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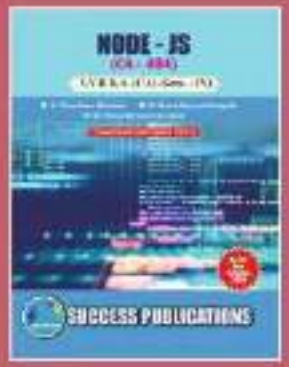

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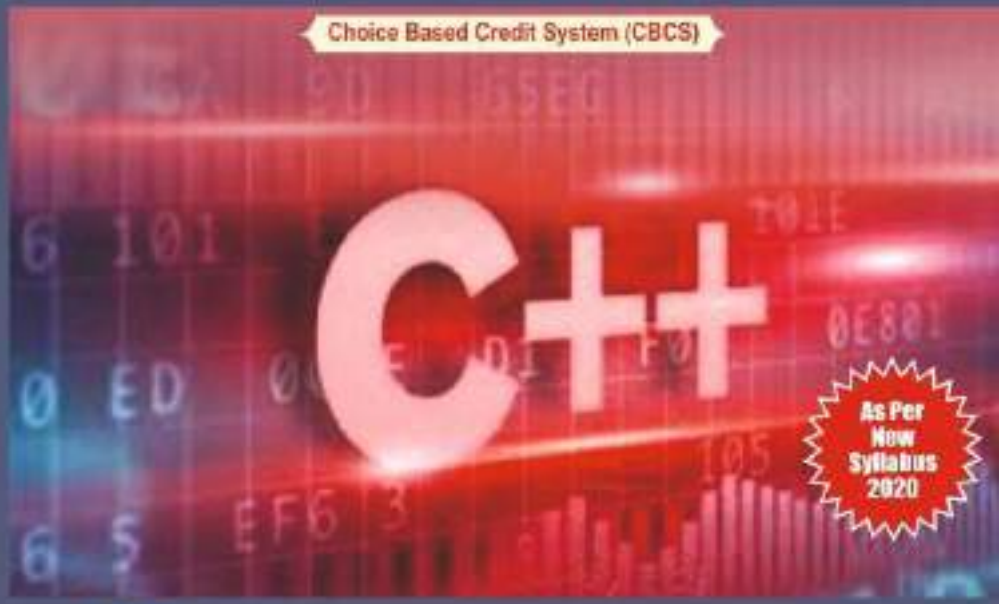

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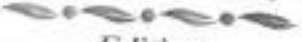

