoining oceans

Studies on characteristics of aerosols and droughts and extreme weather events with reference to remote sensing applications

Climate Variability and moisture recycling

Understand the tropical tropopause over the Indian monsoon region which play an important role in the stratosphere-troposphere exchange processes and hence climate change.

Monitoring the upper troposphere and lower stratospheric temperature due to natural variability and anthropogenic climate change.

13. Department of Mathematics

1.Graph Theory

GRAPH LABELING AND DATA ENCRYPTION

Graph theory is closely associated to extensive thrust areas of present research with tremendous potential for applications in a variety of disciplines. The diagram below illustrates the different aspects of Graph Theory.

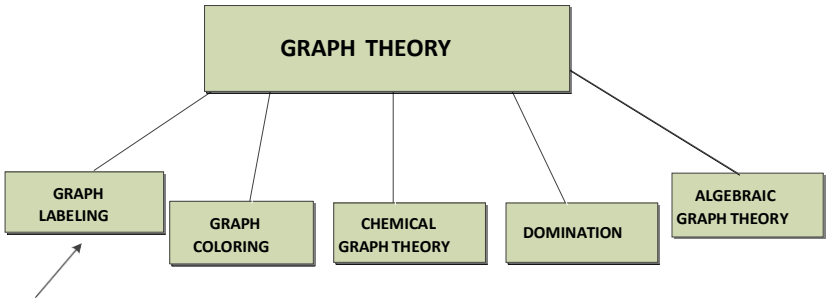


Fig 1. Various Research topics in Graph theory

Labeling of graphs is one of the most interesting areas of investigation in graph theory. A labeling of a graph G is an assignment of integers to the vertices or to the

edges or to both, satisfying certain conditions. Numerous variations of labeling have been investigated in the literature to name a few the figure is illustrated.

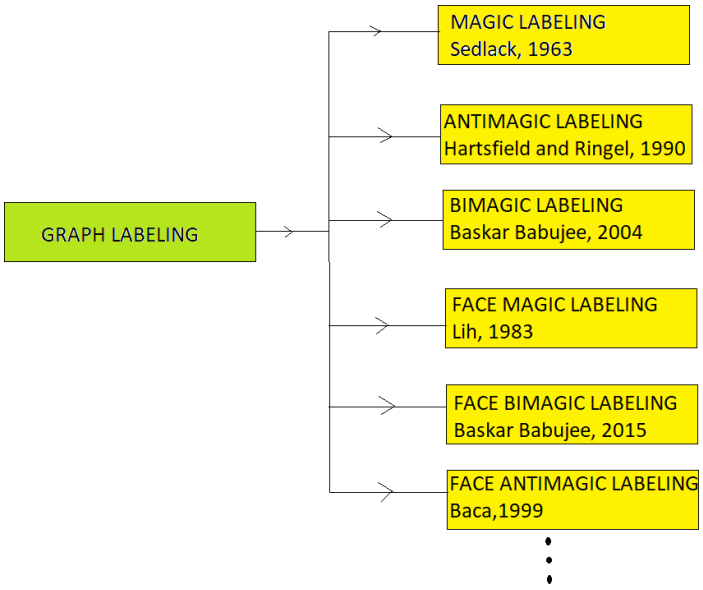


Fig 2. Types of labelings

A survey on recent results, conjectures and open problems on graph labeling is presented in “A Dynamic Survey of Graph Labeling” [J.A. Gallian]. Graph labeling plays a vital role in the main stream of mathematics because of its application in diverse fields which includes theory of computaion, cryptography, number theory and many more.

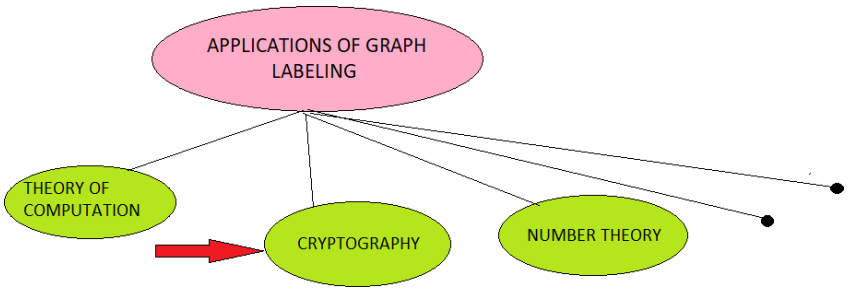


Fig 3. Applications of Graph Labeling

In cryptography, an unencrypted data is referred as plaintext. Plaintext is converted to ciphertext, which is then decrypted to identify the plaintext. Since decryption requires a secret key or password, only an authorized user can access data. The development and creation of mathematical algorithms used to encrypt and decrypt messages is most closely associated with this conception, whereas cryptanalysis is the science of analyzing and breaking encryption schemes.

The adoption of graph labeling approach in conjunction with cryptography to encrypt and decrypt the message is an ongoing facet of research. The proposed project provides labeling techniques that can be employed to encrypt numbers for distinctive graph structures to make the encryption more complicated. This work has a wide range of applications in real-time authentication and validation of user interfaces.

Review of Status of Research and Development in the subject

In 2005 [J. Baskar Babujee, On graph coding, The Mathematics Education, Volume, XXIX, No. 3, September 2005] and 2012 [J. Baskar Babujee and S. Babitha, Encrypting and Decrypting Number using Labeled Graphs, European Journal of Scientific Research, Vol. 75, No. 1, pp. 14□24, 2012], Baskar babujee used combinatorial techniques to encrypt and decrypt numbers through labeled graphs. In 2020, [Shobana, Baskar babujee and Ismail Naci Cangul, A new cryptographic method by means of molecular graphs, Proceedings of the JangjeonMathematical Society 23 (2020), No. 4, pp. 503 – 507.] shobana et al. used weiner index of a selected molecular graph to avoid the interference of adversaries to encrypt and decrypt a secret message. In 2020, [Kuppan, Shobana and Ismail Naci Cangul, Encrypting and decrypting algorithms using strong face graph of a tree, vol 5, Issue 4,(2020), 225-233.] the concept of face antimagic labeling is used for a strong face of duplication of all vertices by the edges of a tree to encrypt and decrypt 13 secret numbers.

Most of the techniques used in cryptography are based on discrete mathematical structures and number theoretic concepts. In future, a new labeling

technique can be used to encrypt pin numbers (secret numbers) using various graph structures to complicate the encryption which can used in ATMs, banks and military for sharing the secret data.

Fig 4. ATM – Pin Number

Fig 5. Secret Codes – Military

2.Fluid Dynamics

. Fluid dynamics has a wide range of application ranging from the field of Engineering to science, medical, agriculture and many more.

. From simple concept of flow of liquids to the complex form of analyzing the space and ocean,the part of fluid dynamics is inevitable.

. The Department of Mathematics has 13faculties with doctorate in the field of Fluid Dynamics and guiding nearly 20 students in the same.

. Research works are being carried out with respect to topics related to hydro elastics and study of water wave in coastal regions, stability analysis of fluid flows, flow in porous and non-porous regions, theoretical seismology, nano fluid, heat and mass transfer to name a few.

.The department has a wide scope for expanding its research activities in fluid dynamics with collaborative works and funded projects.

3.Mathematical Modelling

Mathematical Modelling is a research area where we can adopt any real world problem to predict the future occurrences of particular situation we considered. It is the need of an hour on any time as it helps to monitor and predict to facilitate a better suggestion

and solution for the future by making the actual problem in the form of a model particularly a mathematical model.

Mathematical modelling can take many forms like Disease Models under Mathematical Biology, Stocks and share price fluctuations models under Economic Prediction Models, Mechanical models for machine making and working procedure, Computer Architecture models leads to Artificial Intelligence and Machine Learning, etc. In the current scenario, updating ourselves based on the needs is necessary.

For example, if we have a mathematical model using Differential equations, the domain and space of the solution is to be analysed and to be adopted to the real situation and is to be compared. In the same way other equations are also analysed and make better corroboration with the real situation and hence the required suggestions may be arrived. Recent years, COVID-19 models were also published based on the needs of different regions and countries. In those models also some specific suggestions were given like how the vaccination effect and lock down effects are projected and how a government initiatives were widespread and active.

4. **Research about the field Algebra**

Algebra plays a prominent role in Mathematics, which includes Geometry, Number Theory and Analysis.

As the development in the field of Algebra is growing faster and making significant changes globally for the past few decades, it is inevitable to have a deeper understanding of the subject and its recent developments, especially in group theory, ring theory and its applications. Modern Abstract Algebra offers a suitable field for intellectual adventure.

Ring theory evolved from several folds in the fabric of Mathematics and influenced all branches of Mathematics. Ring theory arises in various mathematical situations. They have played a great role in finding new connections between various branches of Mathematics. Specifically, modern commutative ring theory has its roots in problems of algebraic number theory and algebraic geometry.

As a result, algebraic structures are used in mathematics with wide ranging applications in many disciplines such as theoretical physics, computer sciences, control engineering, information sciences, coding theory, and topological spaces.

5.FUZZY OPTIMIZATION TECHNIQUES

- Optimization strategies are a powerful set of tools for effectively managing an organization's resources and, as a result, achieving the goal. These techniques are employed in several areas. In a production problem, for example, the goal can be to determine the resource combination that optimizes profits.

- There are many factors which influence the optimization problem. One such factor is the existence of multiple decision variables in a problem. Another factor that may add to the difficulty of solving an optimization problem is the complex nature of relationships between the decision variables and the associated outcome. The existence of constraints on the decision variables also plays a vital role in solving the same. From a practical standpoint, the optimization strategies which are applied to a given problem will provide a solution which is not acceptable if the constraints are not incorporated into the decision variable.

- An optimization problem is mathematically represented as follows:

$$Optimize\ Z = (x_1, x_2, x_3, \dots, x_n) \quad \text{---------- (1)}$$

≤

$$subject\ to\ h(x_1, x_2, x_3, \dots, x_n)\ \{\geq\}\ c_j, j = 1,2,3, \dots, m \quad \text{---------- (2)}$$

=

In the above representation, $(x_1, x_2, x_3, \dots, x_n)$ are the decision variables and Z is the objective function which is stated in terms of these decision variables. The equation

(2) represents the set of constraints which are imposed on the solution. The constraint equations take the form of equality relationships and inequality relationships.

- The well known class of problems for which effective solution strategies have been developed is linear programming problems (LPP). The objective and constraint relationships are both expressed as linear functions of decision variables in a LPP. Other classes of problems include integer-programming problems, in which some (or all) of the decision variables must have integer values, and quadratic programming problems, in which the objective relationship is a quadratic function of the decision variables. There are generalized computer methods that meet these conditions for solving optimization problems.

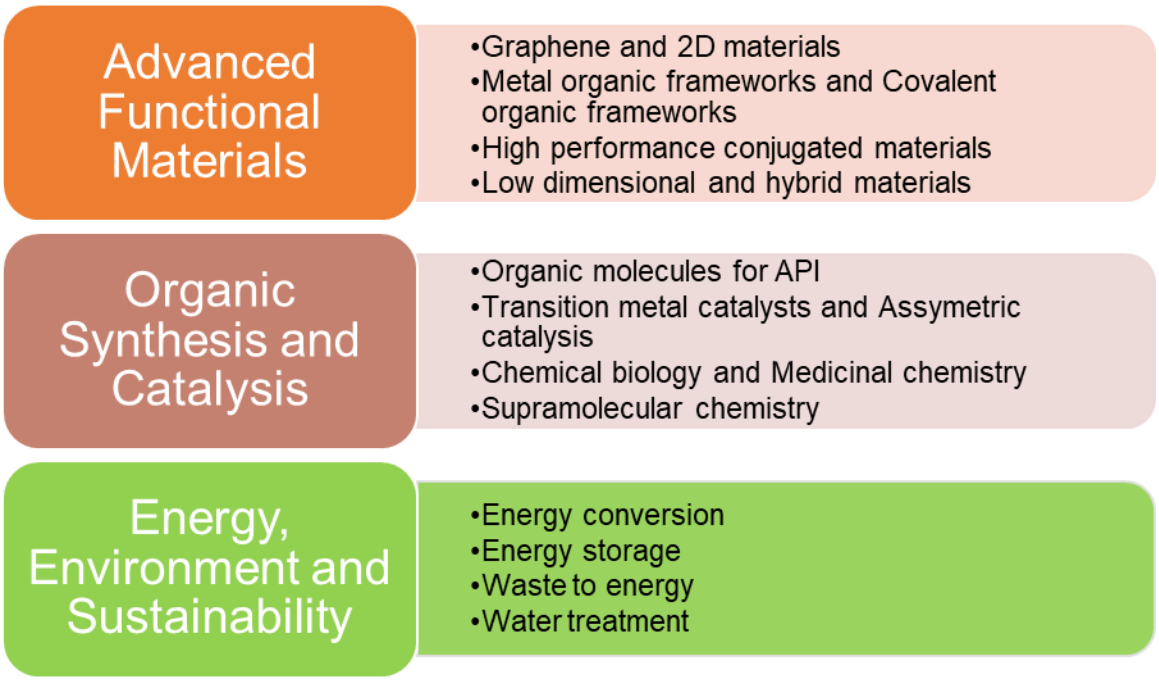
- The most important factor which influences a decision making problem is the nature ofuncertainty. In real life situations, the data available is not precise. The fuzzy set theoryprovides a mathematical way to handle such uncertainties and/or vagueness in practical
- There are more than 15 researchers who are working on fuzzy optimization problems.Some of the research works are mentioned below:
    - Melita Vinoliah. E and Ganesan. K – " A novel approach for the solution ofgeneralized fuzzy assignment problem" in 2021
    - Melita Vinoliah. E and Ganesan. K – "A solution approach for a multi-objective fuzzy generalized assignment problem" in 2021.
    - Vidhya V et.al – " An alternate method for finding more for less solution tofuzzy transportation problem with mixed constraints" in 2021.
    - Mohanaselvi et.al – " Fuzzy linear programming problem with generalizedtrapezoidal fuzzy numbers" in 2020.
    - Leelavathy.T and Ganesan.K – " A distinct technique for fuzzy travellingsalesman problem" – 2019.
    - Mohanaselvi.S and Hemapriya.G – "Application of fuzzy logic to earthquakedamage predictions" - 2019.
    - Yogashanthi.T et.al – "A new approach for solving flow shop scheduling problems with generalized intuitionistic fuzzy numbers" – 2019.

- The proposed researches can be extended to multi-indexed multi-objective fuzzy optimization problems, especially generalized fuzzy assignment problems where it emphasizes minimization of task cost and time at different locations and when the tasks are preferred by different machines.

14. Department of Chemistry

The Department of Chemistry' core research interests and specialisation can be divided into three main thrust areas (i) Advanced Functional Materials (AFM) (ii) Organic Synthesis and Catalysis (OSC) and (iii) Energy, Environment and Sustainability (EES). The department aspires to carry out cutting edge research in these frontier areas of chemical sciences and work towards achieving excellence in use inspired research that further moves to the next stage of translational research for better societal outreach.

Main areas of research



One of the major themes of research in the department of chemistry focuses on specially functionalized advanced materials towards applications in the area of biosensors, electronics and porous membrane development. This thrust area of

research also includes activities like synthesis of nanostructured materials for catalysis, photocatalysis, corrosion mitigation and separation technology.

Organic synthesis and catalysis as a discipline, has evolved from being a topic of fundamental sciences into a mature field that translates the understanding of fundamental concepts and transform it to industrial chemistry. Research activities in the area of organic synthesis and catalysis focuses on natural product extraction, organic synthesis and structure-activity relationship with a particular emphasis on API (Active Pharmaceutical Ingredient) towards identifying compounds which has potential application as anti-inflammatory, anti-cancer, anti-viral drugs and for treating neurodegenerative issues like Parkinson's and Alzheimer's disease. Organic crystal engineering, mechanically responsive molecular crystals, pharmaceutical co-crystals and their physico-chemical properties are another area of intense research carried out by the faculties in the department. Chemosensors, fluorescent molecular switches, fluorescent molecular tags, photodynamic therapeutic drugs, transition metal catalysis, homogeneous catalysis and asymmetric catalysis are the other topics of interest in this thrust area of research.

Research within the division of energy, environment and sustainability covers a wide spectrum of topics. The world today is grappling with serious pollution issues primarily caused by burning of fossil fuels such as coal, oil, and natural gas. The need for a robust and proven technology to convert renewable energy to electricity is more demanding and, in this context, solar photovoltaic (PV) technology has emerged as a key technology towards facile production of electricity. Research in energy theme is focused on the design and synthesis of new and low-cost alternative materials for energy conversion, storage, and end-use. Electrochemical energy storage as a focused research area covers number of technological areas: development of novel cathode and anode materials for lithium and sodium-ion batteries, materials for supercapacitors, electro catalysts and polymer electrolyte membranes for direct alcohols fuel cells. In the area of sustainability research development of novel functionalised colloids, polymer composites and 2D materials as membranes are developed with hydrophilic-lipophilic characteristics for oil-water separation. Porous materials with multifunctional properties

for sorption, catalysis, water treatment and storage of energetic materials is another key area of research in this division.

The department is also well equipped with state-of-the-art equipment's including Nuclear Magnetic Resonance (NMR) spectrometers, time resolved photoluminescence setup, BET surface area analyser, X-ray diffractometer, High resolution mass spectrometer, FT-IR spectrometer. These facilities are accessible not only to researchers from the department but also to researchers from other institutes.

