CHAPTER 48

TECHNOLOGY
APPLIED SCIENCES AND HUMANITIES

Doctoral Theses

01. BAINNIE
Studies on Biopolymers and it's Blends for Advanced Wound Dressing.
Supervisors: Dr. Purnima Jain and Dr. Roli Purwar
Th 26182

Abstract

The work presented in the thesis is based on the preparation of polymer nanocomposites nanofibrous mats incorporated with two different nanoclays. Its effect on the processing, morphology, thermal, rheological, mechanical, antimicrobial and barrier properties of nanocomposites nanofibrous mats has been studied. In these recent years, polymer nanocomposites have attracted and gained a lot of attention worldwide from industrialists and academicians. Polymer nanocomposites are dominating over conventional polymer composites because of unique enhanced properties. These unique properties of polymer nanocomposites increased its diverse applications in various engineering fields such as biomedical, filtration, defense etc. applications. This research work is focused on the preparation of polyvinyl alcohol (PVA) nanocomposite nanofibrous mats by electrospinning method which was doped with three different compositions (0.25 wt%, 0.5 wt% and 0.75 wt%) of Cloisite 30B and Cu-MMT. Mechanical, physical, chemical, thermal, rheological and antibacterial properties of the nanocomposite nanofibrous mats were determined. Sodium-montmorillonite clay (Na-MMT) was modified with cupric chloride (CuCl2) through ion exchange method to form coppermontmorillonite (Cu-MMT). Scanning electron microscopy (SEM), Energy- dispersive X-ray spectroscopy (EDX), X-ray Diffraction (XRD) and particle size analysis were performed to characterize the modified clay. The formation of smooth and bead-free nanoclay loaded PVA nanofibres was observed through SEM and FESEM. Proper intercalation and exfoliation was observed from XRD. The thermal stability of all the clay loaded nanocomposites was improved. The melting temperature of nanocomposites shifted towards the lower range of melting temperature due to weakening of bonds determined by DSC. DMA found the improved storage modulus and increase in Tanδ on incorporating the Cloisite 30B and CuMMT in nanocomposites. Tensile strength and viscosity increases with the increase in concentration of Cloisite 30B and CuMMT showing Newtonian behabior. Both the clays loaded nanofibrous mats showed good antibacterial property against the Gram-positive bacteria and Gram-negative bacteria. These enhanced properties of the PVA nanocomposite nanofibrous mats can be used for the microbial protection applications.

Contents

1. Introduction and literature survey 2. Experimental methods and characterizations.3. Electrospinning and morphology of nanofibers 4.

Thermal behaviour and rheology 5. Antimicrobial properties 6. Tensile properties, porosity and WVTR. Summary and Future scope.

02. CHAUBEY (Ankita)
Phytoconstituents of Fruit Shell of Aegle Marmelos and Their Therapeutic Potential.
Supervisor: Prof. Ashok K. Dubey
Th 26181

Abstract

Aegle marmelos (Bael) has been regarded as one of the most important medicinal plants. It has been used extensively in Ayurvedic system of medicine. Most parts of Bael (root, stem, leaf, fruit and seed) are well characterized. However, fruit epicarp (shell) is normally wasted away and has not been investigated for its phytoconstituents and their potential as therapeutics, which formed the basis of the research work presented in the thesis. Epicarp phytoconstituents were fractionated, isolated and characterized for their chemical classes, structure and bioactivities. Therapeutically significant classes of compounds like, polyphenols, glycosides, sterols and carbohydrates were found in methanolic extract of the fruit-shell. Probable identities of phytoconstituents were based on similarity index (SI). A total 209 compounds were detected in GC-MS spectra, out of which 59 could be identified by matching with library compounds. This observation suggested the high probability of finding new compounds from this source. Six compounds: 4-Hydroxybenzeneacetic acid; 5-Oxo-pyrrolidine-2-carboxylic acid methyl ester; Trans-sinapyl alcohol; DL-Proline, 5-oxo-methyl ester; 5- (Hydroxymethyl)-2- furaldehyde and 2,4-Dihydroxy-2,5-dimethyl-3(2H)- furan-3-one are being reported for the first time from bael. Compounds recovered in butanol and aqueous fractions demonstrated better activities for protecting cells against oxidative stress and for inhibition of lipid peroxidation. Sixteen partially purified compounds and five pure compounds were isolated during the present work. Structural characterization of the pure compounds was done by employing various spectral techniques, for example, NMR, LC-MS-MS Quadrupole, FT-IR and UV spectra. Three of five isolated compounds were identified as 1,2-dihydroxybenzene, Benzoic acid and Quercetin. The compounds had shown better anti-oxidant activity than the standard molecules, Ascorbic acid and Tocopherol. The purified compound, AMM4 had shown potent anti-inflammatory, anti-diabetic and anti-aging activities, which were found better than the reference compounds. Also, AMM5 displayed potent anti-aging property.