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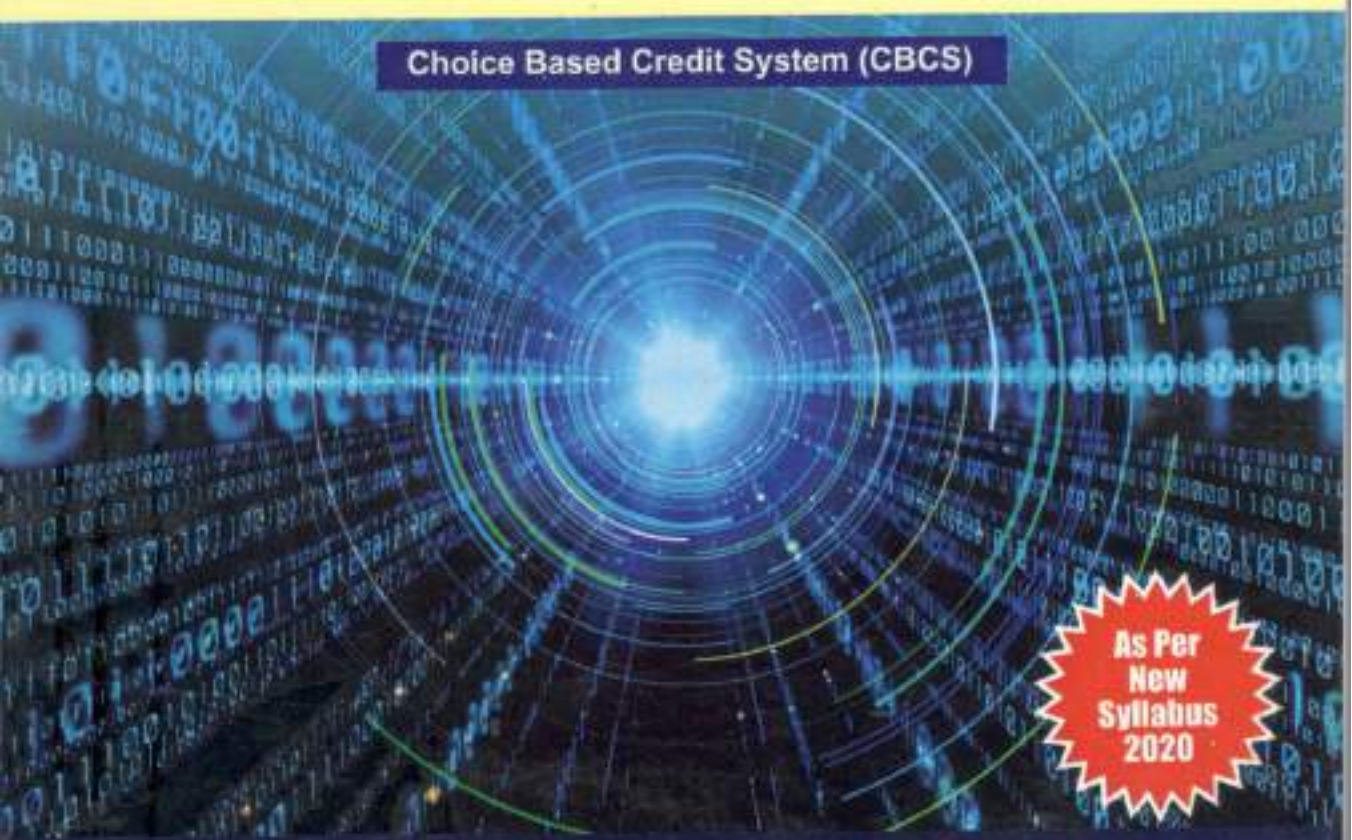

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Parameters of Science Fiction

Vijaykumar R. Punekar

InSc

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Preface

Science Fiction, as a new genre, existed at the beginning of the twentieth century when an American radio engineer and magazine editor, Hugo Gernsback labeled the new genre as 'Scientifiction' in 1926, to characterize the contents of the magazine *Amazing Stories*. Later, the term was rechristened as *Astounding Science Fiction* in 1938. It was only in the 1950's or after the World War II that the label Science Fiction was applied to paperback novels, incorporating science.

To understand how Science Fiction evolved as a specialized form of writing or as a literary genre, it is essential to find prototypes in earlier works and to assess the basic parameters of Science Fiction. Mary Shelley's *Frankenstein* (1817) was the first book in the history of writing having all the characteristics of Science Fiction. But genealogies of Science Fiction can be found in Plato's *The Republic* (Fourth Century B.C.), Lucian's *Satires* (Second Century A.D.), Thomas More's *Utopia* (1492) and Jonathan Swift's *Gulliver Travels* (1726).Similarly in India, Science Fiction writing began with Jagadananada Roy's *Shukra Bhraman* (*Travels to Moon*) which appeared in Bengali in 1879.But some elements of Science Fiction could be seen in the *Purans* and the great epics, *the Mahabharata* and *the Ramayana* as well.

This book presents the coherence between the basic parameters of Science Fiction and utilization and presence of some of the dominant parameters of Science Fiction in the selected works of Indian Writers in English. It also studies the projection of basic parameters of Science Fiction in the selected Indian Science Fiction. The parameters can be grouped into eleven categories. **First** is the concept of science used by the selected Indian writers of Science Fiction. It is evident to see how Indian writers are successful in weaving the various concepts or theories or phenomena of science into their works. Basically it is assumed that science is universal. So writers get the advantage of universality, naturally, by writing Science Fiction. The s**econd** is the handling of Space and Time in Science Fiction. The book reveals and projects how Indian Science Fiction writers are good at handling space and time in their works. One assumption is that there are no limitations or boundaries for science fiction writers in regard to handling time and space. The t**hird** grouped parameter is the handling of characters with superpower, machineries, robots, space-voyages, space-ships combined with realism. Some writers of Science