15. INTERDISCIPLINARY INSTITUTE OF INDIAN SYSTEM OF MEDICINE (IIISM)

PLANT TO PATIENT

IIISM focuses on utilizing its in house facilities and expertise to develop new ayurvedic herbal formulations for treating diabetes, neural and metabolic disorders. In line with the IIISM goal of "Plant to patient", thrust is given to generate, record and maintain qualitative data for the ayurvedic herbal formulations. Data generation starts with formulating and standardization of herbal formulation using LC-MS, HPTLC and NMR. Pharmacokinetic and pharmacodynamic parameters of the drugs are evaluated in the approved DTL facility. CLSM and FACS based i*nvitro* and *invivo* studies are carried out to evaluate immunobiological and epigenetic influence of the drug on human cell lines and appropriate animal models. The ayurvedic formulation is finally evaluated at IIISM metabolic ward facility on human patients to study its safety and efficacy. Overall, the impetus is to market an ayurvedic drug for treating patients, which has qualitative and quantitative data on par with currently available allopathy drugs.

PYTOCHEMISTRY DIVISION

Developing standard HPLC and HPTLC protocols for analysis of herbal formulation to facilitate its commercialization. Ayurveda formulations will be further

analysed for lead molecules using bio-assay guided fractionation process. Identified lead molecules will be modified using synthetic methodology to enhance its bio activity.

NMR DIVISION

Isolation and Purification of proteins (Macromolecule) from medicinal plants. Identifying SDS electrophoresis to confirm molecular weight of protein. Crystallization of purified protein using hanging drop and sitting drop vapor diffusion technique and crystal structure determination. Ligan binding assay for the purified protein to identify suitable target (ligand) using NMR spectroscopy. NMR is used to calculate the KD value, STD experiment and relaxations measurement (T1 & T2) for the purified protein. Nano material synthesis using purified protein and developing a formulation for the herbal treatment.

MOLECULAR BIOLOGY AND IMMUNOBIOLOGY DIVISION

Screening molecules from endophytic fungal sources and herbal plants using novel inhouse developed bioassay protocols. Identified molecules are investigate for their ability to therapeutically modulate chromosome conformation in human cell lines. In theory, this type of epigenetic regulation could be used to create a permanent cure option that will carry to the next generation. Potential molecules with ability to carry out epigenetic modifications will be commercialized.

Preclinical & Clinical evaluation of safety and efficacy of Herbal /Herbo-mineral formulations

In order for a drug regulatory agency to meet the high demand of the public, there is a need for well-designed, randomized, double-blind, and placebo-controlled clinical trials to establish the safety and efficacy of herbal drugs along with modern drugs. In this context metabolic facility in IIISM is unique and could be used to develop and document safety profile of herbal products as well as study herb-drug interactions in patients. Proper methodology and standardised data generated with such clinical trials should aid in developing a Ayurvedic formulation which could be commercialized.

AYURVEDIC BIOLOGY

Rasayana and degenerative diseases especially of the central nervous and musculo skeletal systems, Prakriti and human genomics, Role of pathya and nutritional sciences in health and disease, Physiological, immunological and biochemical correlates of traditional Ayurvedic procedures such as Panchakarma.

16. Center for Environmental Nuclear Research (CENR)

I - Radio protection and Wound Healing

i. Identification of Phyto-molecules for radioprotection and wound healing applications

- Screening of selected plants from literature to determine their radio protective and wound healing properties.
- Plants which passed the screening process will further be processed to extract their active bioactive compounds.
- To study the radio protective effect, blood lymphocytes pre and post irradiation with Gamma rays will be treated with bioactive compounds and plant extract. MTT assay, cell cycle and gene expression studies will be performed.
- For wound healing efficacy, the extracted phyto compounds and plant extracts were used to nanostructured mats using electrospinning technique. The mats synthesized will be investigated for their physical, chemical properties antibacterial activities. Finally the wound healing efficacy of the nanofibrous mats will be studied *in vivo* in rat model.

II Radiation shielding

i. Radiation shielding properties of boric acid and borax decahydrate

- Synthesis and characterization of Nanoboron Composite (NBC) material
- Optimization of mechanical and Physical characteristics for Production of HPC-M40 incorporated NBC's
- Production and characterization of Bio Caulk by *bacillus pasteurii* and its remediation properties with boron incorporated with high-performance concrete
- Strength properties of borated concrete incorporated with Bio-caulk
- Investigation the shielding efficacy of HPC incorporated NBC's for Gamma and Neutron attenuation.

ii. Construction of hallow transport container

- Gadolinium doped boron compounds like boric acid and borax nano particles will be synthesized for the gamma and neutron radiation shielding.
- Plasto paris and admixtures will be added into the Bio-Caulk borated concrete to increase the strength properties and to reduce the setting time. This combination of the concrete has good workability, high durability, and increase in strength properties, self-healing properties and radiation attenuation.
- Construction of hallow transport container coated with Gadolinium and lead for transporting high energy neutron sources.

iii. Fabrication of radiation protective triple layered textiles

- Synthesis and characterization of nano boron composite for radiation shielding (x-ray, Gamma Rays & Neutron beams)
- Fabrication of triple layered cloths incorporated with nao boron composite.
- Analysis the shielding efficacy of fabricated textile for x-rays, Gamma and Neutron attenuation.

III - Renewable Energy

i. An experimental study of a bio digester with a lower Hydraulic Retention Time and higher efficiency for converting food waste into useable energy

- A techno-economic research will be conducted on the possibilities of producing biogas from various aspects of food waste generated locally on the SRMIST campus.
- The microbial population and microbes types have an important influence in determining the composition of biogas, which is generated by four types of microorganisms: fermentative, syntrophic, acetogenic, and methanogenic bacteria.
- These bacteria are found in nature and serve various functions in the waste anaerobic degrading process.
- Due to its increased conversion efficiency, thermophilic digestion, on the other hand, allows for a higher volume of feed loading with a shorter hydraulic retention period.
- To address the aforementioned issue, organic and inorganic additives, as well as a microbial organism, will play a significant role in increasing energy efficiency while decreasing hydraulic retention time.

ii. Experiments on sugarcane bagasse pyrolytic oil production through flash pyrolysis utilizing a rotary screw reactor

- This work will demonstrate how precise pyrolysis mechanism processes and bio-oil yields can influence the maximal reaction temperature in the 450-550°C range.
- The goal of this study has to look into the feasibility of using sugarcane bagasse as a feedstock for bio-oil production on a small scale.
- A rotary screw pyrolysis reactor with a throughput capacity of 40kg/h was used. At 550°C and a feedstock particle size of 1 mm, the highest bio-oil and bio-char yields of 70.1 and 15.3 wt.% were obtained, respectively.

- Biochar is a carbon-rich material that can be used as a soil supplement to sequester carbon while also improving the soil's physical characteristics, such as soil structure and porosity. It also improves microbiological purity and water retention.
- As a result, adopting sustainable Bio-char for agriculture is a novel and beneficial approach.

iii. A pilot study of downdraft gasification of mixed waste plus municipal waste materials into useful energy conversion

- The gasification of mixed garbage will be performed to determine the tar concentration, gas composition, and gas flow rate using a stratified downdraft gasifier for MSW.
- With a maximum gas flow rate of 250 Nm^3/h, a larger equivalence ratio increased the quality of product gas (CO and H_2).
- It will find that the air flow rate had a direct impact on the combustion temperature and operating conditions.
- While comparing with conventional open firing systems, this gasification rate yielded 15% more attainment.
- The developed gasifier drying system resorted to a moisture removal rate of 55%. Finally, this technique reduces fuel use by 40% while eliminating the same quantity of moisture.

The above mentioned research works will be carried out in collaboration with the Indira Gandhi Centre for Atomic Research (IGCAR), Synkromax Biotech Private Limited (SBPL), Spray Engineering Devices Limited (SEDL), Sardar Patel Renewable Energy Research Institute (SPRERI), and SRMIST's College of Agricultural Sciences.

Ramapuram Campus

1. Waste water treatment
2. E-mobility
3. Additive manufacturing
4. Artificial intelligence, Robotics and IoT for societal applications
   a) Agriculture
   b) Healthcare
   c) Disaster Management
   d) Rural Development.

Vadapalani Campus

1. Department of Computer Science and Engineering

THRUST AREA	TITLE OF RESEARCH	RESEARCH ABSTRACT
Game Theory	**Game Theory Based Message Propagation Model in Social Network**	The growing trend in social media is to collect a huge volume of online data. Viral marketing in social network adopts Influence Maximization methodology to identify influenced nodes. For viral marketing, the business marketing process selects a seed set of customers and activates each customer using free products, hoping that through Word of mouth effect, the product adoption would propagate in the network. The scope of this research intends to develop a game theory based mathematical model for a social network which identifies customer clusters based on preferences, learn the customer,

		identify seed nodes to propagate messages in viral marketing
Deep Learning	**Diagnosis of Melanoma Tumor in Human Skin using Deep Learning Techniques**	The research is focused to provide quicker predictive analytics tools for disease detection thus facilitating the earliest treatment. My research specifically focuses on: • Developing multi-purpose and generic Deep Learning Architectures which can be used to build transfer learning models to provide solutions to interdisciplinary problems. • Designing new computing solutions to address real-world problems pertaining to healthcare diagnostic solutions. Some of the projects that I am currently working on are as follows: 1. Diagnosis of Melanoma Tumor in Human Skin using Deep Learning Techniques Abstract: The current research utilizes the power of Deep Convolutional Neural Network to provide solution to the described problem. Suitable techniques for tuning the model to prevent overfitting will be applied and model will be subjected to rigorous validation and

		testing before it can be deployed.
	Medical Leave (ML) Management System using Blockchain - College Students	Objective : Secure Data Sharing ; Avoid fraudulent ML submission by students Abstract : Medical leaves are often used by students when they are sick or having any medical emergency. But it is seen that students are taking advantage of this system to get extra leaves from their university by providing fake Medical Certificates. The ongoing research work proposes a blockchain-enabled system that will not only stop this fake medical certificates but also automate the whole process. Doctor's identity is verified and then the cryptographic hash will be generated as medical leave. University can verify it on their side by providing essential details and prevent fake ML submissions. This idea can be generalized and extended to other areas like Medical records, reports and

		information shared among the clinics, hospitals, healthcare providers, researchers, insurance companies and patient families and these information will face various issues and challenges during sharing . There is a necessity to safeguard these valuable data's and confidential reports.
Social Network Analysis	**Detection and Notification of security breach in Facebook**	The fake Facebook or any social media accounts are created with the existing images in the user accounts. The fake accounts are used by the attackers to cause the data breach or affect the reputation/collecting money of individuals/organizations. The objective is to implement the framework for the process of identifying the fake accounts involved in affecting the reputation, collecting money etc. The same must be prevented or notified to the appropriate authority for further actions. The target beneficiaries are individuals and organizations who will be made aware of the social networking frauds and also make them aware of all the possible attacks.

IA	**Development of new approaches for the early detection of Alzheimer's Disease.**	Aim of the proposed system is to develop an automated tool for Alzheimer's Disease prediction using multi textural biomarkers. Planning to use FreeSurfer, an automated segmentation tool to segment the Hippocampus and Amygdala from the left hemispherical region of the human MRI. Extracting the textural feature from the segmented region of interest and used as input to the Adaptive Neuro Fuzzy Inference System (ANFIS) classifier for the classification of different groups of subjects. MATLAB (R2018b) software tool is used for the various stages in the medical image analysis.
Deep learning for Image Processing	**Classification of brain tumor and analysis of brain tumor for persons of various ages**	The diagnosis of severe malignant conditions of cancer disease is one of the applications of image processing and deep learning. Many researchers have been working on segmenting and classifying brain MRI brain tumour images. The procedure of identifying tumor sections with masks put in the correct location is known as brain tumor segmentation. With the recent development of deep learning methods for handling various computer vision issues, a number of deep learning strategies for segmenting and classifying brain tumours have been attempted, with varying degrees of success. My research attempts to deploy and analyse

		the performance of state-of-the-art technologies and the various deep learning algorithms like dense Neural Network, Convolution Neural Network, VGG16 Models in order to address the challenges. The BRATS Dataset is used to train the models, and the methods' performance is compared. The research also aims to analyse images of people of all ages for various stages of tumor.
Deep Learning	**Landslide Risk analysis using Deep learning techniques and Satellite images**	Landslides are a severe geological phenomenon prevalent in mountainous areas. Landslides usually happen without explicit notification. Landslip/ Landslide creates a broad range of terrain inclinations, such as rock falls, the great collapse of slopes, and slight residue flows. It causes extensive destruction across highways, connecting bridges, it affects the entire transportation, civilized residences, cultivating fields, meadows, forests areas, etc. This geological change might lead to immense loss of people's livelihood and property, natural resources which is the key to the economy of the country, being an urbanized area there could be loss in economic activities. The objective of this work is to analyse the landslide hazard and risk regions in Kerala, Idukki district, in particular. The conventional

		approaches for identification of landslides, predicting future risk, associated with slope failures, followed by emphasizing the advantages of modern geospatial techniques such as satellite remote sensing images and Digital Elevation Model in updating landslide inventory maps. Machine learning techniques and deep learning has been extensively used with geographical data producing effective results for assessment of natural hazard and environmental research. Based on recent studies, deep learning is a reliable tool addressing remote sensing challenges such as trade-off in imaging systems producing poor quality investigation, in addition, to expedite consequent tasks such as image recognition, object detection, classification, and so on. Conventional methods, like pixel and object-based machine learning methods, have been broadly explored.
Virtual Reality	**Rich 3D Experience - Virtual Reality based Digital Gallery for Heritage Museums**	With the huge advancement of information technologies, the digitization process has become more progressive and diversified. Presently, a few well-known museums have created virtual environments in the form of digitized information on their web pages or pre-recording their tour guide through portable devices for visitors convenient. Thus, the versatile analysis of virtual museums has the potential to enable greater understanding

		the values of resources to depot cultural heritage. To bridge a gap between visitors and monuments, we must reinforce the importance of interactive activities at a greater level of engagement and sense of presence. It could be achieved through the implementation of AR & VR techniques. Our intention is to describe various strategies that aid to enhance a visitor's virtual experience in a museum and art galleries through digital technology
Machine Learning	**Performance Analysis of Real-time Plant Species Recognition using Bilateral Network combined with Machine Learning classifier**	A real-time plant species recognition under an unconstrained environment is a challenging and time consuming process. The recognition model should cope up with the computer vision challenges such as scale variations, illumination changes, camera viewpoint or object orientation changes, cluttered backgrounds and structure of leaf (simple or compound). In this paper, a bilateral convolutional neural network (CNN) with machine learning classifiers are investigated in relation to the real-time implementation of plant species recognition. The CNN models considered are MobileNet, Xception and DenseNet-121. In the bilateral CNNs (Homogeneous/Heterogeneous type), the models are connected using the cascade early fusion strategy. The Bilateral CNN is used in the process of feature extraction.

		Then, the extracted features are classified using different machine learning classifiers such as Linear Discriminant Analysis (LDA), multinomial Logistic Regression (MLR), Naïve Bayes (NB), k-Nearest Neighbor (k-NN), Classification and Regression Tree (CART), Random Forest Classifier (RF), Bagging Classifier (BC), Multi-Layer Perceptron (MLP) and Support Vector Machine (SVM).
Image Processing	**Tumor Detection in Medical Images using Segmentation and Feature Extraction Technique**	Tumor is one of the most common fatal diseases worldwide, and the detection at an early stage is crucial to reduce the incidence of death. There has been a tremendous growth in medical image segmentation and classification for diagnosing cancer. This led to the various developments in medical research that helps in diagnosing types of cancers and other human medical problems. This work focuses on performing effective segmentation procedures for both color and, gray scale images, Also, this work paves a way for detecting tumor in medical images by extracting and selecting the feature from the segmented image. The study also discusses the design of Segmentation, features extraction, and image classification for detecting tumor. Finally, we compared the

		tumor detection in medical images by proposed algorithm is experimented and compared with other existing algorithms which show the promising achievement in terms of their evaluation metrics.