Contents

1. Introduction 2. Literature review 3. Material and methods 4. Result and discussion 5. Summary 6. Bibliography.

03. DADWAL (Anica)
Production and Applicability of Thermostable Recombinant Cellobiohydrolase and β-Glucosidase of Myceliophthora Thermophila in the Conversion of Cellulosic Residues to Ethanol.
Supervisors: Dr. Shilpa Sharma and Prof. Tulasi Satyanarayana
Th 26186

Abstract

The heavy dependence on fossil fuels as source of energy has adversely affected the environment. Besides, these are also exhaustible. Therefore, there has been an undue emphasis on finding renewable energy sources. Cellulosic bioethanol (2G biofuel) as an alternative fuel has been recognized as environmentally sustainable because it is produced from abundantly available and renewable lignocellulosic agricultural residues. Saccharification of lignocellulosic biomass is carried out by using appropriate blend of cellulolytic and hemicellulolytic enzyme cocktails. The three cellulase enzymes namely endoglucanase, cellobiohydrolase and β-glucosidase act cooperatively to deconstruct lignocellulose. Wild type microbes do not produce these enzymes in adequate titres. In the recent past, several investigations have, therefore, been attempted in developing fungal mutant strains and recombinants capable of producing enzymes in high titres. Investigations have not yet been carried out on utilizing the recombinant cellulases of the thermophilic mold Myceliophthora thermophila in formulating enzyme cocktails. This investigation reports cloning and heterologous expression of synthetic cellobiohydrolase (MtCel6A) and β-glucosidase (MtBgl3c) encoding genes of Myceliophthora thermophila in E. coli for the first time. The structural and functional characterization of the enzymes has been performed using various in silico approaches, including molecular docking and MD simulations. The biochemical characterization of the enzymes suggested that these are extremozymes with tolerance to elevated temperatures, organic solvents, detergents and salt. The enzymes also exhibited end product tolerance. These features make them useful in the saccharification as well as in other biotechnological applications. Their applicability in biomass saccharification has been confirmed. The optimum blend of the three recombinant cellulases in different ratios has been optimized to develop enzyme cocktails for the saccharification of the pretreated paddy straw and sugarcane bagasse. The recombinant cellulase mix in combination with Cellic Tec2 and native fungal cellulases was selected as the best enzyme cocktail. The ethanol production was attained after fermentation of the paddy straw and sugarcane bagasse hydrolysates. This is the first study that confirmed the utility of recombinant enzymes of M. thermophila in developing enzyme cocktails in saccharifying cellulosic residues, and fermentation of hydrolysates to ethanol.

Contents

1. Introduction 2. Review of literature 3. Material and methods 4. Results 5. Discussion 6. Summary and conclusion. Bibliography and List of publications and presentations.