Fiction make their heroes so powerful, so omniscient and gifted as to cast doubts about whether the heroes are really gods in disguise. Science Fiction deals with the fate of the entire world or planet or Galactic Empire, or the Whole race or even the Universe. Science Fiction writers create characters that not only make the Universe but also save the entire Universe. Men and women who appear in SF stories are merely representatives of humanity. The **fourth** parameter is the Narrative technique benefitting in minimizing the distance between setting and events. It is really a difficult task faced by the writer in creating a narrator who can minimize the distance between setting and events, imaginary and real, improbable and probable, unbelievable and believable and impossible and possible. In the history of Science Fiction, it is seen that the narrator of Science Fiction succeeds in performing this task. He creates a sense of realism which is applicable to the present or the future or what has already happened to Mankind. The present book proposes to explore how selected Indian writers succeed in using different techniques of narration to minimize the distance between setting and events. The **fifth** parameter is the presence of epical pattern, element of suspense, grandeur and impossible probabilities and improbable possibilities. There is a resemblance between the form of the epic and Science Fiction as far as their elements are concerned. For instance the element of adventure, suspense, subject-matter, characterization, style appear both in the epic and Science Fiction. The **sixth** is an attitude of writers to Science and the Genre of Science Fiction. Many writers of Science Fiction are of the view that sociology and human relations should merge with modern sciences to facilitate writing of Science Fiction. The form has the opportunity to reach a much larger audience than other types of the novel. It is mainly because there are many scientists who write Science Fiction in the hope of providing knowledge of likely developments in science. Therefore they write very seriously about immediately likely developments. It becomes necesscity to comment on their attitude to both science and the genre Science Fiction. The **seventh** parameter discussed in the book is the effectiveness with which the writer juxtaposes science and its use in present and the future. Science Fiction shapes the future whatever the speculations or visions drawn by writers. They certainly affect the future. Science Fiction makes present and future predictions with a touch of logical reasoning. Futuristic changes are present in all forms of Science Fiction. The **eighth** parameter is most important. It is an interface between Science and Fiction. Basically elements of science and fiction intermingle with each other to establish an organized body of knowledge

or truth. Both the branches aim at man should be energetic, humble, constructive and critical in action and application of scientific knowledge for the betterment and improvement of material condition of life. The results are reliable and logical. Elements like vision, realism-lifelikeness, romance, suspense, truth, speculation, anticipation go together in shaping human life in the world of science and fiction. The **ninth** parameter discussed in this book is prophetic vision and changes in social, political, cultural tradition of the universe. Science Fiction writers anticipate changes in social, political, cultural tradition of the universe. Writers visualize the dominant changes in the context of realistic setting. The **tenth** parameter examined in the book is the balance between realism and romance. Science Fiction mingles the genre of romance and realism. And the last parameter is *Novum*-new thing or themes or issues handled in Science Fiction. The common themes which Science Fiction writers handle are space voyage, rivalry of insect civilization with humanity, war tanks, man eating planets, collision with another star, super accelerating of life, man versus superman with superpower, germ development, future city, decline and fall of galactic empire and so on. Science Fiction writers show innovation in handling the issues relating to society.

The book discusses in separate chapters Jayant Narlikar's *The Return of Vaman* (1990), Rimi B. Chatterjee's *Signal Red* (2007), Anil Menon's *The Beast with Nine Billion Feet* (2009) and Samit Basu's *Turbulence* (2010) in the light of these parameters of Science Fiction. In conclusion part critical comments are made to reveal the importance of all parameters of Science Fiction to study and write any work of Science Fiction.

Acknowledgement

The present book was originally submitted as the partial fulfillment for the degree of Doctorate of Philosophy in English from the Department of English, Savitribai Phule Pune University, in July 2016 under the guidance of Dr Sangita Ghodake, Professor, Department of English, PDEA's B.G. College, Pune. The title of the thesis is "Interface of Science and Fiction: A Parametric Study of Selected Indian Science Fiction". Dr Sangita Ghodake with her gracious generosity with time, inspiring conversations and valuable critical comments, has encouraged me to undertake and complete this work. I would like to thank Late Prof Dr K S Iyer, my mentor, for his unfathomable support in giving me the identity of what I am. It was he who had a strong belief in my ability to initiate and to complete the PhD research work. My genuine thank goes to Dr.Ashok Chaskar, whom I consider my Godfather and the most constant supporter during the academic journey.