2. Department of Electronics and Communication Engineering

Thrust area	Title of the research work	Brief write up of the research work
Wireless Communication	A secure optimization based routing algorithm for Vehicular Ad hoc Network (VANET) with trust based authentication	This research proposes and analyses various solutions to clustering issues in 'VANET' and ensures timely delivery of information to the vehicle's end-to-end connection. The research also works on the non-availability of many nodes and routers, serious scalability and hidden node problems. The research focuses on analyzing and developing new clustering techniques to improve network stability with reliable communication amongst vehicles. The work considers Artificial intelligence (AI) to achieve traffic safety, convenience, and security

		performance.
	Dynamic Spectrum Sharing and Allocation in Cognitive Adhoc Networks	The main objective of the research is to design a distributive Auction based game for spectrum allocation in cognitive Adhoc networks, design a multi objective genetic optimization for reducing the power utilized in sharing the spectrum in distributed networks and to test the performance of the cognitive radio in medical observation using real time Test bed calibration.
	Efficient Full Duplex IRS aided NOMA System Design using Deep Learning	The work uses an optimum multiple access technique called Non-Orthogonal Multiple Access (NOMA). The work selects Intelligent Reflecting Surface (IRS) to improve error rate performance. The work also introduces an appropriate Deep Learning algorithm to enhance the error rate performance of the IRS-aided NOMA system. The work analyze the performance in real-time applications as well.
	Implementation of Reconfigurable High Speed Architecture for Long Term Evolution Systems	The work focuses on SoC based CGRA (Coarse Grained Reconfigurable Architecture). Reconfigurable processing elements will be designed to reduce the switching activities of CGRA based SoC architecture. Proposed Reduced delay UL-DL LTE based digital reconfigurable FPGA system will be used to wireless communication and digital communication processes. Further the

		enhanced application like 4G/5G, proposed work will be helpful to improve the timing reduction from ns to ps.
	Efficient routing protocol with localization based congestion control for underwater wireless sensor network	The work focuses on implementation of angle routing protocol and evaluate its performance in underwater communication. It analyzes priority-based localization and evaluate its performance. The work also provides algorithms to minimize the congestion, to prioritizing the traffic. It also suggests localization of error using angle based forwarding scheme with the shortest path to the destination using fitness function. The work is considering NS3 simulation.
VLSI/Embedded Systems	Machine learning based performance estimation for CMOS VLSI circuits	The work proposes the design methods to predict the activity with high power consumption. It also detects the switching activity and the power information to identify local hot spots. The proposed design method uses supervised learning method, which provides a fast and accurate estimation of power without affecting the accuracy of the system. The work considers Power estimation using random forest algorithm.
	Hardware acceleration of Stochastic Computing Based Deep Learning System	The objective of this work is to develop a deep learning system architecture which provides the hardware efficiency with Stochastic Computing. The work proposes fully parallel and scalable hardware implementations of large-scale deep learning systems. This work

		also focuses on Profiling technique to identify time consumption of specific function on FPGA rather than in the processor. The work describes the optimization in realization of hardware efficient deep learning system.
	Machine Learning in VLSI IC Design	The objective of the proposed work is to develop less complex and low cost power estimation technique. The work uses supervised learning method, which provides a fast and accurate estimation of power without affecting the accuracy of the system. The algorithms proposed in this work are compared against each other. The results will indicate high prediction accuracy and effectiveness. The supervised ML algorithms like Linear Least-Square Regression, Ridge Regression, Nearest Neighbors Regression, and Neural Network Regression are considered in this work.
	Remote sensing	The work proposes a Hybrid Deep Learning improved BAT optimization algorithm (HDIB) for soil classification using remote sensing hyperspectral features. A recurring Deep Learning (DL) Neural Network (NN) is used for classifying the HS images, considering the datasets of Pavia University, Salinas and Tamilnadu Hill Scene, which in turn improves the reliability of classification. The performance of the proposed HDIB based soil classifier is compared and analyzed with existing

		methodologies like Single Layer Perceptron (SLP), Convolutional Neural Networks (CNN) and Deep Metric Learning (DML).
	Controller design for an Autonomous vehicle system	This work focuses on an autonomous control vehicle which is designed to detect and track the other vehicle to their surveillance limits. Image segmentation and pattern analysis techniques are used to detect and locate the vehicle by means of their front and rear lights. The work proposes On-board camera which ensures all the real-time constraints on the road environment and assure excellent detection and tracking performance. Various challenges in vehicle detection and tracking will be considered in this controller design work.
Image Processing	Diagnosis and Severity Level Detection of Alzheimers Disease using Deep learning Techniques	This research work investigates and analyses the anatomical changes in different regions of Alzheimer's brain MRI images in order to identify biomarkers for the diagnosis. The primary intensions of this research are to design and develop effective method for AD detection process. Initially it identifies regional pattern and analyze the structural changes in the brain sub regions specifically Grey Matter

		(GM) White Matter (WM) and hippocampus. The work explores optimization concepts of hybrid techniques for segmenting sub regions in the brain.
	Multiple eye disease detection	The main objective of this work is to analyze the retinal fundus images for various disease detection such as cardiovascular disease, diabetes, lung diseases. The study of retinal fundus image is used for the prediction of multiple diseases in our human body. This can be achieved by pre-processing, segmentation, feature extraction and classification. The work considers dilated convolution method for segmentation, convolution neural network for feature extraction, and multiclass SVM for classification.

3. Department of Mechanical Engineering

1. Manufacturing - Machining
2. Materials Engineering
3. Thermal or Energy Engineering

The following table gives the information about various research works carried out under each stream and brief description of the each research work.

Thrust area	Title of the research work	Brief write up of the research work
Manufacturing - Machining	Real time fault diagnosis on mono-block centrifugal pump using deep learning algorithm	The main objective of this research is to determine the fault occurring in the mono-block centrifugal pumps with greater accuracy and faster results using vibrational signals. In this study an experimental setup of industrial mono-block centrifugal pumps is used for diagnosing the faults using the data acquisition system.
	Investigation and Optimization of cutting parameters on high-speed machining of β- Titanium alloy using multi-layered coated Tools.	The objective of the present work is to investigate the possibility of using multi-layered coated tools to reduce the tool wear in turning of titanium alloys by providing suitable cutting fluid under different machining conditions by utilizing a high pressure coolant delivery system.
	Performance evaluation of textured diamond coated tools on machining AA2024 aluminum alloy	The texturing of tools is a promising approach to improve the tribological properties of mating surfaces and to reduce the tool-chip adhesion. In this work the performance of surface textured tools is evaluated for different orientation of texture.
Materials Engineering	Experimental investigation on the performance characteristics of lubricant oil blended with TiO2,	In this research work the wear characteristics of the Lubricant oil is to be determined by the addition of three

	Al_2O_3, SiO_2. Nanoparticles as additives	different nano-additives namely TiO2, Al_2O_3, SiO_2. The nano-additives are added with oil in different proportions and the characteristics are to be evaluated.
	Investigation on Mechanical properties and Machining behaviour of Graphite and Zirconia reinforced AA6061 Metal Matrix Hybrid Nano Composites	In this work a Graphite and Zirconia reinforced AA6061 Metal Matrix Hybrid Nano Composites were prepared with different percentage of Graphite and Zirconia and its machining characteristics were studied
	Experimental Investigation and Parametric Optimization of Aluminum and Magnesium base alloy fabrication in MMC for structural applications	In this work the metal matrix composites (MMCs) were prepared from reinforcement particles of boron carbide and AL7075T6 with weight fraction range 5% and 95%. The stir casting process is carried out at a speed of 700-800 rev/min by graphite impeller about 5 minutes. The machining characteristics are studied by the use of unconventional machining process
	Study of hot corrosion behaviour of Nickel based super alloys in molten salt technology used in thermal energy storage applications	The scope of this research is to improve the high temperature corrosion resistance of Inconel 625, Incoloy 800 H & Haste alloy X used in Molten salts technology in thermal energy storage applications.

	Investigation of wear, tribo-corrosion behaviour and stress corrosion cracking of C-TIG and A-TIG welded AISI 304L stainless steel	The current study is to investigate the influence of micro structures of base metal, weld metals on mechanical properties, wear, tribo-corrosion, stress corrosion cracking of AISI 304L stainless steel weld joints. The weld joints are prepared using Activated Flux Tungsten Inert Gas (A-TIG) and conventional Tungsten Inert Gas (C-TIG).
	Mechanical and metallurgical characterization of titanium alloy through equal channel angular pressing process.	Equal channel angular pressing is one of the best severe plastic deformation methods to enhance mechanical properties of titanium alloy. Tensile strength, hardness, and microstructures can be improved by the severe plastic deformation technique. By improving the mechanical and metallurgical properties of material which can be an alternative to Hard steels.
	A study on Rheological and lubricating properties of nano-lubricants containing Metal Oxide nanoparticles	This research work is aimed to develop different concentrations of Metal oxide-nano gear lubricants and estimate their lubricating properties for high temperature gearbox applications. Temperature dependent lubricating properties such as density, kinematic viscosity, anti-wear properties can be estimated by pycnometer, rotational

		viscometer and Four-ball wear test.
Thermal or Energy Engineering	Charge Stratification using Phase Change Material for Thermal Storage Applications.	In this work an experimental set up is to be developed with 3 different aspect ratio storage tanks to store and release the heat energy with the help of PCM. It is proposed to use organic (Paraffin), Inorganic (Metal hydrates) and Nanomaterials (Graphene nanoplatelets) as PCM and its characteristics are to be studied. The temperatures are measured with the help data acquisition system (DAS) and are used to determine the variation in charging efficiency, Stratification number and Richardson number of the storage system.
	An Experimental Investigation on the performance and Emission characteristics of a CI Engine using Ternary Blends of Diesel Algal Bio Diesel and Methanol as Fuels	In this research the performance of IC engines are tested with different blend of algae with Diesel. The emission characteristics were studied with all the blends and found that Bio -Diesel give better performance.
	Investigation on Performance and cost reduction of Dish Solar Concentrator	The objective of the research work is to design a weightless low-cost parabolic Dish Solar Concentrator (DSC) with small to moderate size for direct electricity generation.
	Effect of Doped Nano Additives on the Combustion,	The major objective of this proposed research work is to identify a suitable

	Performance and Emission characteristics of Algae Oil in CI Engine.	variety of Algae for the production of Algae based bio fuel for CI engine and to conduct the experimental investigation of CI engine with algae-based bio fuel mixed with doped nano additives and to find the optimum ratio of the additives to the fuel for the better performance and optimum emission control. Further,it is proposed to analyze the engine wear and the environmental effect of the nano additives.
	Development of Catalytic Converters using different materials and their effects on the emission reduction in CI engine	This research is an attempt to find out how the deadly emission by the vehicular pollution could be reduced, the most prevalent ones like CO, HC, Nox, CO_2, O_2 and smoke density. Hence a combination of two investigations have been associated for this research – the change in the noble metal (like Platinum and Rhodium), and the different blends of Neem oil with diesel. The justification for this combination being - the cost efficiency, availability, performance, reduction of harmful toxic levels, facilitates the replacement of the coating of catalytic converters with other alternates.
	Dispersion pattern of sulphur Di-oxide in the neighborhood of North Chennai Thermal Power	North Chennai industrial area, has registered a successful and planned expansion of industries during the past

	Station (NCTPS)	five decades. However, a sporadic development of residential colonies has also sprung up in the area. As a result, the magnitude and severity of air pollution problems have attracted the attention of the public. There is a necessity, therefore, to adopt a systematic procedure for controlling the quantum of pollutants emitted from each industry located in the area, in order to maintain the ambient air quality in the North Chennai area, and in the neighborhoods of the industries in the North Chennai area within safe limits. The first step to be initiated, in this relevance, is to simulate the ambient Air Quality in the North Chennai area with the purpose of assessing the presently prevailing air quality.

4. Department of Chemistry:

Thrust area	Title of the research wok	Brief write up of the research work
		The polarized ketene dithioacetal is well known in synthetic organic sulfur chemistry as push-pull system. Dithioketene is a versatile molecule. It is embodied with three functional groups

Synthetic Organic Chemistry	Synthesis, Characterization and Biological activity of Nitro enamine substituted Heterocyclic Compounds	on ethylene motif, *viz.*, alkylamine, methylsulfanyl and nitro, each one of which is amenable for synthetic exploitation and functional group manipulation. With an excellent electron-withdrawing nitro group in place, the nitro-ethylene substructure is a good Michael acceptor. The methylsulfanyl group is an electron donor and is also a good leaving group. The methylsulfanyl group in ketene acetal can be replaced with a variety of nucleophiles, by substitution nucleophilic vinyl (S_NV) mechanism. We have aimed to synthesis heterocyclic compounds using nitroketene dithio acetal and oxo ketene acetal and to study their biological activities.
	Diversity Oriented Multi-Component (DOS-MCR) approach to design highly functional small organic	Synthetic organic chemistry plays a crucial role in medicinal chemistry for identifying new drugs. Diversity Oriented Synthesis (DOS) which aims at building skeletally diverse scaffolds using readily available building blocks is emerging as important area of research in synthetic organic chemistry. Multi Component Reaction (MCR) protocol in greener solvent is one of the significant strategies, which will satisfy the

	molecules with inherent flexibility	fulfilment of green chemistry approach and gives highly efficient, reduced waste, atom and step economic eco-friendly synthetic protocols for complex moieties. Integrating the strategies of DOS in to the realm of MCR will be a great opportunity to exploit the demand posed by chemical biology for huge number of small molecules. we propose novel synthetic strategies for libraries of highly functionalized bioactive small molecules.

5. Department of Physics

Thrust area	Title of the research work/ Targeted Applications	Write up of research work in brief
Nanomaterials	**Supercapacitors**	We are working in Metal sulphide/Graphene oxide nanoparticles for embedding in a polymer matrix. Various percentages of **Metal sulphide / Graphene oxide are reinforced into the polymer** were synthesized and the properties were analyzed. We are working the efficiency of the supercapacitors.
	Solar Cells (Experimental)	We have chosen **Metal Oxides and their Composites for the Photoelectrode of Dye Sensitized Solar Cells**. The metal oxides employed for the fabrication of DSSCs has solar absorption below a threshold wavelength, i.e., they have absorption at ultraviolet region. We are working on many metal oxides like SnO2, NiO, ZrO2, Co3O4, WO etc… The efforts will be taken to improve the efficiency of the solar cell.
	Solar Cells (Theoretical)	Aim of this work is to obtain **modelling and simulate a low cost Pb (Lead) free PSC (Perovskite Solar Cell)**. We are working to simulate and construct a low-cost eco-friendly perovskite solar cell by both on theoretical and experimental way. Our future work is plan concentrate on experimental work and compare the theoretical and experimental results.
		Water splitting is the chemical reaction in which water is broken down into oxygen and hydrogen by using Electrolysis method. The **splitted Hydrogen & Oxygen will be used for**

6. Department of Management Studies

Domain	Topic	Thrust area of research
Marketing	**A study on digital psychology for e-commerce that influence the buying Behaviour of gen z**	This research studies digital psychology and explores it in relation generation Z, and to understand concept and principles of digital psychology and identify how it influence the buying Behaviour of Gen Z, To determine techniques that can be applied in E-commerce marketing and website designing to persuade Gen Z,
		Research Method - A qualitative method with Descriptive approach and stratified sampling technique will be followed, questionnaire method will be used to collect data, if needed interview technique will be used. Stakeholder Benefit - Small scale e-commerce brands targeting young population can make use of this study.
	To analyze / examine the effect / influence of electronic word of mouth (ewom) in deciding to buy life insurance products in India	This research aims to understand the insurance customer demographics, their expectations from Insurers, understand the current challenges and expectations from insurance prospects across Awareness. The study aims to conduct a needs analysis and understanding of the product and its comparisons. The study also aims to and decision making process and to understand the influence / effect of feedback / opinions / inputs from digital channels in their buying decision ,

		Research Methods: Secondary Research and Primary Research - To understand challenges, expectations, Influences, engagement touch points through Survey Questionnaire to Insurance Prospects , Customers of identified Customer Segment , Sampling technique & Sampling Procedure – To be Decided Sampling technique & Sampling Procedure – To be Decided., Stakeholders Benefit (expected) : Insurance Companies, Technology Companies, Insurance Agencies
	Enhancing customer experience through application of next gen technologies in insurance industry	This research aims to study the modern technologies that insurers currently deploy to enhance their customer experience and to suggest right combination of technologies to handle customer service / interactions.
		Research Methodology : Secondary research to find the current best practices in the customer service area of insurers and Survey involving customers of insurers., Stakeholders benefiting : Insurer to deploy the right set of technologies to enhance the customer experience

	Drivers of ethical decision in marketing activities	The research studies about the ethical decisions in marketing can be classified in functional areas like product, pricing, promotion and place. The other way to explore the marketing research is as ethics in marketing strategy and ethics in marketing communication. This thesis would confine to ethical decision making strategy and focus on an empirical study on service sector employees. A survey of 700-800 service sector employees is to be administered for the research. The study is undertaken among service sector employees, determining the mediators role in ethical decision making strategy of employees in marketing activities, analyzing the correlation between demographic variables and Independent variables in the ethical decision making of service sector marketing employees are the objectives of this thesis. The benefits of integrating ethics in marketing strategy are: Improving marketing performance- Socially responsible companies and their personnel would respond to the stakeholder's demands, acts as a Moral Marketing Compass, win-win Marketing- focus on customer value will increase company value., keeps marketing legal which reduces the risk of cutting corners and turning a blind eye.

		Research Methodology: Various statistical methods used in the international level are said to be research analysis of variance (ANOVA), multivariate analysis of variance (MANOVA), regression analysis, confirmatory factor analysis (CFA), and exploratory factor analysis (EFA) and Structural Equation Modelling (SEM) These would be used in Statistical
Human Resource Management	**Agile Strategies in small and medium enterprises**	The Research tries to understand agile strategies*To analysis impact of agile strategies on SMES*To identify the area of implementation of agile strategies in SMES.
		Research Methodology: A qualitative method with a descriptive approach can be used in this study. This study depends upon the responses which will be collected from the smes across Tamil Nadu. The snowball sampling method will be used to select the respondent. Primary and secondary data is used for the research study. Primary data will be collected through a structured questionnaire. Statistical tools (Chi-square test, One-way Anova, regression and frequency etc) will be used for analyzing the data. Stakeholders Benefited: This study will be helpful for SMES to be flexible and adaptive in changing scenarios.

	Emotional intelligence and its impact on performance of entrepreneurs in msme sectors	The research reveal the demographic profile of the respondents and aims to study the growth and development of MSME sector. It also examines the factors influencing the emotional intelligence and its impact on performance of entrepreneurs in MSME sectors. The study also studies the impact of emotional intelligence on performance of MSME sectors. It also offers suitable suggestions to enhance the emotional intelligence and its impact on performance of entrepreneurs in MSME sectors on the basis of the findings of the study. Population to be studied: Entrepreneurs in MSME sectors
		Research Methodology: Sampling techniques: Frequency analysis, Descriptive statistics, Independent sample T test, One way ANOVA, Chi Square test, Correlation analysis, Multiple Regression and Structural Equation Modelling. Stakeholders Benefit (Expected): Start up entrepreneurs, New and existing entrepreneurs
	Influence of green hrm on financial performance of organisations	The research is focused on adaption of Green HRM in the organization such as Green recruitment, Green training, Green performance management and Green reward and how adapting these Green HRM activities has an effect in improving the overall financial performance ,
		Research Method - Descriptive study with stratified sampling technique will be used, primary data will be collected using questionnaire method ,T- Test, Anova, correlation, regression and SEM will be used for data analysis. The Stakeholder Benefit -

		Food Industry, Electronic industry
	Emerging Green HRM Trends in IT Industry.	The research aims to analyze impact of the modern technologies that insurers currently deploy to enhance their customer experience and to suggest right combination of technologies to handle customer service / interactions
		Research Methodology: Secondary research to find the current best practices in the customer service area of insurers and Survey involving customers of insurers Stakeholders benefiting: Insurer to deploy the right set of technologies to enhance the customer experience.
		Research Methods: Secondary Research and Primary Research - To understand challenges, expectations, Influences, Green HRM in IT Industry. Sampling technique & Sampling Procedure to be decided.
	A impact of student Diversity on Academic Institutions Climate	The Research helps to understand the diversity differences, expectations from the students in Academic institutions. The present day colleges are highly diverse in their student composition and often educational institutions are facing a number of problems created by the diversity. The study will be helpful in understanding these diversities and in providing policy insights to educational institutions and to the government.