04.   DUA (Nibha)
Study of the Growth Properties and Structure of Classes of Integral Functions Represented by Dirichlet Series in One and Several Variables.
Supervisor: Dr. Niraj Kumar
Th 26184

Abstract

The thesis is organized into six chapters together with the list of references. The present work mainly deals with the study of growth properties and algebraic, functional and topological structures of several classes of integral functions represented by Dirichlet series. The summary of the work presented in each chapter

is briefly outlined as follows-Chapter 1: This chapter is introductory in nature and gives the details of development in the research on the entire functions represented by Dirichlet series in one and several variables, along with the basic definitions and notations which have been continuously used in the subsequent chapters. Chapter 2: In this chapter, a condition on vector valued coefficients of multiple Dirichlet series has been obtained for when the series converges at all points in the complex plane. Further, a class M is considered consisting of vector valued multiple Dirichlet series of form 1X m=1 ame [Chapter 3: The aim of this chapter is to study the dual nature of a class of vector valued entire Dirichlet series of slow growth, that is, when the order of an entire function represented by Dirichlet series is zero. Characterization of the coefficient multipliers for some classes of vector valued entire Dirichlet series has also been obtained. Chapter 4: This chapter deals in exhibiting a property for which type of an integral function of an integral function represented by Dirichlet series for a finite order is finite. In other words, we obtain a condition on the growth parameters of functions f(s) and g(s) for when the type of h(s) is finite. Here h(s) = f(log g(s)) where f(s) and g(s) are entire functions represented by Dirichlet series. Chapter 5: In this chapter, we consider a class F of multiple Dirichlet series of Form 1X t=1 cte<Chapter 6: In this chapter we consider a class K of vector valued Dirichlet series and prove it to be an FK Space and Fréchet space. Further, we provide the functional analytic structures of Two norm space and Saks space to some subclasses of class K.

Contents

1. Introduction 2. Certain results on a class of integral functions represented by multiple dirichlet series 3. Some results on coefficient multipliers for a class of vector valued entire dirichlet series of slow growth 4. Result on an integral function of an integral function represented by dirichlet series 5. On class of entire dirichlet series with variable sequence of complex exponents 6. Results on certain classes of vector valued entire dirichlet series. Bibliography

05. PALO (Nishi Deepa)
Study of Nonlinear Wave Propagation in Compressible Flow.
Supervisor: Prof. J. Jena
Th 26180

Abstract

This thesis embodies fwe chapters followed by the scope for the further research and the references lists which are beneficial for the development and application of the methods discussed here. The content of the thesis are briefed below. Chapter 1: The first chapter is a preface to outline the present thesis. As the title of the thesis suggests, it is imperative to discuss the non-linearity in the field of hyperbolic type of waves. Since major real life problems are highly non-linear in nature, the formulation of the problems mathematically lead to complicated partial differential equations. The present thesis discusses certain features of non-linear compressible flows. It is evident that the study of fluid flow is significantly applicable in major industrial areas ranging from medicines to aircrafts. Despite over so many decades of rigorous studies on compressible flows and its applications in solving real world problems, many concerned technical issues continue to be controversial and debated. The versatility of the topic in terms of its application is the main motivation behind this thesis. In fluid dynamics the compressible flow refers to those fluid flow whose velocity exceeds the speed of sound. In such type of flows when there is a substantial change is pressure occurs, the emergence of shock wave takes place.

