CHARUSAT
CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

Department of Mathematical Sciences

P. D. Patel Institute of APPLIED SCIENCES

Ongoing Research Work (KBK)

Research Area: Fractional Calculus, Mathematical Physics

- Fractional derivatives are widely used by researchers in modelling realistic systems. Such derivatives, due to their nonlocal nature are able to model memory and hereditary effects observed in physical systems. It is observed that systems involving fractional derivatives can exhibit chaos. Below a threshold value of fractional order derivative, these systems show regular behavior. **We are studying chaos in various fractional order system.**
- We are **developing analytic and numerical methods to solve fractional differential equations** with various fractional order derivatives.
- Linear viscoelasticity is certainly the field of the most extensive applications of fractional calculus, in view of its ability to model hereditary phenomena with long memory. **We develop fractional viscoelastic models with various fractional derivative operator.**
- **Lie Algebra and Fractional order polynomials**
- **Image Processing using Fractional calculus**
- We trying to **obtain certain properties of fractional order polynomials using Lie-Algebra**.
- We are working on **applications of fractional calculus in image processing.**

Ongoing Research Work (MHC)

Research Area: Special Functions, Hypergeometric Function, Mittag-Leffler Function

- Special Functions are developed out of Mathematical Physics and Statistics. Many Special Functions appear as solutions of differential equations or integral of elementary functions.

- Gauss hypergeometric function, Bessel functions, Legendre, Laguerre, Hermite functions, Mittag-Leffler function are here worth mentioning.

- Some mathematical models depending upon more number of parameters and to control them as per the physical problem requirement, the generalized structure of Special Functions is needed. We have generalized Gauss hypergeometric function, Bessel functions, and Mittag-Leffler function satisfying infinite order ordinary and fractional differential equations and studied their properties together with the eigen function property by the construction of a new operator with the aid of ordinary and classical fractional derivatives operators.

Ongoing Research Work: (JRP)

Research Area: Tribology, Fluid Mechanics

- Tribology is very useful to reduce the friction and wear of the system. Nowadays, it is important and crucial in industries.
- We are working on magnetic fluid based squeeze film bearing systems with the effect of porosity, roughness and slip velocity.
- Mainly we have studied the performance of squeeze film Slider bearing, Annular bearing, circular bearing and Journal bearing considering the influence of magnetic fluid, porosity, roughness and slip velocity.
- In our investigation, we start with the Reynolds equation of the conventional fluid based bearing system. Then, we modified this Reynolds equation with Ferrofluid flow models(Neuringer-Rosensweig's model, Shliomis' model, Jenkins's model), Porosity, roughness and slip velocity. After solving modified equation, we can derived Pressure, Load carrying capacity and Friction of the bearing system. In this way we can analyse the performance of the bearing system.
- Our above research is totally theoretical.

Ongoing Research Work: (YFP)

Research Area: Compartmental Modeling & Computational Methods

- Dynamical models are crucial in the field of engineering, science and technology as they represent the real world phenomena
- Compartmental modelling can be considered as the best tool to comprehend physical phenomena as well as the effect of various parameters involved in the dynamic models.
- Due to the complex nature of biology, chemistry, physics, pharmacokinetics model, it is necessary to reduce into simple form so that one can easily understand the effect, behaviour and interaction of various parameters which can be easily achieve using compartment modelling.
- Most of the time compartment models are described mathematically by ordinary or partial differential equations .
- As more parameters are involved, the mathematical modeling leads to complicated system of differential equations and solution to such kind of problem became a challenge for one.
- So we required a computational methods which provide solution with less computational efforts and less time.

Ongoing Research Work (RVS)

Research Area: Special Functions, Orthogonal polynomials and their generalizations

- The extension to classical polynomials along with their q-versions in the sense of p-deformation
- The inverse series relations of these p-polynomial with the help of general inversion pair
- Combinatorial identities with help of general inversion pair
- p-Version of Riorden's classification of Combinatorial identities
- The differential equation of p-polynomial using recurrence and differential recurrence relation
- The generating function relation, summation formulas involving the polynomials
- The Companion matrix and its application to find eigen values
- p-version of Ramanujan's theorems