	A study on the role of family support on covid-19 front line women workers	The research talks about the front-line workers are equally competing to combat against Covid 19, but only the doctors and nurses have been hailed as heroes. But the contribution of other front line workers are not highly recognized. The other front line workers are complementing the services rendered by the doctors and nurses. Hence, acknowledging and appreciating the services of the other front line workers like police, corporation and service sector workers is the need of the hour. The global frontline workforce are Predominantly women.
	Challenges faced by Indian organizations in engaging Gen Z work force	The research explore the level of importance of various enablers given by Gen Z in engagement. • To determine the enablers that influence employee engagement of Gen Z Research methods sampling techniques- Random sampling data collection mode- questionnaire stakeholders benefiting from this research- Corporate firms, HR
	Impact of artificial intelligence in HR talent acquisition in Chennai region	The research Explains about the impact of AI make on the traditional HR Recruitment without Human touch. To assess the efficiency of AI implementation in HR Recruitment. To explore the current state of AI in the traditional HR Recruitment process.

Finance	**Investor perception and Awareness on Gold Investment**	The research explores the Gold as a currency plays a key role in the economic growth and development of a nation. Gold is one of the oldest precious metals to be known to humanity and also been an investment choice. Due to its elegance, liquidity, investment characteristics and industrial properties, the metal is possessed and preserved worldwide. The global demand for gold revolves around the following categories namely gold, jewelry, finance, reserves of central banks and technology. The Gold Control Act forbade the private keeping of gold bars in India until 1990. The investment in gold was essentially 22-carat jewelry. Investment in small bars, both importing ten tolas and locally manufactured small bars, which have proliferated from local refineries, has greatly increased since 1990. In November 2015, the Sovereign Gold Bond (SGB) scheme was introduced by the Reserve Bank of India with the intention of reducing demand for physical gold and transferring a portion of the domestic savings used to buy gold into financial savings. People in India regard gold as a safe asset class that provides financial inclusion and expansion of wealth. People's perspective of thinking gold only for ornamental usage has changed to considering it as an investment asset. Investors see gold as a systemic risk hedging instrument against inflation. The study aims to assess the knowledge and understanding of the investor about various gold investment avenues, such as Gold etfs, Sovereign Gold Bonds, Digital

		Gold, Gold Equity Funds and Physical Gold. It intends to measure the different variables affecting their investment in gold, the gold price drivers in India, etc. In addition, the analysis attempts to find out how gold investment products perform in conjunction with other properties, gold price volatility variables, and gold trends. The research aims to study investors; strategic asset allocation of gold, which can provide long-term investment understanding of gold. The research paper is to be done as a descriptive study where the primary data is to be collected with the aid of questionnaire and secondary data from various published research papers, journals etc. Overall, the analysis will serve as a guide to understand and appreciate the value of gold as an investment rather than a luxury asset for Indian investors.

NCR Campus, Ghaziabad

Artificial Intelligence (AI): Artificial Intelligence is one of the thrust area of research. AI forms the basis of computer systems handling tasks such as planning and scheduling, automated reasoning, voice recognition and translation on smartphones, knowledge representation, piloting driverless cars, machine learning, natural language, and robotics and vision that automate chores in homes and factories. In research, AI is

being used in a rising number of applications, such as handling the enormous amounts of data that support fields including astronomy and genomics, producing climate models and weather forecasts, and identifying signs of disease in medical imaging.

Internet of Things (IoT): Internet of Things is an emerging paradigm and a revolutionary methodology for future that supports the communication between electronic devices and sensors through the internet in order to simplify our lives. IoT is increasingly becoming a significant feature of our life that can be sensed everywhere around us. In research IoT is more prominently focusing on energy, power, 5G networks, security, IoT large scale pilots, e-Health, Assisted Living and e_Wellness, Wearables, Cyber-physical systems, Ambient Intelligence.

Antenna & RF Communication: The major thrust area of the department is based on all the four major components of a wireless communication system: transmitter, receiver, communication channel and antenna. The requirements of future 4G communication systems are expected to be met by Orthogonal Frequency Division Multiplexing (OFDM)and Multiple-Input–Multiple-Output (MIMO) systems. Main thrust of the above work has been improving Transmitter and Receiver designs so that less power is required to be transmitted. This will reduce RFI to other users, reduce biological hazard and also improve compatibility with other systems. Similarly improved antenna designs based on metamaterialsare given so that they can give optimum performance even with lesser received signal strength.

VLSI Design: In the area of VLSI, our approach has been more development oriented using commercial software. Research work going on includes: VLSI Testing, Low power circuits, Reversible and QCA based designs, Spintronics. Research scholars are working on techniques for designing circuits that are more energy, power and time efficient at the architecture level. Research is also going on towards developing efficient hardware using design techniques such as retiming, folding, unfolding, design of low power Field Programmable Gate Arrays (FPGA's) at the architecture level and evolvable hardware techniques using Genetic Algorithms for circuit optimization.

Electrical Machines and Drives: Electrical Machines and Drives research are mainly focused on fault diagnosis and condition monitoring of electrical equipment, i.e.,

transformer, motor, generator, converter, etc. Advanced control of medium voltage high power industrial AC drives and advanced nonlinear control techniques to address fundamental problems in the area of motor drives is another focus of current research. It is also focused on control of high-power AC drives, torque ripple minimization of AC Drives such as Permanent Magnet Synchronous Motor (PMSM) and Switched Reluctance Motor (SRM) Drives, high-performance control of electric drives, building and industrial processes energy efficiency enhancement, biomimetic fish propulsion and central pattern generation mechanisms etc.

Science and Humanities

Kattankulathur Campus

Academic research is to seek the truth and new knowledge which enhances social development. Such research is one of the integral responsibilities of faculty members working in an academic institution. Research is highly valued as a process in the College of Science and Humanities. Faculty members and Research scholars in all research departments are motivated to conduct Research not only for the purposes of publishing more article but also to identify solutions to help solve the real time problems.

DEPARTMENT OF BIOTECHNOLOGY

I. Stem cells and Regenerative Medicine

Stem cell research focusses on cellular therapy for Neurodegenerative disorder, auto immune disease and infectious disease such as spinal cord injury, Rheumatoid arthritis and Tuberculosis respectively

Comparative studies of cellular therapy with various drugs on Rheumatoid arthritis and Tuberculosis

Working towards the therapeutic approach of cellular therapy from bench to bedside

II. Neurogenetics and Nanotechnology

Neurogenetics and Nanotechnology Research focusses primarily on understanding the genetic basis of human diseases using cell lines and animal models.

Currently, the aim is to analyse the role of specific genes and pathways in the progression of diseases like Alzheimer's disease and different types of cancer using zebrafish model system.

Identification of specific molecules and synthesizing nanoparticles that could have therapeutic potential and role of selenium and its derivatives in Alzheimer's disease using zebrafish as animal model.

III. Biodegradable polymers from microorganism

Focus on screening and optimization of polymer producing microorganisms and main aim of research is the production of biodegradable and eco-friendly alternatives to the plastics from microorganisms. Moreover, the currently explored isolates are producing biopolymers naturally as a carbon reserve. But the quantity and quality of production is low which cannot meet our requirements. Therefore, it is the need of time to produce good quality aswell as high quantity of bio plastics from microorganisms for more commercial use of the product.

IV. Fisheries Biotechnology

Aim of this work is bringing a translation approach in the scientific findings. The current research have undertaken has been into the identifying potential vaccine candidates for fishes in the aquaculture industry, thus mitigating the need for use extensive chemicals in the field. Working on the ability of some of the sea sourced materials in the construction activity along with a combination of silicates and bacteria. The need for innovation in the construction industry is ever expanding with the costs and viability of the current resources becoming high and scarce, respectively

V. New diagnostic method for pregnancy complication.

This is focusing on the pregnancy related issues in women having exaggerated levels of certain chemicals. .

The objective of the study is to determine the effectiveness of protein receptors as valid biomarkers in the body fluids of pregnant women. The aim is to examine the correlation between the receptors and pregnancy complications. The further aim of this study is to pave way for an affordable diagnostic method for pregnancy complication.

VI. Therapeutic approach of Medicinal plants on different types of cancer

This study is based on medicinal plants which can be considered for cancer treatment. Zebrafish will be used as an animal model to mimic disease conditions and to investigate the pathways of cancer. Evaluation of effect of medicinal plant on cancer genes and various pathways of different types of cancers.

VII Cosmetics from Algal Biotechnology

Focus on the pigment extracts from algae and use those pigments for the synthesis of nanoparticles as a natural colorant in food colors as well as in lipsticks, eye shadows, etc. peptides and proteins derived from algae are used as skin moisturizers that have no side effects and also using them treating against the resistant epidermal pathogens.

Department of Biochemistry

Alternative drugs to control the Diseases caused by pathogen

The continuous use of antibiotics has resulted in multi resistant bacterial strains all over the world. Consequently, there is an urgent need to search for alternative drugs to synthetic antibiotics and the recovery of natural molecules that would allow the consistent and proper control of pathogen caused diseases. The source of these molecules may be microbial or from plant source. Ideally, these molecules should be as natural as possible with a wide range of action over several pathogens, easy to produce, and not prone to induce resistance. Investigations will be conducted to explore the possibility of using these novel compounds to which may ultimately constitute an important part of development of new therapeutic strategies. Some of the delivery systems like injectable microspheres, liposomes and implantable hydrogels will be studied for controlled delivery of these drugs. These active compounds also find their place in food and agricultural industries for preservation and to control plant pathogens. The principal mechanism of rapid killing of microbial pathogens is attributed to perturbation of microbial cell membrane. Others include interfering with metabolism and targeting cytoplasmic components.

SCHOOL OF COMMERCE AND ECONOMICS

School of Commerce and Economics is dynamic nature to find and explore thrust areas of research from the various studies which are considered as an interdisciplinary boundary. In addition to these, discussion with the faculty members in the department

the following thrust areas are given on the basis of contemporary research and policy issues have emerged in the recent periods.

Finance

Financial literacy
Behavioral Finance
Carbon Accounting,
Corporate restructuring
Fintech
Entrepreneurial Finance
Alternative Finance
Economic variables and capital market
Stock Market Efficiency
Role of technology in providing financial services
Income Computation & Disclosure Standards and the Ind-Accounting Standards

Human Resource Management

Human Capital Development
Knowledge Management
Talent Management
HRD Climate and Risk Management
International HR Policies
Cross Cultural Management and Leadership

Marketing

Behavioural aspects of decision making
Co-creation with customers
Role of digital media in B2B Marketing

Interdisciplinary Areas

International Economics

Industrial Economics

Globalization, trade and development

Fiscal and Financial Economics

Supply Chain and Retail Management

Big Data Analytics

Impact of COvid-19 in industries and commerce

DEPARTMENT OF COMPUTER APPLICATIONS

The research activities of the department focus on distinguished the world changing research contributions. The department aims to nurture research ethnicity in our institute by promoting research in newly and emerging challenged frontier areas of science and technology. Also, the department creates awareness and opportunities for the faculty, research scholars and students. In the department level, the research focuses mainly on Bio medical and Image processing, E-voting system, Education system, Agriculture, Social media, Enterprise resource planning system, Sentiment and emotional analysis, Secured digital documents and Bit coin transactions. The complete research activities of the department faculties, research scholars and students are as follows:

MACHINE LEARNING AND DEEP LEARNING:

Real-Time Event Detection Using Social Media Data Sources: This research work involves applying deep learning algorithms for Real-time event detection by linking heterogeneous media and metadata that can be employed in both single-platform and cross platform application scenarios.

Detection of patterns of Arrhythmia conditions: Machine learning and Deep learning methods are widely used in classifying ECG signals. This proposed research work is to detect the heart beats of various patterns of Arrhythmia condition and devise a novel way to predict the different pattern of ECG signals using Deep learning techniques.

Predicting University Admission: The Admission in an educational institution is an exhaustive task that requires lot of background preparations on management side.

Every year the number of courses, number faculties and the number of students got increased in all educational institution. So the management needs to predict the number of admission for their yearly budget. This research work is to focus on for predicting number of students getting admission for each course on upcoming year in a university using time series machine learning algorithms.

Learning prediction based on educational data using Data mining and Machine learning techniques.

CRYPTOGRAPHY AND NETWORK SECURITY:

In this research, a new approach is proposed to secure biometric data for multiple multilevel multimodal cryptography algorithms (MMMC). The proposed algorithm gives effective user authentication and secure data transmission in cloud server networks.

BLOCKCHAIN TECHNOLOGY:

E Voting System: An efficient user authentication, authorization, and secure voting using QR Code and H-PSP-ECC for improving the data security and user verification with blockchain technology.

Bit coin Transactions: Secured bit coin crypto currency transactions achieved through distributed consensus mechanism, hash functions and cryptography.

DEPARTMENT OF COMPUTER SCIENCE

Intelligent Agricultural Plant Disease Detection and Classification using Multimodal Fusion based Deep Learning Models

The proposed model aims to detect and classify the plant leaf diseases using Deep Learning techniques. The overall process involves different stages of operations. Primarily, the noise removal and contrast enhancement techniques are applied to improve the quality of the images. Besides, the image segmentation technique is applied to identify the diseased portions of the plant disease images. In addition, Deep

Learning models are applied as a feature extractor to derive the feature vectors. Finally, the classification of plant disease images takes place using the classifiers.

- Deep Transfer Learning Enabled EfficientNet with Extreme Learning Machine (ELM) model for agricultural plant disease detection and classification.
- A novel black widow optimization (BWO) with SqueezeNet and Extreme Gradient Boosting (XGBoost) model for Plant Disease Detection and Classification
- Deep Transfer Learning based Multimodal Fusion Technique for Plant Disease Detection and Classification

MACHINE LEARNING

In many applications, missing data raises significant issues in the large database for quantitative analysis. As a result of these issues, the inference of the computational process produces biased results, more damage of data, the error rate may increase and more difficult to accomplish the process of imputation. Focused my research work to introduce the most powerful approaches for the prediction of disguised missing data using machine learning techniques with actual data analysis. In the past few decades, heart disease has been a common and dangerous disease caused by the containment of fat and it occurs due to excess pressure in the human body. Extend my research work for the detection of heart disease using machine learning algorithms. Autism Spectrum Disorder (ASD) is a neurodevelopmental issue that influences interaction, communication, learning capacity. According to ASD, the problem starts with childhood and continues to keep going on into adolescence and adulthood. Therefore, ASD has been studied by specialists using innovative technologies such as Machine Learning to develop indicative planning, exactness, and quality. The advancement of a new approach for ASD diagnosis with ML is the more genuine claim in recent research. Data Breaches in healthcare is almost inevitable and it needs to be handled in an efficient way of transferring the sensitive information. My research work focused on preserving sensitive medical information of the patients by using Logistic image encryption algorithm to encrypt the medical

data. It provides high level data security across the connection, interoperability, on-demand access at a high speed in less time to the users.

Component-based development, machine learning and monitoring measures for smart healthcare systems using Artificial Intelligence

The research focus concentrates on component-based development, machine learning and monitoring measures for smart healthcare systems using Artificial Intelligence. The component-based method targeted to detect various frauds obtaining in credit card-based systems, insurance systems as well as various classification of power distribution systems. The works recapitulates the critical investigation of prediction methods and classification on stages of disease and techniques to identify the patient's survival in terms of heart rate and lung nodule detection. Estimation of heart rate, detection of lung nodule feature extraction using improved machine learning algorithms and recent methods in artificial intelligence that supports convolutional neural network and artificial neural network classifier methods are the key research domain area.

Secured Traceability System in Agri - Food Supply Chain using Blockchain

Blockchain Technology

Blockchain is a distributed ledger that keeps records of all the transactions with the capabilities like trustworthiness, and security. The proposed system caters food farming traceability with agricultural product and farmers that employs the block chain technique and ensures at par security, consensus, distributed ledger, quick settlement and decentralization, thus achieving the goal of minimizing the cost incurred in the food processing system and building trust. Smart contracts play a pivot role in the field of agricultural insurance. Agricultural insurance based upon 'block chain' that comprises of major weather incidents and associated payouts enlisted on a smart contract, connected to the mobile wallets with timely weather updates notified by the field sensors and interrelated with data from proximity weather stations would enable prompt payout during any natural calamity such as flood or drought. The Dataset comprises of data pertaining to crops, weather, irrigation and fertilizers. Implementation of block chain

technique in agricultural domain helps in forming trustworthy community amidst the stakeholders. Also, a centralized system which is professionally governed and managed by certain retired officers makes the traceability system more trustworthy. Examination by the Government agriculture department benefits the system in its successful implementation. These professionals can offer wise suggestions to the farmers enabling them to take fruitful decisions.