This study bring forth an outline of the present state of knowledge on such eects which include discus- sions of: (i) Some features of shock wave interactions (ii) Distortion of amplitudes of pulses (iii) Studying intermediate shocks etc. Overall, the survey highlights the need for additional understanding of fundamental transport mechanisms of certain kinds of shock waves, formulating them mathematically by understanding their physical phenomenon and solving them. The second chapter deals with a certain kinds of wave propagation and interaction phenomena. In this chapter, the singular surface theory is used to determine the modes of wave propagation and its development into discontinuities in a dusty gas with axial magnetic field. The transport equation for the jump in the velocity gradient is evaluated. The effects of the dust particle and magnetic field on the formation of shocks are investigated numerically and the results are depicted for different values of dust and magnetic parameters. Further, the evolution of the characteristic shock is discussed and its interaction with singular surface is considered. The formation of transmitted and reflected waves after interaction as well as jump in shock wave acceleration are discussed. Chapter 3: The third chapter is all about disturbances of finite amplitudes in the wave motions. Here the evolutions of small and large compressive pulses are studied in a two-phase flow of gas and dust particles with a variable azimuthal velocity. The method of relatively undistorted waves is used to study the mechanical pulses of different types in a rotational, axisymmetric dusty gas. Asymptotic expansion procedure is used to discuss the non-linear theory of geometrical acoustics. The influence of the solid particles and the rotational effect of the medium on the distortion are investigated. It is observed that the presence of dust in the rotational flow delays the onset of shock formation thereby increasing the distance where the shock is formed first. Chapter 4: In the fourth chapter, the developmental behaviour of one-dimensional shock waves in a dusty rotational flow has been considered. The mathematical scheme based on the kinematics of one-dimensional fluid flow for the derivation of an infinite hierarchy of transport equations has been employed. The scheme is a truncation procedure which helps to examine the system of transport equations in a simple form. The first two approximations are studied to illustrate the effects of dust and rotational parameters. Chapter 5: The fifth chapter concerned with the evolution of a weak discontinuity wave i.e., an acceleration wave for one dimensional unsteady flow of a plasma with axial magnetic field in presence of dust particles are considered for study. Lie group of transformations is used to study the self-similar solutions. Further, interaction of the acceleration wave with strong shock is investigated. The influence of dust particles and magnetic field in the process of propagation and interaction are examined. The cases of reflected and transmitted waves after interaction are discussed.

Contents

1. Introduction 2. Interaction of singular surface and characteristic shock in dusty gas with magnetic effects 3. Development of small and large compressive pulses in two phase flow 4. An analytical approach to study kinematics of shock waves in a dusty cylindrical gas flow 5. Evolution of acceleration wave and interaction with a strong shock in a plasma with axial magnetic field and dust particles and Bibliography.

06.   SHARMA (Rukmani)
       Role of Air Pollution in Damaging Building Over Delhi.
       Supervisor: Prof. Anjana Sarkar
       Th 26188

Abstract

Air Pollution has become an emergent threat to the world which is not only affecting flora and fauna but also leading grievance menace to the architecture of the country. Air pollution is one of the major challenges faced by our country. In the urban environment, particulate pollution is contributing to the degradation of the outermost layer of walls by decoloring the paint/whitewash. Air pollution damaging the building material, but the change is rapid over the years. The life expediency of buildings is decreasing due to it. The need is for both qualitative and quantitative studies for determining the damage caused by air pollutants. From studies, it had been revealed that air pollution is responsible for reducing the mechanical strength of buildings. It has also been revealed that pollutants like SOx, NOx, PM, etc. are responsible for the deterioration of buildings. Researchers are employing methods that can the effect of these pollutants on the walls of the buildings by adding nanofillers in paints and coatings for the external wall of the building. The degradation pattern of building material is responsible for the economic burden on the government. In the present study, different mortars of cement and lime-gypsum of different formulations are fabricated. The fabricated mortars were analyzed with physical, mechanical and morphological properties for two years. The studies revealed that the exposed specimen of mortar were degrading due to air pollution. The physical degradation like bulk density had increased for the exposed specimen as the pollutant penetrated the bulk. Moisture content and moisture regain were high in the exposed specimens while the air diffusivity was low for the exposed samples. The mechanical strength of the exposed specimens was low in comparison to the unexposed. The pollutants that are responsible for the degradation of buildings were Si, Al, N, C, Ca, Fe. Chapter 1 elaborates about pollution, pollutants with their type and emission sources. It further explains the six major pollutants present in the atmosphere. It reviews the survey about the problem and the methods for reducing the effect of pollution on buildings. It further elaborates about the urban air pollution from global to local witha detailed study on Delhi. The source that contributes to increasing pollution has been discussed. The measurement and consequences on human health are discussed. In addition, the aim and scope of the research work have also been accounted for. a detailed study on Delhi. The source that contributes to increasing pollution has been discussed. The measurement and consequences on human health are discussed. In addition, the aim and scope of the research work have also been accounted for. Chapter 5 determines the surface morphology of the pollutants that are damaging the building. In this, the sampling was done on the tinfoil which was analyzed by the SEM and SEM-EDX. The types of pollutants that are degrading buildings were analyzed. Further, the concentrations of pollutants with time were analyzed and theimpact of contaminates on the building was studied with time. The chapter highlight is the type of pollutants found and their concentrations. Chapter 6 concludes all the entire work that has been done in previous chapters. It also includes the future scope of the study. The recommendations were also given to provide a healthy environment to the buildings.