Objectives:

- To build a well-organized and trust worthy framework for food safety and profit for all departments involved in food supply chain.
- To ensure food safety and smart contracts to farmers
- To guarantee insurance in case of any natural calamities
- To minimize the cost needed in the food processing system
- To give wise suggestion to farmers by Govt. Panel
- To trace the product when the consumer scan the QR code

Application of geoinformatics in flood inundation mapping, modeling, simulation and emergency flood response system

Flood risk assessments are carried out to identify the source of potential flooding, the extent of flooding and the proposed mitigation and protection measures. Flood mapping, modeling and simulation are important for understanding flood risk and hazards. The evaluation and design of flood mitigation solutions will address both current and potential future flood risk conditions. It can also be used to provide flood forecasts, enabling communities to be prepared for and respond to impending disaster. The objectives of the analysis will be preparing of base maps, processing and mapping of all thematic layers to generate flood inundation maps using combination of satellite imageries and GIS environment, flood modeling and simulation using different software, categorization of flood risk zones, field verification and validation of results. Flood wave

arrival timings will be calculated which shows the appearance of the first wave in a cross section of the channel due to high surge of flood water. An emergency flood response system will be prepared using the results as network enabled solution which can facilitate management of post disaster activities caused due to flood, like percentage of area affected, road information, other infrastructure information. It facilitates people to manage the information related to flood during critical flood seasons and analyze the extent of damage. The system can be used in planning and executing emergency response measures using the information in the form of GIS maps and database.

An effective detection and monitoring of Covid – 19 cases using datamining techniques

Covid–19 is a recent non–tolerable disease spread globally by SARS VIRUS which made the life style of humanity upside down. Researchers are applying their efforts to find possible solutions to this issue rapidly. This is the motivation of the proposed research work. This research work focusses in obtaining the symptoms of recently infected Covid–19 patients to identify whether the patient is Covid positive or negative. To perform this research work, datamining has been chosen in which decision tree classifier is selected. The main intention of this research is to make a health provider take better decisions about patient and provide quick solution to mitigate the spread of Covid–19 in the society. A novel decision tree has been constructed using ID3 algorithm after analyzing the real time Covid–19 dataset and hence new decision rules are framed by the proposed work. The same data is analyzed again using Artificial Neural Networks (ANN) for further error minimization which provide better accuracy. This research work also focus on IoT based frameworks for early detection, monitoring and controlling of Covid–19 diseases with better security designs using datamining and machine learning techniques.

Digital Image Processing

The Focussed area of research is **Digital Image processing**. Ii is an emerging and traditional area that is very much supported to machine learning, Deep Learning etc. Image processing is manipulation of an image that has been digitised and uploaded into

a computer. Software programs modify the image to make it more useful, and can for example be used to enable image recognition. Recent researches that is very essential to the society under health care , agriculture are currently pursuing with my research scholars. The numerous applications like Biomedical imaging, Pattern Recognition, image segmentation and classification, Remote sensing, Video analysis, Machine Robot has widely used the digital image processing techniques. Once the image was processed then it was trained either through any machine learning technique or through Neural Network. Hence The*field*of*image processing*has been the subject of intensive *research*and development activities for several decades.

Another Major ongoing research area is **Cloud Computing**. The researches can be make in the education sector, IT industry. Different research problems can be identified and statistical tools can be applied processing can be done under machine learning and finally deploy in the cloud

Cloud Computing: A swanky technology for all

Modern business platform use hybrid cloud approaches and it is very much required to have applications that accelerate performances and improve the efficiency of resources. Since the inception of cloud as a commercial partner in all forms of needs, everybody who lives on earth and beyond is very much depending on frequent updates of infrastructures, which include hardware, software and so on. The blend of data, storage, environments, devices, users, user experiences, user interfaces is demanding new visions which may balance the ecosystem. Hence we need to have strong desire on research to compare the existing approaches and predict the next generation technologies to support the growing business network. Equally threats are growing and the data theft is the new challenge, which has to be prevented. New algorithms will be the next need in every service and utility. Also, it is noted that we could see that Big Data, Artificial and Expert Systems (Machine Learning, Deep Learning), Edge Computing, Fog Computing, Green Computing, Internet of Things are massively a part of cloud. Every application which may involve trade, bank, education, sports, entertainment, governance, finance, power distribution, water distribution, monitoring

systems, travel, transport, tourism, medical, social media, general media, geospatial lives, military, mining, prediction systems, and controller systems is into cloud.

Therefore, data management, process management, resource management, application management, device management, security and protection, protocols for upgraded environments, user interfaces (we may expect much more beyond speech) and user experience management, interoperability and way more management areas are open for new algorithms as the generic and pioneering algorithms are found to have good success stories only in specific and controlled scenarios. Optimization would be the new trend in technical and tech analogical experiments.

Every life on earth and other planets have become tech users and are knowingly or unknowingly a part of cloud system and hence more success stories may be expected in parallel and distributed systems particularly in cloud ecosystem.

DEPARTMENT OF JOURNALISM AND MASS COMMUNICATION

Technological advancements in Mass Communication have unearthed a plethora of research areas. In contrast, the interjection of social media in the path of the evolution of Mass Communication has made researchers work on understanding and analysing its impact on the audience as a priority. As a result, research studies concerning **Social Media** have become the primary area of interest for the Department of Journalism and Mass Communication, College of Science and Humanities. **Media Literacy, Digital Culture, Disinformation, Political Discourse, and Gender Violence** sub-themes the department publications have consistently focused on. The following favoured area of interest in the department has been '**Film Studie**s'. Several scholars have exerted themselves to produce research works on the sun themes of **gender stereotypes and semiotics** behind the films that have made a massive impact on society and the film industry. Apart from these areas, **broadcasting** has always been the area that fascinates the scholars in the department. Some of the vital sub-theme in broadcast includes **Reality shows, News shows and Violence in day to day programming**.

School of Media Studies

The Department of JMC and Department of Visual Communications focuses on:

- Media Literacy
- Digital Culture
- Disinformation
- Political Discourse
- Gender Violence.

Several scholars have exerted themselves to produce research works on the sun themes of gender stereotypes and semiotics behind the films that have made a massive impact on society and the film industry. Apart from these areas, broadcasting has always been the area that fascinates the scholars in the department. Some of the vital sub-theme in broadcast includes Reality shows, News shows and Violence in day to day programming

School of Languages

The Language Departments focus on the following research areas.

- Linguistics
- English Language Teaching
- Gender Studies
- Women Studies
- Film Studies
- Consciousness studies
- Culture Studies
- Heterogeneity
- Ethnography
- Anthropology
- History of Tamil Grammar
- History of Tamil Editions
- Modern Literature
- Ancient Literature

Ramapuram Campus

Name of the Department: **Department of Biotechnology (B.Sc.,)**

THRUST AREA: **BIOTECHNOLOGY FOR GREEN ENERGY**

The world confronted with the energy crisis and pollution from fossil fuels and plastics. It is necessary to develop faster growth rate with increased level of lipid and high value lipid producing strains. Heterotrophic cultivation of strain possibly produces some positive results, but still the development is needed to make efficient strains. The purpose of the project is to develop efficient microalgae and cyanobacteria strain, which could produce more targeted compounds under stress condition and genetic manipulations. Also, the efficient strain could be suitable for producing high-value lipids in large scale. The metal based stress induction studies are very limited. In this study it is proposed to synthesize of iron doped metal oxides for improve cell growth and targeted compounds in microalgae and cyanobacteria. To study the morphological changes, protein expression and DNA sequence. The stress tolerant strains are further improved by gene knock out of specific gene and over expression of targeted gene will bring more specific results in this field, which could be the future for lipid and high value lipids.

Name of the Department: **Department of Computer Science & Applications (MCA)**

THRUST AREA: **DATA ANALYTICS**.

Sentiment Analysis is the active research in the field of NLP (Natural Language Processing) which understands the languages used in social media and uncovers the sentiment behind it to extract valuable business insight. The sentiment analysis framework developed in this research encompasses three models such as Skip-Gram Hierarchical Softmax Model, Sentiment Polarity Prediction Model, Named Entity Extraction Model and Automatic Reviews Summarization Model. This framework enables to understand the people’s behavior and attitudes to make effective decisions for business services. Skip-Gram Hierarchical Softmax Model is designed for better word representation. The parameters of skip gram model are fine-tuned to improve the accuracy in the feature extraction process. This encoder-decoder model aims to

generate a summary in an abstractive way. For comparative analysis, various benchmark datasets are utilized. The efficiency of the proposed approach is analyzed using different metrics such as accuracy, precision, recall, F-measure and Recall-Oriented Understudy of Gisting Evaluation (ROUGE).

Name of the Department **– Department of Computer Science (B.Sc.,)**

THRUST AREA - **TRUCK LOAD OPTIMIZER**

The application was planned to optimize the implementation logic to accommodate the items into the containers with the optimized manner comprising of specific size and provide the end result with best matching and better usage of spaces and boxing methods. The grouping of items based on the delivery geographic location, dimensions of the items and the weightage of the items was taken into consideration. We develop a new heuristic algorithm using novel heuristic rules and a dynamic data structure to mimic human intelligence, thus providing a new solution approach to 3-D pallet packing. Comprehensive empirical testing, to include new methods for generating problems with known optimal solutions, demonstrate that our algorithm achieves pallet volume utilizations comparable or better than the best-known solutions, while finding these solutions very quickly. Computer-independent complexity results were achieved. Heuristics produce results by themselves, or they can be used in conjunction with optimization algorithms to improve their efficiency (e.g., they may be used to generate good seed values).

Medicine

SRM Medical College

The Dept of Pharmacology & Dept of Clinical Pharmacology at SRM Medical College are actively involved in collaborative regulatory & academic clinical trials in drug development for several diseases. Some of the thrust areas are mentioned below.

A. Research on Vaccines

Vaccines are a heterogeneous class of prophylactic medicinal products containing antigenic substances capable of inducing *specific*, *active* and *protective* host immunity against an infective agent or toxin, or against other important antigenic substances produced by infective agents.

- Vaccines demand special consideration because:
    - Vaccines are given to healthy individuals, mostly children and infants.
    - Vaccines are given to prevent disease; this limits tolerability of adverse events.
    - Vaccines are biological products which are highly complex substances derived from living materials, and sometimes comprising living organisms. They require specialized assays and testing to assure their quality and safety on a lot-to-lot basis.

Clinical development on vaccines

- **Phase I**
    - Early studies with human subjects
    - Explore the safety, immunogenicity of multiple dose levels of vaccine under development
- **Phase II** – Assess the safety, immunogenicity
    - Early efficacy of selected doses of the vaccine
    - Generate hypothesis for later testing

- **Phase III**
    - Large scale
    - Confirm efficacy of the vaccine in target population
    - Proves consistency in manufacturing process

Vaccine clinical trial at SRM MCH&RC

Since 2014, clinical trials on vaccines are conducted at SRM MCH&RC. Phase III trials of ROTAVAC vaccine, pentavalent vaccines, have been conducted.

Recently,COVAXIN™, India's COVID-19 vaccine by Bharat Biotech is developed in collaboration with the Indian Council of Medical Research (ICMR) - National Institute of Virology (NIV). This inactivated vaccine is developed and manufactured in Bharat Biotech's BSL-3 (Bio-Safety Level 3) bio containment facility. COVAXIN™ is a highly purified and whole virion inactivated SARS-CoV-2 vaccine (BBV-152), manufactured in a Vero cell manufacturing platform.

The Phase 1 Clinical trial of BBV152

In a Phase 1 placebo-controlled, double-blinded clinical trial, an inactivated SARS-CoV-2 vaccine (BBV152) was evaluated in 375 subjects.

The Phase 2 Clinical trial of BBV152

In a double-blind, randomized, multi-center, phase 2 clinical trial a total of 380 healthy children and adults were randomized to receive two vaccine formulations (n=190 each) with 3 µg and 6 µg with Algel-IMDG. Two intramuscular doses of vaccines were administered (four weeks apart).

ICMR- Phase 3 trial of COVAXINat SRM MCH&RC

The phase 3 trial is going on at SRM MCH&RC which is one of the largest efficacy trials of COVID vaccines in India. SRM MCH&RC got a sanctioned budget of Rs 1,01,74,075 from ICMR for the phase 3 clinical trial.

Other proposed COVID vaccine studies

1.Serum Institute, ICMR-NARI (Indian Council of Medical Research National AIDS Research Institute) -COVOVAX study.
2.Astra Zeneca COVID vaccine candidate AZD1222 for its study in India. But this study was not initiated in India by Sponsor.
3. A Phase III clinical trial of meningococcal vaccine
4. A phase III clinical trial of recombinant BCG vaccine on COVID-19 contacts
5. A Phase III clinical trial of Sanofi-GSK covid vaccine trial
6. A Phase III clinical trial of covid vaccine by Genova pharmaceuticals

B. Gestational diabetes

Gestational diabetes mellitus (GDM) is a serious pregnancy complication, in which women without previously diagnosed diabetes develop chronic hyperglycaemia during gestation. In most cases, this hyperglycaemia is the result of impaired glucose tolerance.

The department of OBG are involved in many areas like screening methods, corelation with endocrinological conditions, any pathophysiological factors of GDM etc.

C. **Cardio-pulmonary diseases:** The association of a dietary metabolite TMAO with coronary artery disease is being studied. We are also evaluating the efficacy of an anti platelet agent aspirin, a drug that is widely used in cardiovascular disease prevention and anti-inflammatory agent colchicine in the prevention of progression of COVID -19, which is a multi-centric clinical trial. A multimarker strategy to prognosticate patients with acute coronary syndrome has been evaluated in order to identify patient who are at a high risk of recurrent major adverse cardiovascular events following an initial acute coronary event. A registry of patients with acute heart failure involving seven sites from different parts of the country is in progress. A registry in patients with COPD with 9 centers across India is also ongoing. The above studies are done in collaboration with investigators from general medicine, pulmonary medicine and cardiology

D. **Surgical trials**: Novel medical devices to help patients undergoing surgery to improve hemostasis and improve wound healing are being investigated. The efficacy of a novel absorable hemostat powder is being compared with the gold standard for achieving hemostasis among patients undergoing intra abdominal surgery. A clinical trial is underway to evaluate the clinical efficacy and safety Of Theruptor Surgical Wound Dressing In Comparison With Tegaderm of 3M and Plain Gauze dressing on Wound Healing In Patients undergoing abdominal surgeries. Another trial seeks to evaluate Theruptor Sterile Barrier Wound Dressing In Comparison With Bactigras of Smith & Nephew and Allevyn of Smith & Nephew on Wound Healing in Patients With Chronic Infected ulcers. The above studies are done in collaboration with investigators from general surgery

E. **Adenomyosis:** Adenomyosis is a condition that affects women of all age groups, but more susceptible in the age group of 35 to 50 years. Patient presents with dysmenorrhea, abnormal vaginal bleeding, dyspareunia. There is no effective medication available in the management of this condition. We are currently undertaking a study to evaluate the effectiveness of a novel medication cabergoline in relieving the symptoms of the disease. We have also performed a systematic review to evaluate the drug therapy of adenomyosis and endometriosis. The above studies are done in collaboration with investigators from obstetrics & gynecology.

SRM School of Public Health (SPH)-

Background

Public Health is multi-disciplinary and more social than medical. It is more about prevention than cure. Public Health is dependent on Planetary Health. i.e., the ‘health’ of biodiversity, natural resources (air, water, soil) and communities affects individual health. The sustainability of human race is dependent on the planet’s sustainability.

Vision of SPH:	Leadership for equitable, sustainable and holistic health
Scope of research at SPH:	University level to global; individuals to populations
Kinds of public health research:	Cross-sectional, longitudinal, interventional, or observational studies
Investigators:	SPH Faculty (9 nos), PhD and PG students, partners
Funding:	External funded (ICMR, AYUSH, MoHFW, TN Govt) and a few non-funded research projects
Themes:	SPH's research focus are broadly on **Wellness**, **Planetary Health** and **Sustainability**.

The research projects at SPH have been shaped by the vision, faculty / student interest and opportunities. They have been categorised under the following thematic areas:

1. UNIVERSITY WELLNESS PROGRAM

The University Wellness Program (UWP) is a pioneering and novel pedagogic approach, launched by SPH in Nov 2019, with the aim of equipping students with technical and leadership skills to achieve wellness and campus sustainability. i.e., UWP is a platform that facilitates the students to design and implement multi-disciplinary research and action projects that address campus related challenges. In the process, they acquire the necessary soft and technical skills to solve real-life problems. The durability of UWP is secured since the projects and activities are explicitly linked to existing curricula and evaluation system of the university.

The UWP projects have been on various aspects of wellness of students and faculty, such as, mental wellbeing, and environmental issues such as water quality, bio-hazardous waste, and air quality. Students, guided by faculty, have identified SRM students' wellness status (physical, mental), the wellbeing needs, and recommendations. Since its inception, ~20 student research projects have been completed and benefiting > 200 students.

In 2021, UWP spread to other departments like Depts of Computer Science Education, Visual Communication, Psychiatry, Clinical Psychology, and Student Affairs. UWP core

committee and sub-committees have been formed to address the different aspects of UWP in a focused manner.

Future Plan: UWP Consolidated plan for SRMIST; UWP collaboration with other universities; securing external funds.

2. PLANETARY HEALTH

Issues of Global Warming and Climate change are here and now, and it is imperative that institutes of higher learning like SRMIST get engaged in bringing out appropriate solutions to tackle them. Anthropocentric activities have caused climate change, which in turn is not only damaging planetary health but is also affecting public health. Shutting down of schools currently (November 2021) in India's capital due to air pollution causing severe breathing, is only a harbinger of difficult times ahead because of our unsustainable ways.