Contents

1. Introduction and literature survey 2. Materials and Experimental techniques 3. Mechanical studies of cement mortar 4. Mechanical studies of lime- gypsum mortar 5. Morphological characterization of buildings in Delhi 6. Summary, Conclusion and Future scope and List of publications.

07. SINGH (Ankita)
Synthesis of Nonomaterials for the Study of Solar Energy Conversion.
Supervisors: Prof. Sanjeeve Thakur and Prof. Ranjana Jha
Th 26187

Abstract

The thesis entitled "Synthesis of Nanomaterials for the Study of Solar Energy Conversion." deals with the synthesis of MoSe2 and its composites for their efficient use as a counter electrode in dye sensitized solar cells. The material synthesized at optimised parameters using hydrothermal autoclave technique was then composed with reduced graphene oxide in two different routes to generate a well dispersed system for the further use. MoSe2 was also modified by the aniline over it by adopting conventional in situ oxidative polymerisation and emulsion in situ oxidative polymerisation method. The aim was to develop method which will allow better control over the morphology adopted by the PANI when grown over MoSe2 nanoparticles because the control over the shape and size of the PANI is difficult and depends on several factor including route taken to polymerise it. The results have suggested that the results were obtained in a more controlled manner in the emulsion polymerisation method. In the next step, the ternary hybrid system of MoSe2, rGO and PANI was developed by polymerisation of aniline over pre-synthesized MoSe2-rGO nanocomposite. The aim was to generate synergism among all the three components to obtain a well dispersed electronically conducting system which will serve as an efficient counter electrode in the DSSC. Both the binary composite performed better as was evident from the characterisation results for example, FESEM showed the controlled growth of the polymer, surface studies (from BET) showed buffered up surface area and electrochemical studies suggest lower resistance for the charge transfer.

Contents

1. Introduction 2. Material, methods and characterization 3. Optimisation experiments 4. Ternary composite based on $moSe_2$-Rgo/PANI nanocomposite as an efficient counter electrode in dye sensitized solar cells (DSSC) 5. Electrochemical characterization of molybdenum diselenide/polyaniline nanocomposite synthesized by emulsion polymerization. 6. Summary , Conclusion and Future scope of the work . References. Journal Publications. Book chapters. Conferences and Workshops.

08. SINGH (Nirupma)
Network Biology and Machine Learning for Mining of Drug Targets in Microbial CVDS for Structure Based Drug Design.
Supervisor: Prof. Sonika Bhatnagar
Th 26183

Abstract

Microbial Cardiovascular Diseases (CVDs) is a class of CVDs that involves an array of viruses, bacteria, fungi and parasites contributing to the pathogenesis of CVDs [1] either via direct infection of vascular cells or via the indirect effects of cytokines or acute phase proteins induced by infection at non- vascular sites [2]. This paradigm

has been supported by multiple epidemiological studies that have established positive associations between the risk of cardiovascular disease morbidity & mortality and markers of infection [3]. A large number of different infectious agents including bacteria and viruses have been linked with an increased risk of cardiovascular disease [4, 5]. The recent COVID-19 pandemic also shows high mortality rate in patients with presence of underlying cardiovascular comorbidities with COVID-19. Apart from this, COVID-19 can also cause cardiovascular disorders including myocardial injury, arrhythmias, acute coronary syndrome and venous thromboembolism [6]. Regardless the prevalence of microbial CVDs, the role of microorganisms in inducing heart diseases has not been elucidated at the molecular level [7]. Host-pathogen protein interaction studies can elucidate the role of microbial proteins in initiation, progression and development of CVDs [8]. Interactions between pathogen and host proteins underlie the process of infection. Pathogens manipulate the cellular mechanisms of host organisms via protein-protein interactions (PPIs) in order to take advantage of the capabilities of host cells, leading to infections[9]. Improved understanding of these interactions will contribute to our knowledge of the mechanisms involved in infection and allow novel therapeutic solutions to be devised [10].There are three main microbial CVDs, namely endocarditis, pericarditis and myocarditis. Apart from these three, sixteen other microbial CVDs are known till date. A large amount of data was available related to these microbial CVDs which was mainly PPI data between human host and different categories of pathogens. From the availability of the PPI data in a scattered form emerged the need for a database to provide an easy access to the data related to microbial CVDs from a single source. Consequently, a unified database named MorCVD was constructed and deployed in the form of a web application to ensure the easy availability of the data to a large community of researchers working in the fields of microbiology and CVDs. For constructing the database, the genes related to microbial CVDs were used to extract the PPI information from several Host-Pathogen Interaction databases. The data was cleaned, pre-processed, and enriched with some more useful information and was subsequently organized into a database. The online database has several search options which makes it an interactive web application. After the construction of the database, the analysis of the host-pathogen PPI (HP-PPI) data housed in the MorCVD database was undertaken to gain useful molecular insights about microbial CVDs. Network Biology is one such approach that helped in fulfilling this objective by providing a systems level understanding of protein-protein interactions. Protein-protein interactions between host and pathogen proteins play a vital role in initiating infection and disease [11]. Hence, A tripartite network of CVD associated HPIs (cHPI) was constructed between pathogens, their proteins and host proteins. Similar approach was used to construct a whole HPI (wHPI) network for all the HPIs reported till date. The topological analysis of the networks helped in identifying the central nodes that are essential to maintain the network structure. In biological terms, the central nodes of the network are those key proteins that are essential in maintaining the flow of information and network of HPIs in human body during disease complications. As many signaling pathways are activated due to infection, central proteins and specific pathways for microbial CVDs were identified by comparison with the wHPI network and selecting the ones that were unique to the cHPI network. A similar approach was used for identifying the enriched gene ontologies for microbial CVDs. The pathways leading to the CVD complications in the human body due to microbial infections were also identified. This study helped in identifying the key proteins and pathways involved in microbial CVDs.

Contents

1. Introduction and review of literature 2. Materials and methods 3. MorCVD: a unified database for host- pathogen protein-protein interactions involved in microbial CVDs 4. Tripartite network study of host-pathogen protein-protein interactions in microbial CVDs 5. Machine learning for prediction of drug targets in microbe associated cardiovascular diseases 6. Quantitative three-dimensional structure-activity relationship studies on dihydropyrimidone inhibitors of human neutrophil elastase 7. Conclusion and Future scope of the work 8. List of publications 9. List of conferences and workshops 10. Bibliography.

09. SINGH (Pradeep Kumar)
Modeling and Analysis of Blood Flow in Human Circulatory System.
Supervisor: Prof. J.K. Misra
Th 26185