Planetary Health research is an immense opportunity for developing green solutions. SPH faculty and students aim to collaborate and develop innovative ideas and sustainable solutions for our planet and health. SPH is a member of the Harvard University initiative called the *Planetary Health Alliance* and is conducting various student research projects on water and environmental pollution, especially on campus and in the UBA villages.

Future Plan: SPH has signed an MoU with the National Institute of Advanced Studies (NIAS, Bangalore), to conduct a multi- disciplinary research work on Planetary Health. In addition, with the support of Indian Institute of Remote Sensing (ISRO) we are conducting various training programs on Remote Sensing and GIS and its application on Planetary Health, to prepare young researchers. SPH is in the process of signing an MoU with the National Institute of Disaster Management (NIDM) for conducting research and training programs to identify, model and mitigate disasters. We are yet to secure external research funds for this theme.

3. HEALTHY AGEING

Ageing is often misconstrued as being the same as 'becoming old'. On the contrary, it is a process that begins at birth. Healthy ageing results from developing and maintaining functional ability of the body for well-being in older age. The foundation for good health in old age is laid in childhood.

India's current demographic profile is favourable when compared to developed countries, with a higher proportion of young population. However, in a couple of decades, the demographic transition will lead to one in five being an elderly who are likely to live longer but with non-communicable, chronic diseases, especially in states like Kerala and Tamilnadu. This translates to soaring expenditure and a heavy burden on the healthcare system. Therefore, it is crucial that we pay attention to the good health and wellbeing of children and the youth right away, and address issues of the elderly, in parallel.

SPH has been conducting research for a decade on various domains of wellbeing among children, adolescents, and the elderly.

SPH successfully completed the prestigious government funded project including Integrated Child Development Services (ICDS) project to provide health status on various development indicators of children in Tamilnadu.

SPH has also completed the funded project National Family Health Survey-5 for TN and Puducherry, from the Ministry of Health and Family Welfare, Govt of India. This project is large not only in terms of the budget (~Rs. 9 Cr) but also in terms of its operations, wherein we needed to collect data on the demographic and health status of > 15000 households (men, women and children) sampled across all districts of TN and Puducherry. NFHS data acts as reference for researchers, governments and policy makers for any interventions and projections.

(i) Child Health

The Centre for Child Rights, an initiative taken by the Pro-Chancellor (Academics) along with Satyarthi Foundation, is being operated under SPH, with Dr. Kalpana (Assoc Prof, SPH) as the in-charge. Research on children's health, rights and developmental issues will be an important part of the centre.

SPH has undertaken research to study the physical and mental wellbeing status of children. Emotional health is the hallmark of the healthy mental status of children. Its significance in education promotes children's performance in schools. 2 PhD students have registered on the topics 'Emotional Intelligence' and 'Sensory Gardens' for children. One ICMR research project is ongoing to study the stress level of university students in Chennai and to develop a strategy to let to let go.

Future Plan: We plan to focus on the emotional health of children from especially difficult circumstances (orphanages, Covid 19, and migration impact etc).

(ii) Geriatric Health

Research conducted by Dr. Jennifer GH for her PhD, guided by Prof. Bagawan Das focused on geriatric depression and suicidal ideation using *Spatial Epidemiology*. It found that neighbourhood environment (distance from facilities, recreation, and offices etc), living alone and poor socio-economic status had a significant impact on geriatric depression and suicidal ideation. This research was the first of its kind in India in the field of *Spatial Epidemiology*. It covered all domains of ageing and developed neighbourhood sampling method for public health research. Currently, research in this area is ongoing on the morbidity profile and social determinants, out of pocket expenditures among the elderly.

Future Plan: To take up projects from Building a knowledge base on population ageing in India (BKPAI) and Longitudinal Ageing Study in India (LASI) surveys and including the Unnat Bharat Abhiyan villages as SPH field station. Due to epidemiological transition, the prominent cause of death and morbidity in Tamil Nadu has shifted to NCDs/lifestyle/degenerated diseases from infectious and maternal/child healthcare issues. We are planning to undertake research in multi-disciplinary research into non-communicable diseases among the elderly population in TN. This will include identification of prevalence, risk factors, out of pocket expenditure, income source and insurance schemes. It will look at policies and gaps in addressing NCDs among elderly.

4. TRIBAL HEALTH

Since inception SPH has focused on *Tribal Health*, particularly of Malayali Tribes, with the intent of understanding the health of the underrepresented population through various completed and ongoing projects.

- UNICEF Funded "Thalassemia Screening and Genetic Counselling for Tribal populations in Sitteri Panchayat" (completed)
- Rotary International funded "Screening for Thalassemia and Genetic Counseling for Tribal populations in Sitteri Panchayat" (completed)

- “Estimate the burden of TB among the tribal population and develop an innovative health system model to strengthen TB control in the tribal areas (completed; fresh proposed)
- Assessment of Childhood Injury and establishment of ‘Mobile-based community child injury surveillance system’ (m-CCISS) among Tribals in Dharmapuri district, Tamil Nadu (completed)
- Quality of life of Tribal People: Development of Individual, Household and Community based Multi-factor Indices

Currently, we have 2 ongoing ICMR Projects that are dedicated to tribal Health:

- SPH is part of the National Tribal Task Force for study on Hemoglobinopathies and G6 PD Deficiency among Tribes of Tamil Nadu, with SPH focusing on the Malayali, Kurumans, and Irula Tribes of Dharmapuri.
- An exploratory study on establishing a Public-Private Partnership to increase the Hep-B vaccination level among Irula Tribes in Tamil Nadu.

Also, we have PhD students/ thesis focusing on Tribal Health.

- “The Influence of Family Social Capital on Health Status of Children Diagnosed with Thalassemia among the Indigenous Malayali Tribe, Tamil Nadu” (completed)
- “The Generational Evolution of Wellness Perceptions and Practices among the Tribes of the Nilgiris” (ongoing)

Future Plan: We are ideating to a establish a ‘*Center of Excellence in Tribal Health’* situated at Kotagiri, TN. The aim of the CoE on Tribal Health is to 1) To establish a field level center for conducting Public Health research 2) to understand and leverage local health traditions for sustainable wellness 3) to translate research findings to craft policies to address disparities at the governance levels and 4) Collaborate with local NGOs and provide culturally relevant support and interventions.

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College of Occupational Therapy

Our major areas of research:

1. Sensory Integration
2. Autism
3. Virtual reality-based intervention for the disabled population

1. Sensory Integration:

The prevalence of sensory processing disorder(SPD) issues is reported to be around 1 in 20 to 1 in 6.25 children in the US general population (Ahn et al., 2004; Ben-Sasson et al., 2009), and a more recent study in Finland found the prevalence of sensory abnormalities to be around 8.3% in an epidemiological population of 8-year-old children (Jussila et al., 2020). Children with either SPD can have difficulties with processing sensations from tactile, auditory, visual, gustatory, olfactory, proprioceptive, and/or vestibular systems. Such children are often considered to have challenges in sensory integration (SI), which is the ability of the nervous system to process and organize sensory stimuli in the environment for adaptive functioning (Ayres', 1972). These deficits can affect a child's adaptive behavior, learning, coordinated movements, active playfulness, reading, and arithmetic abilities (Parham, 1998; Bundy et al., 2007). There is no objective assessment tool to measure sensory processing problems and quantify the effectiveness of sensory integration therapy. Currently, we have applied for a funded research project (SERB) with the Electricals and Electronics department, SRMIST as a coinvestigator. Title: **Design, Development, and Validation of User-Adaptive Sensory Integration Room for Children with Autism Spectrum Disorder using IoT and Machine Learning Approach**

2. Autism:

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by persistent deficits in social communication and social interaction as well as restricted, repetitive patterns of behavior, interests, or activities (American Psychiatric Association, 2013). Children with autism have poor eye contact, toe walking, body rocking, hand flapping, poor balance, and uneven pressure while walking, running, etc. There is no objective assessment tool to measure eye contact, balance, etc. currently we have developed an eye-tracking tool with the collaboration of the Biomedical Engineering department, SRMIST, and applied for a patent. Nowadays most of the children have flat food due to our lifestyle and lack of opportunities to walk in the sand during the developmental period in childhood. Due to sensory processing issues, Autism child put more pressure on their foot during walking and running which produce

more deviation/ abnormalities in the leg. I have discussed with HOD, Biomedical research to develop a sensor to identify pressure on Hip, Knee, and ankle joint and muscle force during the walking and running of autistic children. Similarly, we are planning to develop various assessment tools and outcome measures using technology to quantify the improvement of occupational therapy intervention for children with Autism.

3. Virtual reality intervention program for disabled population:

Traditionally, occupational therapists have used mirrors to assist in rehabilitation following a neurological event. Mirror therapy may consist of placing a full-length mirror in front of an individual so that they can receive visual feedback regarding their movement and posture. The theory proposes that when the individual attempts to move both arms to complete a task or exercise, the visual feedback received of the "perceived" impaired arm moving (which is the reflection of the unimpaired arm) will encourage neuroplasticity and the "re-wiring" of brain connections to improve movement following the injury.

When we compare mirror therapy with the current virtual reality trend, it's easy to see how they relate. Virtual reality systems used in rehabilitation provide a virtual image of an individual's impaired arm moving (via the screen) to complete a desired virtual task. This is relying on the same means of visual feedback to help work on motor planning. Couple the relationship between virtual reality and mirror therapy and add evidence supporting mental practice positive influence on improving affected limb recovery and it's easy to see how the therapy world is jumping on these new and interactive virtual reality products. Our 2 PG passed out students have done research to identify the effectiveness of Virtual reality rehabilitation in hand function recovery for stroke. Similarly, the Virtual reality method is useful for pediatric, orthopedic, and neurological occupational therapy rehabilitation. We are encouraging our PG students to take up Virtual reality OT research in the above-mentioned populations.

SRM COLLEGE OF PHARMACY

Thrust Areas

- Department of Pharmaceutics aims to enhance the **solubility, absorption and bioavailability of BCS Class –II, Class – III drugs** and focused on **developing Novel drug delivery systems, Transdermal drug delivery systems, Nano-carrier based targeted drug delivery systems and Herbal formulation development.**
- Department of Pharmaceutical Chemistry is actively involved in **the isolation of natural product, herbal formulations for PCOS and development of novel anti-inflammatory, Anti-cancer, Anti -TB agents.**
- Department of Pharmacology involves pre-clinical testing of natural products wherein the screening of natural compounds for various categories such as **Nootropics, Anti-inflammatory and Nociceptives, Hyperlipidemic, Hypoglycaemic agents.** Pharmacological *in-vitro* and *in-vivo* Pharmacological screening including toxicity testing of novel natural bioactive molecules as per OECD guidelines involving **In vitro technique development** serving as replacements of in vivo animal models, development of specific bioactive substances which can be employed to improve the nootropic functions, **Studies of bioactive molecules on experimentally induced diabetes, and its implications in animal models**.
- Department of Pharmaceutical Analysis involves **method development and validation of pharmaceutical formulation, Stability studies of Pharmaceuticals, Impurity Profiling of Pharmaceuticals, Bio analytical method development and validation.** Artificial Neural network (ANN) implemented method development and validation Green chemistry implemented Analytical Techniques, **QbD Approach** of method development and validation, Herbal drug standardization
- Department of Pharmacognosy involves proper identification and evaluation of crude drugs from natural sources ultimately ensuring the **purity, safety, and efficacy of natural drugs.** The **macroscopical, microscopical and physico-chemical standardization parameters in accordance with the guidelines given by the World Health Organization (WHO) along with bioassay guided fractionation of plant extracts** particularly, chromatographic separation is yet

another promising thrust area that can lead to isolation of therapeutically active molecules.

- Department of Pharmacy Practice involves Clinical research as a specialty area of patients to assess the safety and effectiveness of the drugs. Current thrust areas of research includes **Drug-herb interactions, Pharmaceutical care, Renal diseases, Metabolic disorders, Respiratory disorders, Clinical Pharmacokinetics, Clinical toxicology** and antibiotic stewardship.

SRM College of Physiotherapy

Cardiorespiratory

Thrust areas of research in cardiopulmonary physiotherapy focuses on cardiopulmonary variables, treatment of post covid patients, breathing pattern disorders, patient education, lifestyle modification apart from cardiopulmonary rehabilitation. The research in patient education, breathing pattern disorders, lifestyle modifications involve in primary prevention of cardiopulmonary disorders. Below are the details of the ongoing research topics:

- The effect of Ball and Balloon exercise in treating risk of injury among University level athletes with breathing pattern disorder.
- Evaluation of feasibility and acceptability of an evidence-based patient education booklet in Tamil for people with knee osteoarthritis.
- Peripheral muscle weakness in post Covid 19 patients- A case control study.
- Association of gastrooesophageal reflux disease and diaphragmatic function.
- Heartrate variability among post Covid 19 patients and non-infected are matched individuals.
- Predict the musculoskeletal injuries in young skaters using Functional Movement Screen.
- Prevalence of sleep apnea in obese school going children.
- Evaluation of cardiovascular endurance using six-minute walk test among post covid 19 diabetic population.

Orthopaedic Physiotherapy

- Effect of Hip rotation in low back pain - Previous research had examined the effects of back pain on spinal movements; coordination between the lumbar spine and hips, but studies on effect of hip rotation in chronic low back pain was limited.
- Effect of Glutei muscles in osteoarthritis of knee - Research on hip osteoarthritis is prevalent but its compensatory effect and tightness on weight transference of knee is limited.
- Recent Physiotherapy techniques, effects of prosthesis, functional dependence and quality of life in Bilateral Above Knee Amputation - Evidence on stump management, bandaging, transfers, weight bearing and prosthesis is available but application of recent techniques for functional mobility is limited.
- Impact of tibial rotation in knee, hip and pelvis – Tibial torsion can be congenital or acquired due to abnormal posture of lower limb. Its effect can lead to serious effects in joints and can cause joint effusion and affect mobility.
- Importance of hamstring muscle flexibility to prevent musculoskeletal disorders in lower limb – Hamstring tightness starts from childhood and is present in almost 90% of population and it is one of the causes for various musculoskeletal disorders from spine to foot. So there is a need for the topic.
- Patient education on chronic musculoskeletal pain
- Exercise on chronic pain
- Exercise on Inflammation
- Exercise on sarcopenia in metabolic disorder
- Functional electrical stimulation in Neurological disorders
- Electrical stimulation in Dysphonia and dysphagia
- Electrical stimulation in lower cranial nerve dysfunction
- Neuromuscular Facilitation in Peripheral nerve injuries
- Yoga Therapy for respiratory disorders

- Yoga Therapy for stress reduction
- Yoga Therapy stretching for sports person
- Neuromuscular electrical stimulation for diastasis recti
- Iontophoresis for arthritis disorders
- Research on IASTM- Instrument Assisted Soft Tissue Mobilization techniques for ankle and foot component to enhance the functional ability.
- To enhance the value of hands-on technique among physiotherapy students.
- OSTEARTHRITIS (Knee) - formulate an **individualised therapy protocol** to enhance the lifestyle of an individual.

Systemic illness is a common condition experienced by most of the person in day to day life. Musculoskeletal involvement is more common among them. Person with thyroid dysfunction usually have several musculoskeletal manifestation such as Carpal tunnel syndrome, Trigger finger, reduced mobility. It is always to be noted that person with musculoskeletal condition must be ruled out for thyroid dysfunction as physiologically thyroid hormones play a role in growth of tissues and have an impact on O_2 consumption. They greatly contribute to metabolic rate. Since there are several concepts that are dealt with insulin deficiency and musculoskeletal condition, Thyroid dysfunctions must also be considered with the musculoskeletal manifestation. It is greatly in need to address these types of concepts in accordance with BioPsychosocial model to formulate specific protocol which will help in improving the quality of life.Apart from the above, emerging focus is on hardware and software design for rehabilitation research as an interdisciplinary approach, orthopaedic biomechanics and tendon rehabilitation lab.

- Limb length discrepency among school going childrens
    - In this the literature is less ans interested to concentrate more.
    - It also helpful to do correct the problem in early phase.
- Appropriate wheelchair modifications for the para athelete players.

- Most of the para athelete are not using the appropriate wheelchair.
- Due to this their performance will be affected.
- Their respiratory muscle easily goes for fatigue.

- Less weight assistive transfering device for the elderly aged group.
    - In india, the transferring devices are more weighted.
    - Also expensive.
    - Main aim to provide the transferring device with cost effective.
- Working on distal muscle groups to initiate the shoulder range of movements.
    - Due to myo-facial chains, activation of distal muscle groups will provide more benefits to initiate the shoulder group of muscles.
- Effect of dry needling technique among scar mobilization.
    - Dry needling technique is an invasive procedure to release the mechanical disruption of motor trigger points.