Abstract

The intricacies of biological processes in human body are so complex that studying one process in isolation is di cult. For instance, the blood flow mechanism in human body and its effect on cure and treatment of certain diseases is di cult to understand without using chemical and physical processes, and mathematical concepts as well. The physiological features of the heart and the cardiovascular system and special characteristics of blood flow can be better understood taking a multidisciplinary approach. Most of the mechanisms in biological systems are based on diffusion process. Functioning of kidney is one such area which uses the process of diffusion to purify blood. Waste products such as uric acid, urea, creatine etc. in the blood are filtered out by the kidney, and a malfunctioning kidney can lead to uraemia. In such a situation, an artificial kidney, a name given to haemodylyser, is used as an alternate. Keeping this background in mind, objectives of this thesis were set. The major objective being simulation of blood flow and prediction of the extent of kidney failure. This was aimed to be achieved using theoretical results obtained on blood flow behaviour in presence of abnormalities and blood diseases. The affected blood flow can predict the extent of blood purification which, in turn, can indicate the functioning of kidney. Accordingly, the present thesis has been divided into six chapters. Each chapter deals with the different aspects of Modeling of blood flow in human circulation system. Chapter 1 gives the overall introduction of the topic including brief description of physiological features of blood, blood flow and cardiovascular system. The chapter also describes the various models used to analyse the blood flow problems. The chapter contains an exhaustive literature survey of the various research papers available on the topic. Chapter 2 deals with comparative analysis on angular flow and mass transfer in haemodialysis. In this chapter, we have analysis a half channel model of haemodialysis in which two parts are considered. Lower part is for blood flow and upper part is for dialysate flow. This half channel model is used as an artificial kidney to understand the behavior and working of the kidney. We have assumed that the flow in haemodialysis is done by diffusion only hence, we have modeled the whole system using diffusing equation. Due to some abnormality, permeability of semipermeable membrane may be disturbed. Assuming that the permeability is periodic in nature by which an angular flow happened, we have considered the flow as steady and fully developed and neglected the longitudinal term in diffusion equation. The non- dimensional diffusion equation is simplified by separation of variables to ordinary differential equation along with boundary condition which is the form of Sturm-Liouville form. To get

power series form of solution, we have applied Frobenius method in Sturm-Liouville form to get all values in terms of eigenvalues. Graphs have been plotted between concentration (Cn) of impure blood and axial direction using different values of angles, Peclet number, radius and Sherwood number and results obtained are discussed in detail. Chapter 3 describes the analysis on angular flow and mass transfer in haemodialysis using DTM. In this chapter, we have discussed the half channel model for haemodialysis by taking longitudinal diffusion term in the diffusion equation. The problem is solved using separation of variables. In this case, ordinary differential equation contains one additional term in the form of Peclet number which is not included in chapter 2. The equation obtained has been solved by differential transform method (DTM). We have obtained the values of concentration in terms of eigenvalues by using numerical data. Results obtained in graphs again establish that the periodic nature of permeability afects the concentration of impure blood. These graphs also show the impact of Peclet number on concentration. Chapter 4 deals with binary search adaptive differential transform method. In this chapter, we have developed binary search adaptive MsDTM to solve population growth problem, the solubility problem and the quadratic Ricatti equation. We have also compared these results with the exact solutions which are similar to each other along with the graph in which we show that the computation is done with in bound truncation error. We have also made the comparison with the results obtained between adaptive MsDTM and binary search adaptive MsDTM which shows that the iterations required in computation using our proposed method are very less. Apart from these, the solutions of the du ng equation and the Rayleigh differential equation have also been obtained using binary search adaptive MsDTM and compared the results with RK4 method which resemble each other and computation is done with in bound truncation error. Chapter 5 deals with the method developed in the chapter 4 that has been used partially to solve the blood flow problem in the stenotic region and the results obtained are discussed in detail in this Chapter 5 entitled 'An unsteady analysis through arteries with a stenosis using hybrid DTM'. In this chapter, we have discussed the stenosis due to divergence and convergence of blood ow in arteries, referred to as tapered angles in the chapter. For modeling of blood ow in arteries, the Navier-Stokes equations are used. We have considered a 2D, unsteady, axisymmetric, laminar flow in a stenotic region where the blood is considered as incompressible fluid. To solve the problem numerically, we have used hybrid DTM in which time domain is solved by binary search adaptive MsDTM which was developed and discussed in Chapter 4. We have calculated the velocity pro les at different portion of radius and different times using this new method developed in Chapter 4. It has been found that the results obtained by this new method are in agreement with the results obtained by the finite difference method. It has also been noted that the time and computational cost is very less using this new method in comparison to the other method. Finally overall conclusions of the thesis have been compiled in Chapter 6 with remarks on future scope of work.

Contents

1. Introduction 2. Comparative analysis on angular flow and mass transfer in haemodialysis 3. A comparative study of fluid flow in haemodialyser using differential transform method 4. Binary search adaptive differential transform method 5. An unsteady analysis of blood flow through arteries with a stenosis using hybrid differential transform method 6. Combined Conclusion of the Thesis. Appendix and Bibliography.