Sports physiotherapy:

1. The current practices of sports physiotherapist in **implementing psychological strategies during athletes' return to play rehabilitation**, and explore their attitudes and challenges in doing so.
2. Goal setting and encouraging to employ positive attitudes throughout rehabilitation.
3. At present **Para Olympic** games are conducting around the world , **sports physiotherapist in finding the prevalence of musculoskeletal or athletic injuries** are most common **among para athletes** and this research can helpful in implementing the sports physiotherapy strategies during para athletes return to play rehabilitation.
4. There are many athletics injuries common in sports and most of the injuries are not a recurrent , but some of the injuries are even difficult to diagnose like **ATHLETIC PUBALGIA and HIP INJURIES IN SPORTS.** Setting a **research to find prevalence of athletic pubalgia among athletes in INDIA.**

5. **Misdiagnosed Hernia** among sports athletes is one of the threatening injury. Many ongoing researchs finding the associated cause, differential cause and treatment.
6. **Wheel chair modification** to prevent injuries and improve the speed and performance among **Para athletes during games.**
7. Return to sport in non-surgically treated patient with Anterior cruciate ligament injury.
8. **A quick test** and sporting function in knee pain among 10 – 14 year adolescent athletes **(45 sec anterior knee pain provocation test).**
9. Patella plays a majore role in athletes in postural control, if patella tendinopathy occurs in athletes can alter the postural control. **Research on going in Patellar tendinopathy alter the postural control among athletes.** Shoulder plays a major role in overhead athletes, **prevention of shoulder injury programme can be done in athletic association.**

Community rehabilitation

1.Institutional based geriatric rehabilitation
2.Tele Physiotherapy/Tele Rehabilitation
3.Ergonomics for different occupations
4.community fitness training
5.Real time Tele monitoring

Gynaecology

Effect of breastfeeding education among rural antenatal women,System assisted pelvic floor exercises in the management of female stress incontinence, Functional neuromuscular stimulation for coactivation of core muscle in the prevention of stress incontinence, postsurgery rehabilitation protocol standardization for pelvic organ prolapse, antenatal exercise regimes for gestational diabetic, physiotherapy rehabilitation guidelines for osteoporotic postmenopausal women, physiotherapy protocol in treating chronic pelvic pain among women with gynaecological infections and

Tools for analyzing cultural and psychosomatic factor towards sexual function and dysfunction among Indian women are the thrust areas of research in women's health physiotherapy.

Paediatrics

- Two-dimensional analysis of gait parameters on normal and overweight children - an observational study
- Effectiveness of core muscles strength training on dynamic balance among overweight children
- Effect of respiratory muscle training using ultra breathe on pulmonary function in Duchenne Muscular Dystrophy with Tele Physiotherapy.
- Effect of aerobics in hearing impaired children
- Effect of Core exercises on Schizophrenic patients
- Effect of suboccipital muscle release technique in Trinitus
- Correlation of Neck posture and Temporomandibular joint disfunction
- Effect of Lifestyle modifications on physical fitness in overweight children.
- Evaluation of feasibility and acceptability of an evidence-based patient education booklet in Tamil for people with knee osteoarthritis
- formatting an assessment tool to enhance the etiology behind hand function among Indian children.
- User friendly measurement tool for monitoring the respiratory mechanism for paediatric population. This idea will help out the therapist to analyze the child better and progress with proper exercise regime.
- In oder to enhance the educational technology, understanding the students better, we are in a process of finding out the learning style and academic skill performance. Psychological and behavior aspects of the student have to be observed for bringing out the good outcomes.

Neurological physiotherapy

Thrust area of research in Neurological physiotherapy is in Motor Relearning, Physical Activity Promotion in Neurological Patients, Telerehabilitation, Robotics in Neurotherapy and Systematic Reviews

Virtual reality for the treatment of motor impairment is a burgeoning application of **digital technology** in neurorehabilitation. Virtual reality systems pose an opportunity for health care providers to augment the dose of task-oriented exercises delivered both in the clinic, and via telerehabilitation models in the home.

New promising interventions to improve **rehabilitation** outcomes such as **virtual reality** (VR)-based interventions have been developed. Using various technical devices (e.g., head-mounted displays, desktop computers, video capture systems, tracking systems, motion-sensing gloves), **VR** delivers realistic experiences by creating virtual environments (VEs)

In the recent years, new technologies have been suggested to enhance the effectiveness of neurorehabilitation include robotic – assisted training, virtual reality, functional electrical stimulation, non - invasive brain stimulation to enhance the intensity and quality of neurorehabilitation by manipulating brain excitability and plasticity.

There are limited efficacy in addressing bradykinesia in Parkinson's disease. Bradykinesia has important consequences on daily living activities, difficulty in dexterous activities, impaired coordination, problem with energy expenditure and quality of life.

Adaptive training with full – body movements using Microsoft kinect movement sensor to reduce bradykinesia in Parkinson's disease.

Biomechanics

1. Emerging technological developments that are applicable to movement analysis for biomechanics. The technologies could therefore provide opportunities to increase the ecological validity of the measurement obtained in biomechanics practice (research, applied).

2. Occupational biomechanics or ergonomics,work place analysis to prevent early degeneration and work stress by modifying the environment.
3. Kinetic and Kinematic analysis of sports activities and functional training, to find out the malalignments and rectifying or preventing the complications.
4. Making of sensors or devices for assessment or a part of treatment.
5. Role in prosthetic and orthotic rehabilitation.

Dental

DENTAL COLLEGE

Department of Oral and Maxillofacial Surgery

1. Research Topic 1: Qualitative And Quantitative analysis of Platelet derived growth factors from PRF, I-PRF and A-PRF at varying time intervals.

2. Research Topic 2: Versatility of Injectable Platelet Rich Fibrin as an Adjuvant in Maxillofacial Surgical Procedures.

Platelet products such as PRP & PRF has been used as an adjuvant in maxillofacial procedures since the mid 90's. Due to the increased availability of regenerative cells, PRF in considered to be a better material in tissue engineering. PRF was introduced by Sir Joseph choukroun in the year 2001.

PRF is a technique in which platelets from participant's own blood are isolated to create and concentrate which is injected (with one's own plasma) into the damaged tissue to aid in better and/or faster healing. It contains various platelet derived such as PDGF, IGF, VEGF, etc.

The numerous other preparation of PRF are S-PRF, A-PRF, L-PRF and I-PRF. In the spectrum of PRF based derivatives Injectable Platelet(PRF) is relatively a new entrant in both validation as well as application in regenerative medicine. The Quantification of the difference in the centrifugation speed of I-PRF lacks literature evidence which has driven us to work on two objectives. We are currently working on these two studies

First Objective: Qualititative and quantitative analysis of release of PDGF from PRF, A-PRF & I-PRF in varying time intervals which is an enzyme linked immunosorbent assay (ELISA) done in association with department of Biotechnology, CV Raman research park, SRMIST.

The second objective - Versatility of Injectable Platelet Rich Fibrin as an Adjuvant in Maxillofacial Surgical Procedures.

This is one of the research proposals currently undertaken by our department. Ongoing research in the

Department of Oral Pathology

3. Research topic : A Novel Approach to Delineate Oral Squamous Cell Carcinoma Margins using Terahertz Imaging and Spectroscopy Globally, oral cancers are the sixth most common type of cancer with India contributing to almost one-third of the total burden and the second country having the highest number of oral cancer cases. Tobacco consumption including smokelesstobacco. betel-quid chewing, excessive alcohol consumption, unhygenic oral condition and sustained viral infections that include the human papillomavirus are some of the risk aspects for the Incidence of oral cancer. Currently, in medical laboratories, Histopathological examination and cryosection is said to be one of the gold standard protocol practised. Since these techniques involve longer time span (say 48 hours) for the arrival of pathologist results and due to manual error and false negative results, there is a need for a device to diagnose the resected margins rapidly and accurately.

The novelty of this research focuses on the Terahertz pulsed Time Domain Spectroscopy application of fresh and formalin fixed oral tissues. The use of the terahertz spectral imaging technique has the potential to become an important tool or Imaging and detection of oral cancer. The technology can also be used as an auxiliary means to diagnose pathology. This approach is quick and fast and has a wide variety of applications in the medical field.

With new technological rise such as terahertz Imaging and spectroscopy, it is possible to achieve them and will be of great use to the patient in preventing the

precancerous lesion to cancer and to reduce the recurrence of cancer after surgery by accurate clearance of margins.

Department of Paediatric Dentistry

4. Project title: Comparative evaluation of oral and intranasal dexmeditomidine as a sedative agent in 6-11 years old children undergoing pediatric dental treatment procedure. A double blinded randomised controlled trial

The field of paediatric dentistry beholds the greatest challenge in managing uncooperative behaviour in the dental setting. Today modern Paediatric dentistry describes the use of range of drugs as adjuvant to behavioural psychology which should enable the dentist to handle most of unmanageable children. Dexmedetomidine is the most recent agent in this group approved by FDA in 1999 for use in humans for analgesia and sedation. ‘

The aim of the study is to compare and evaluate the effectiveness of oral dexmedetomidine and intranasal dexmedetomidine for children undergoing dental treatment.

The objective of the study is to compare and evaluate the onset of sedation, duration of sedation, working time, time of recovery, and depth of sedation, acceptance of the drug, behaviour changes, adverse effects and overall success.

A total of sixty uncooperative children requiring dental treatment is included in the study. Information to the parents about the risk and benefits of sedation and the study will be explained. After obtaining the Informed consent, participants will be scheduled for preanesthetic assessment by anaesthetist in SRM medical hospital. According to the fitness of the participant the instructions regarding sedation will be given to the parent. Computer generated random allocation sequence with double blinding will be followed. The participant will be admitted prior to sedation and be re-evaluated by the anaesthetist.

On the day of sedation -Participants will be weighed in kg and randomly assigned into one of the following two groups: Group A — 5 ug/kg oral dexmedetomidine & Group B —2 ug/kg intranasal dexmedetomidine.

The study parameters will be evaluated by the investigator blinded to the route, after completion of the treatment and recovery from sedation the participant will be discharged and will be evaluated by the anaesthetist before discharge. The expected outcome of the study is to ascertain the better route of administration of dexmeditomidine by doing so the anxiety and fear will be reduced, the extremes of disruptive behaviour can be minimized thus promoting a positive psychological response to treatment.

Department of Orthodontics

5. Project title: Evaluation of surface structural changes and Anti-Bacterial effect of silver, zinc oxide and titanium oxide nanoparticles coated orthodontic stainless steel miniscrews to that of conventional stainless steel miniscrews - An invitro study.

Temporary anchorage devices (TADs) are used in orthodontics as a tool for complete anchorage.For every movement of a tooth in the desired direction, an equal and opposite force is distributed to the anchoring teeth, creating the potential for unwanted tooth movement, this kind of loss of anchorage can be controlled by using TADs

Microbial aggregation around dental implants can lead to loss/loosening of the implants. Ag, ZnO and TiO coated miniscrews are used to avoid microbial aggregation.Several factors including osseointegration at the bone-implant interface and the amount of bacterial colonization around the implants influence the final characteristics and outcomes of dental and orthodontic miniscrews.

6. Project title: Assessment of corrosion resistance of copper nickel-titanium and stainless steel archwires in three different mouthwashes – An vitro study

The aim of the study is to assess the corrosion resistance of Copper Nickel-Titanium and Stainless Steel arch wires in three different mouthwashes.

Various attachments are used during orthodontic treatments which makes dental plaque elimination challenging. This plaque accumulation can gradually lead to periodontal problems like gingivitis as well as dental caries. To prevent these periodontal problems and decalcifications around the fixed appliances, during orthodontic treatments various mouth rinses are suggested. But the long-term use of these mouthwashes can lead to a risk of corrosion in the orthodontic wires. Total sample size = 40 arch wires (20 – Copper Nickel-Titanium and 20 - Stainless-Steel arch wires) Wires will be divided into two groups of Copper Nickel_Titanium arch wire of the dimension 0.016” and Stainless Steel arch wire of the dimension 0.016” x 0.022”. All the wires utilized will not be under any mechanical deformation during the corrosion tests. The Cu NiTi and SS wires will be immersed in Distilled water (control group), Chlorhexidine mouthwash, Fluoride containing mouthwash and betadine mouthwash. The wires will be immersed in 100 ml of each mouthwash which will be kept in a petri dish. The distilled water samples will serve as control. All samples will be immersed for 1.5 hours. This immersion time is equal to three months of 1-min daily mouthwash application. A potentiostat (R-600, Gamry instruments) will be used to perform the potentiodynamic tests for corrosion analysis. The potentiodynamic polarization curves will be obtained from - 500 mV toward the anodic direction, with a scan rate of 1 mV/s and a final voltage of 1500 mV. The surface of the CuNiTi and SS wire after corrosion testing will be observed using a SCANNING ELECTRON MICROSCOPY ANALYSIS, to characterize the topography of the wire surface changes.

7. Project title: Evaluation of ion release from nickel-titanium and stainless steel orthodontic archwires on exposure to various mouthwashes – an in-vitro study

This is an in-vitro study which has been done to assess the release of nickel ions from Nickel_titanium and chromium ions from stainless steel (SS) orthodontic wires on exposure to povidone iodine mouthwash, Chlorhexidine mouthwash, fluoride mouthwash and distilled water.

Methods: The study was done on Stainless steel and Nickel-titanium orthodontic arch wires. The samples were immersed in the various mouthwash for 1,6,12,24, and 168 h. Atomiv adsorption spectroscopy analysis was used to assess the release of

nickel ions from Nickel_titanium and chromium ions from stainless steel (SS) orthodontic wires.

SRM COLLEGE OF NURSING

1.Adolescent Mental Health

Introduction

- Adolescents need safe, secure and conducive environment in family, school and society for the development of mental wellbeing.
- Adolescents are **facing many life challenges** such as changing relationships with peers, new demands at school, family restrictions, and safety issues in their communities.
- Some develop maladaptive patterns in emotional and behavioral spheres if they lack the emotional support from the parents or the care takers

Title of the Study

Relationship of psychosocial stressors with emotional and behavioural problems and quality of life among adolescents in schools.

Objectives

1. To assess the level of psychosocial stress among **adolescents** in schools.

2. To **identify** the **psychosocial stressors of** emotional and behavioural problems among **adolescents** in schools.

3. To assess the **prevalence** of emotional and behavioral problems and level of quality of life among adolescents in schools.

4. To associate the **relationship** of psychosocial stress with emotional and behavioural problems and quality of life among the adolescents in schools.

TOOLS USED FOR ASSESSMENT

- **i)Adolescent life event stressors scale (ALESS) – to assess the psychosocial stressors.**
- **ii) The child behavior check list (CBCL 11-18 YSR) is used to assess emotional and behavioural problems of school going adolescents.**
- **iii) WHO Global School health Survey (GSHS) for India is used to assess the health behaviour of school going adolescents.**
- **Kids screen- 52 items questionnaire to assess the Quality of life among school going adolescents.**

2. Communicable Diseases - COVID19

Collaborative Research Project between SRM College of Nursing,Faculty of Medical and health Sciences,SRM IST and Department of Health Sciences,University West ,Sweden

(Proposal under discussion for refinement)

Introduction

- People with chronic diseases are known to be vulnerable for COVID-19 pandemic. Due to COVID -19, people were panic and was not aware of how, what and whereabouts to prevent the spread of this novel corona (Singh K et al., 2021).
- This study will facilitate the researcher to identify the unexpected health and socio-economic impacts due to COVID-19 related movement control restrictions using qualitative method.

Title of the Study

Patient experiences and perceptions of chronic disease care during the COVID-19 pandemic in India: a qualitative study

Aim: To describe the lived experiences, challenges, coping strategies and socio-economic impact faced by the people with chronic conditions.

Objectives:

- To explore the lived experiences of chronic conditions during COVID-19 pandemic
- To describe the challenges faced by the people with chronic conditions during COVID-19 pandemic
- To discuss the coping strategies used by the people with chronic conditions during COVID-19 pandemic
- To identify the socio-economic impact of chronic conditions due to COVID-19 pandemic

3. Non-Communicable diseases

Introduction

Non communicable diseases are important causes of mortality and morbidity in India. Intensive public health effort required to increase its awareness, treatment and control .

UN sustainable Development Goals highlight the importance of high rates of hypertension control for achieving target of 1/3 reduction in non communicable disease mortality by 2030.

The vast majority of Indian's population [70%] lives in rural areas. Screening for diabetes is seldom done in rural areas, resulting in a much greater burden of undiagnosed diabetes in rural areas.During recent years the important role of education regarding,Diabetes mellitus self management has been demonstrated by numerous studies.

Title of the Study

A study to assess the prevalence and impact of need based intervention on health behavior towards Non Communicable diseases among selected villages in Madhurandhagam block

OBJECTIVES OF THE STUDY:

1.To assess the prevalence of Non Communicable diseases

2.To determine the impact of need based intervention on health behaviour towards Non Communicable diseases

3.To associate the post test level of health behaviour towards Non Communicable diseases with selected demographic variables in study and control group.

TOOLS USED FOR ASSESSMENT

Section A:

It contains Socio demographic variable, clinical variable and bio-physiological variable

Section B:

It contains structured questionnaire with 25 items related to causes, signs and symptoms, diagnosis, complications and prevention of Hypertension

Section C:

It contains structured questionnaire with 25 items related to causes, signs and symptoms, diagnosis, complications and prevention of diabetes

Section D

It contains checklist with 15 items on practices of diabetes and hypertension

4.Maternal Health

Introduction:

- Diabetes is the ninth leading cause of death among women globally causing 2.1 million deaths per year.

- A pregnancy complicated with GDM causes physiological resistance of insulin which predisposes for maternal (pregnancy induced hypertension, macrosomia and obstructed labour due to shoulder dystocia) and foetal (macrosomia, birth injuries, hypoglycaemia, respiratory distress) complications associated with the GDM.
- *Given the complications associated with GDM in South India, the study hypothesize that probiotics supplementation as an adjunct therapy with comprehensive intervention, would pave way for a considerable improvement in maternal glycaemic control in women with GDM (Novel idea).*

Title of the study:

- Effect of Probiotic Supplementation on Glycaemic Control in women with Gestational Diabetes Mellitus (GDM) – Study Protocol for a Randomized Clinical Trial

The study objectives:

- Primary objective: 1. To assess the effect of maternal-probiotic supplementation in glycaemic control among pregnant women with GDM by:
  i. Biochemical measures: Blood glucose levels (Fasting blood glucose, post prandial blood glucose), HbA1C and fecal sample
- Primary objective: 2 . To assess the effect of maternal-probiotic supplementation on maternal parameters:
  i. Clinical variables:
  a) Maternal: weight, mode of delivery, preterm delivery, perineal tear, and co-morbidities like PIH, hydramnios and Vaginal infections.
- Secondary objective: 1. To assess the effect of maternal-probiotic supplementation on neonatal parameters:
- Clinical variables:
  a) Neonatal: birth weight, congenital malformations, birth injuries, shoulder dystocia, hypoglycemia, admission to neonatal intensive care.

Expected outcomes:

- Probiotic supplementation is one of the emerging trend that shows significant impact on maternal blood glucose levels, which will in turn have beneficial effects on maternal and neonatal morbidity and mortality.
- In a developing country like India, with growing burden of diabetes and GDM, developing an innovative effective intervention that promotes glycaemic control that can easily be replicated across various settings will become a priority.
- If the intervention is proven to be effective, this study would become a guideline model to reinforce probiotic as intervention to prevent and treat gestational diabetes mellitus and contribute to improved maternal and neonatal health in South India.

5.Child Health

Introduction:

- 180 million children in need of care and protection 2012 data
- 34,000 children are in conflict with the law
- Tamil Nadu there are 400,000 institutionalized children
- Totally 293 observation homes all over India • Totally 8 observation homes and 9 special homes are in Tamilnadu.

- These numbers acts as an awakening call to the researcher to provide reformative services including education, skill development, counselling, behaviour modification therapy, and psychiatric support during the period of stay in the Special Home.

Title of the study:

- Efficacy of a Combined Intervention Program (CIP) on health promotion outcomes among Vulnerable Adolescents residing at Out of Home Care Institutions.

Aim of the study:

- To assess the efficacy of a Combined Intervention Program on selected health promotion outcomes among vulnerable Adolescents residing in Out of Home Care Institutions.

Study objectives:

- To assess the efficacy of Life skill Training Intervention Program on Resilience, and Emotional & Behavioral Problems among vulnerable adolescents residing at Out of Home Care Institutions
- To assess the efficacy of Mindfullness based Intervention Program on Resilience, and Emotional & Behavioral Problems among vulnerable adolescents residing at Out of Home Care Institutions
- To assess the efficacy of Withania somnifera (indian Ginseng) oral supplement on Resilience, and Emotional & Behavioral Problems among vulnerable adolescents residing at Out of Home Care Institutions.
- To assess the efficacy of (CIP) Combined Intervention Program Resilience, and Emotional & Behavioral Problems among vulnerable adolescents residing at Out of Home Care Institutions
- To associate the efficacy of (CIP) Combined Intervention Program with selected demographic variables

Outcomes Measures and Instruments used to measure outcomes:

- Physical Wellbeing - Oxidative Stress Biomarkers
- Emotional & Behavioral Problems - Self Description Questionnaire
- Resilience - READ Scale
- Cognitive Well being - IQ assessment
- Mental Well being - Beck's Depression Inventory
- Social well being Measures - READ Scale

School of Management

Domain - cum-Specific area of Research (Ex: Marketing-retail analytics, HR-Balanced Score Card)	**Title/s of the Working Paper/s with a brief write up on its significance**
Finance	A study on Tourism finance in Andaman : the indian Archipelago
Finance	Business Ethics
Finance - Investment	A STUDY ON BSE SENSEX BANK STOCK PRICE IMPACT ON INDIAN BOMABY STOCK EXCHANGE
FINANCE -BANKING	A STUDY ON THE IMPACT OF CAPITAL STRUCTURE ON THE PERFFORMANCE OF BANKS
Finance - Behavioural finance	Investment pattern during post covid turbulence
Finance- Financial Inclusion	Financial Inclusion via mobile banking among students This study analyzes the undergraduate student's willingness on the usage of mobile phone in banking transaction which leads to financial inclusion. Research helps to analyze the student's attitude towards mobile banking and their perceived usefulness and ease of use.
Finance - Digital Financial Inclusion, ICT - e-teaching and learning	I am working on e-teaching and learning among faculty members during COVID-19, the benefits they get via e-teaching and the challenges they face on e-teaching and learning. Constructs from UTAUT model is adopted in this study.
Finance - Behavioral Finance	Impact of ESG Score towards Profitability of Stocks The evolution in the mindset of the investors is focused towards the sustainability of Organizations in the recent era. Investors are not only concerned with the growth of the stock prices but also the nature of the

	business the organization involved in. This paper deals with the analysis of Economic , Social and Governance score computed for organization listed in the various indices
Finance	Digital Transformation in Finance, Finance & Investment, Public Economics and Finance, Cost Management.
Management - Finance - Investment Management	Influence of Macro Economic Variables on the Stock Price Movements - Evidence from the Selected Indian IT Stocks
Management - Finance - Stock Market	Behavior of Investors during the Covid Era with special reference to IPOs
Sustainable Finance	Companies have started reporting their non financial performance, that is known as Triple Bottomline reporting. This showcases their responsibility towards environment, society and other stakeholders. Also, corporate governance is given more attention after the collapse of corporate entities like Enron, Sathyam to name a few.
HR - SKILL GAP	SKILL GAP ANALYSIS IN INDIAN HIGHER EDUCATION SYSTEM
HR- EMPLOYEE ENGAGEMENT	1. Determining the impact of transformational, inclusive & authentic leadership's style on employee engagement. Significance: Still which leadership is effective for employee engagement is unclear.. Reason for doing this working paper. 2. Organizational justice and innovative behavior: The mediating role of personal initiative and proactivity.

	Significance: personal initiative and proactivity is needed for innovative behaviour.. Based on organisational justice variable innovative behavior can be achieved by self reported initiative and proactive personality.
HR	Title of the working paper: Work stress and Effective Strategies with Reference to Faculties in Higher Education Institution in Southern Area. Write up on its significance: This paper explains the level of stress encountered by the faculties in Higher education Institutions in Southern Region.
HR	Challenges in virtual learning which is the need of the hour
HR	Workplace Safety, Artificial Intelligence, Job Embeddedness, Women Enrichment.
HR - Employee management	Work life balance of women professional working from Remote Work Station with special reference to IT sectors.
HR- LEARNING AND DEVELOPMENT	1E learning 2 Training effectiveness on online internship for MBA 3 online learning and training
HR- Electronic Recruitment	1. Impact of factors on work life balance due to technology transformation with respect to Information Technology employees 2. Factors affecting the purchase decision of buying mobile phones using online portals.
HR- Stress,Coping,Burnout,Moral Reasoning	"Best Practices in Business Management".Significance - In order to make the business enterprise a profitable and sustainable one, as managers there are certain practices to be followed. This article describes about

	the best practices followed in management of business.
Human Resource-Organisational Performance	Motivation and hygiene factors in multigenerational workforce- A study about generation X and generation Y
HR - Strategic & Gamified approach in Business Development	1. Strategic & Techno gamified approach to address the HR issues in current business scenario. 2. Strategic & Techno gamified approach to address the Marketing issues in current business scenario.. 3. Strategic & Techno gamified approach to address the Operations issues in current business scenario.. 4. Strategic & Techno gamified approach to address the Entrepreneurial issues in current business scenario. 5. Analyzing the association of marketing analytics in enhancing business performance in organization with marketing capabilities as mediator role. 6. Empirical Analysis in analysing the Major Factors of Machine Learning in enhancing the E-business through Structural Equation Modelling (SEM) Approach.
HR-Strategic Human resource planning	TITLE:A Study on Labour Productivity: the role of Performance in SME Manufacturing units. This study assessed the effect of performance management practices on employee productivity at the State department of Labour. The performance management practices were comprised of employee's appraisal as well as provision of feedback on employee's performance. The study undertook a descriptive research design, where primary data was collected through structured questionnaires on the targeted population of middle and lower level

	employees. Respondents was identified and random stratified sampling was undertaken to come up with a sample size of 68 respondents. Questionnaires were answered and returned, which comprised of 67.6% response rate. The study found that there was a strong positive correlation of both employee appraisal and employees performance feedback on employee productivity. The study therefore recommended that organizations to undertake both appraisal for their employees as well as offer feedback on their performance as it increased the productivity of the employees.
HR - work life balance and Job Satisfaction	A STUDY ON THE IMPACT OF FAMILY SUPPORT ON COVID-19 FRONTLINE WOMEN WORKERS. Significance: All the front-line workers are equally competing to combat against Covid 19, but only the doctors and nurses have been hailed as heroes. But the contribution of other front line workers are not highly recognized. The other front line workers are complementing the services rendered by the doctors and nurses. Hence, acknowledging and appreciating the services of the other front line workers like police, corporation and service sector workers is the need of the hour. The global frontline workforce are Predominantly

	women.
HR-Employee engagement	Employee engagement and OCB mediating on employee performance
HUMAN RESOURCE - TRAINING AND DEVELOPMENT	TRAINING AND DEVELOPMENT ANALYSIS IN IT INDUSTRY – THEORETICAL PERSPECTIVE
HR - OCTOPACE , Training & Development, Employee Engagement	OCTOPACE in IT Industry, Training & Development in Manufacturing industry, Employee engagement in Manufacturing industry
Marketing-Business Ethics	1. AGILE MARKETING PRACTICES WITH BETTER ETHICAL JUDGEMENT AMONG EMPLOYEES FROM ROLE SET AND CSR. This paper is on how ethical behaviour of an employee is important with respect to CSR and trust. How the demographic variable influence the ethical judgment and CSR and trust. How roleset configuration enhances ethical judgement. The interplay among the constructs.(Deadline week end) 2. Kaizen, the strategy in Marketing according to Michael Porter -This paper is based on the H2H Marketing, the recent book in Springer by Michael porter where he talks of the current marketing trend where CSR needs focus. How the digitalization and Human to human marketing is relevant. (Quality of the paper with satisfaction is deadline) 3. AI for Performance Management- Book chapter with AI for Performance Management as subsection. It covers various tools of AI at work place and how the ethical performance can be enhanced through AI. (25 NOV with Minimum 20 Pages)

Marketing- customer analytics	The Mobile Payment behavior in the surge of Covid-19 outbreak. Mobile payments, also called m-payments, have gained popularity because of their omnipresent nature.This paper aims to test the technology acceptance model in the purview of mobile payments on the basis of various segments. New payment adoption can be encouraged among Indian consumers by breaking conventional habits and building trust.
Marketing - service quality	Assessment of Hospital service quality in chennai city. A comparative study on service quality provided my various private hospitals. Service quality is assessed by the perceptions and expectations of outpatients. This study will bring an insight about service quality standards followed by the hospitals. The research findings will reveal in which service quality dimension each hospitals are lagging behind or performing well.
Marketing ,Human resources	1.Stress management , 2.Marketing of services
Marketing- Consumer behaviour	Psychological wellbeing while shopping online during lockdown in the Covid era
Marketing - Consumer Behaviour	Title: Systematic Literature review of online Compulsive buying behaviour. As shoppers grow savvier about the internet, the impact of their behavior can modify the buying patterns and also leads to compulsive buying.
Marketing - Market Research	A study on perception of the Farmers on the scenario of "MNC's into Paddy Farming" Initially the agricultural practices are carried by the

	farmers, from that stage now the farmers are entering to agreements with the MNC's for the better selling price and guaranteed sale of the crops. This concept of agreements are most likely to be taken place because of the consumers expectations over the Green or Organic products. In continuation of this scenario, the current study analyses the perception and outcomes of the MNC's into Paddy Farming.
Marketing - Consumer behavior	AI RECONCEPTUALIZING HOTEL INDUSTRY - Hotel industry is one of the fastest growing industry in the world. It generates economy, jobs, improves social development, and peace. Hotel industry is a competitive industry. AI is the version of human intelligence. It is correlated with automation and big data. Augmented reality allows hotel sales and marketing team to merge physical and digital world, which helps guest to attach so much when the product is purchased. AR will be used as a new way of ad in a written form of pamphlets, flyers and so on. Technology advancement is faster than before, hotel entrepreneurs are planing to implement new strategies in infrastructure, management structure and staffing requirements. AI can be applied for a huge range of functions, from basic customer service, to personalisation tasks, more advanced problem-solving.
Marketing-Services & Social Marketing	Title: Indian versus MNCs Salespersons: A Multi-Group Analysis of Selling Skills, Adaptive Selling on Job Satisfaction and Sales Performance A comparative study among Indian and MNC sales

	professionals in Pharmaceutical Industry on selling skills, adaptive selling, marketing and sales strategies leads to sales performance with Job Satisfaction
Marketing - Digital marketing & Consumer behaviour	Role of consumer decision making styles on M-Shopping apps - The purpose of this study is to understand decision-making styles on M-shopping applications. The validated scales are used in this study to examine the decision-making styles and factors affecting the use of mobile shopping applications.
MARKETING-BUYING BEHAVIOUR	Brands Influencing Consumer Buying Behaviors
Marketing-Sustainable Development Goals	Sustainable Development Marketing practices in Telecom Industry This paper focuses on Sustainable Consumer Behavior in Telecom segment by examining the Sustainability and Consumption. It also explores understanding Sustainable Consumer Behavior. Identifying the measure of sustainability and harnessing Sustainable Consumer Behavior.
Digital Marketing	Lead Generator Digital Business Card which is a product developed in Pdf Version. The product is new to the market. It will be used by all the employees working in company for the better Customer Relationship Management. This product will also help the marketers to capture the reference leads which will make a good business Development
Entrepreneurship	Social entrepreneurship
English language education	Role of task based learning in virtual environment to

	enhance English language skills
Systems	Digital transformation in Banking industry
Analytics-Academic Analytics	Machine Learning Approach for Predicting the Student Failure in University Examination - applying machine learning techniques in student data for identifying students who are at the more likely to fail in the university examinations and thus providing needed interventions for improved student performance.

SCHOOL OF LAW

Research Thrust areas Identified;

As on today, no specific research activities are defined or undertaken except PhD program wherein it is heterogeneous in nature. Plans are being made to develop PhD program also in the focused areas to the extent possible under the lines of the proposal under mentioned.

The School of Law is intended to take up special studies and research on the following areas;

1. **Artificial Intelligence and Law**: This a fast emerging area wherein a lot of legal and technical issues are involved. In future like any other areas, practice of Law will also be governed by artificial intelligence. The present generation of Lawyers, judges and legal officers are supposed to know the technology and adoption of the same to a significant extent. Keeping the future in the notice, a cell is already opened to take up serious research in this area. Since it involves, technology, involvement of other experts from the technology stream will also be involved. It will be done through organizing conferences, seminars and

workshops along with documentation of the expert opinions. Identifying new areas of Law involving AI with suggestions and recommendations to the Policy makers will be the prime area of research

2. **Intellectual Property Laws and Security;**

   Intellectual property is one of the prime areas of research in legal perspective as a lot of legal challenges are surfacing often. IP protection at domestic level and international level is not only a complex issue but a necessity too. A number of people do suffer because for their ignorance or improper guidance. Especially the areas like, geographical indication, traditional rights, indigenous and knowledge require a wide research and support. It has to be researched in interdisciplinary dimensions. Research will be undertaken by developing literature, documentation of information and dissemination of the same through different channels. Organizing intellectual events like, conferences, workshops and brain storming sessions will help to develop knowledge bank. Cell for Intellectual Property Rights will be assigned with specific responsibility to carry on the research

3. **Environmental Law and Policies:** Environment issues encompass all arrears of human activities. Regulation of human activities for common good is the main challenge for any government and policy maker. A lot of studies are going on in this perspective. Laws and policies are being structured at domestic and international levels. A lot work is going on in this direction. Still a long way to go to regulate the commercial activities. It is possible only through Laws. Serious research will be undertaken in this perspective, like, survey of existing statutes and policies both at national and international level, gaps found to meet the set objectives and futuristic policies. Organizing special academic events, documentation of the same and proposing the new ideas to the policy holders will be the core area of research.

For time being, these are the areas we would like to concentrate keeping in view, the existing resources. At first stage, we will concentrate on first two areas and in second phase we wish to expand with the third area i.e., Environmental

Law and policies. The proposals are subject to University policies and guidelines.

COLLEGE OF AGRICULTURAL SCIENCES

Climate Smart Agriculture

- Study on Climate smart agriculture adaptation strategy
- Investigations of constraints in adaptation of protected structures
- Investigations of constraints analysis on nursery technologies
- Research on agricultural risk management
- Value chain analysis of corn
- Impact evaluation of development programmes related to farmers
- Study on agricultural labour migration
- Research on Vegetable grafting in Solanaceous and Cucurbitaceous vegetables to impart biotic and abiotic stress resistance

Protected Cultivation

- Research on MAP (Modified atmosphere packing) will be carried out as per the MoU signed with KP Manish's Global Private Limited – cultivation of Andrographis and Tribulus
- Research on off season flowering in mango
- Developing elite planting materials of horticulture crops through tissue culture methods
- Field evaluation of star jasmine and bush pepper
- Protected cultivation of fruit crops
- Development of package of practices for dragon fruit
- Evaluation of tissue culture plants at field level – banana & some important flower crops
- Studies on improving shelf life of flower crops by nano-materials
- Standardization of package of practices for selected medicinal plants and aromatic plants

Crop Improvement

- Collection, regeneration, purification and storing of some important plant genetic resources.
- Acquiring, multiplication, formulation development and cultivation of different mushrooms varieties.
- Molecular plant microbe interaction studies.
- Isolation, and screening of Plant Growth Promoting Rhizobacteria (PGPRS) and bicontrol agents to manage plant disease.
- Bioinoculant formulation development, Mass production, quality control and commercialization of bioinoculants.

Eco-friendly Agriculture

- Establish a Soil, plant, water testing and environmental sample analysing and certification lab.
- Focusing on ZBNF (Zero Budget Natural Farming) and Chewan - Q method of agriculture to sustain the soil health.
- Establish a Non-thermal plasma laboratory and undertaking research in plasma technology for agricultural application to increase yield, waste water treatment, air pollution control and Nanomaterials synthesis.