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I acknowledge that some parts of this book have been appeared in reputed journals and souveniers of national and international conferences for academic purpose.

Vijaykumar R. Punekar

Content Table

CHAPTER 1

Science Fiction: Genesis, Precursors, Definitions, Evolution, Types, and Parameters

It is necessary to examine critically the definitions of Science Fiction, to trace its development as a literary genre in its own right and to evaluate the contribution made by some of the prominent writers to this genre including Indian Science Fiction writers. Further in this book Jayant Narlikar's *The Return of Vaman* (1990), Rimi B. Chatterjee's *Signal Red* (2007), Anil Menon's *The Beast with Nine Billion Feet* (2009) and Samit Basu's *Turbulence* (2010) have been examined from the point of view of their theme and technique of presentation, handling of characters, plot, setting and science in relation to the parameters of Science Fiction. Therefore at the end of this chapter a brief survey of Indian Science Fiction and critical attitudes to these selected writers as Science Fiction writers have been discussed.

It is important to conduct a brief historical account of Science Fiction as there has been prolific writing in it. The focus should be here to trace the development of Science Fiction as a background to study the selected Indian Science Fiction. It is generally observed in the case of literary genre, the genesis and definitions of Science Fiction are disputed in literature. The views of prominent critics and writers to arrive at the major characteristics of Science Fiction and its features need to be considered.

Science Fiction: Some Prominent Definitions and Characteristics

Defining a literary genre has always been a difficult task. Many literary scholars still struggle with the definitions of some literary forms like novel, short-story, one-act-play etc. It happens because literature is a dynamic field, where literary artists experiment with the existing literary forms or invent new ones and sometimes create novel combinations which defeat definitions. Yet it is a human tendency to systematize explanations by classifying, categorizing and defining the world around. In fact, we spontaneously know what a novel is or what a short-story is. But when we try to define it, we try to set a boundary around it and some literary works hang on at the boundary or go beyond it or force us to reconstruct the

boundary wall to admit some new phenomena. We face the same problem when we try to define Science Fiction. We naturally know what Science Fiction is. A bookseller maintains a separate shelf for Science Fiction where we find paperback volumes with bizarre pictures of strange machines, robots, wired people etc. on their cover pages. However, for the purpose of the study of Science Fiction it is necessary to have some kind of a working definition of it. This section examines some important definitions of Science Fiction and arrives at the most significant parameters of Science Fiction.

Origin of the Term 'Science Fiction'

The name Science Fiction was first used in 1928 by Hugo Gernsback the editor of the magazine *Amazing Stories*. He first used the term 'scientifiction'[1] to characterize the stories based on scientific imagination which used scientific gadgets and the knowledge of science dealing with strange lands populated by equally strange people. After three years he changed this name to Science Fiction. Parrinder Patrick notes that 'the term was excessively attached to magazine fiction and to the anthologies which reprinted such fiction. It was only in the 1950's, that the label 'Science Fiction began to be applied to paperback novels'.[2] It shows that the genre Science Fiction got its name only in the first half of the 20th century. But in the field of literature, literary works resembling a literary type can be found much earlier than its date of establishment as a genre. To define the genre called Science Fiction is a difficult task. Should we include Plato's *Republic* in Science Fiction? Should utopias be described as Science Fiction? Can we say that Mary Shelley's *Frankenstein* (1817) is Science Fiction written in order to fulfill Gothic tradition? A definition of Science Fiction has to answer such questions. Therefore if we wish to define and study a literary genre, it is necessary to find out the criteria, which can help to identify works belonging to that literary genre. We must also identify the practitioners and the reading public of that literary type and their purposes. Keeping this in view there is a need to study critically some important definitions of Science Fiction to understand its characteristics and purpose.

Science Fiction Defined in Relation to Science and Technology

The Oxford English Dictionary defines Science Fiction as

> Imaginative fiction based on postulated scientific discoveries or spectacular environmental changes; frequently set in the future or on other planets and involving space or time travel.[3]

Here the word 'imagination' has been used to contrast Science Fiction with the real in the fictional forms like novel and short-story. These forms, normally, deal with day-to-day life and characters and are characterized as realistic forms of fiction as opposed to the fantastic. The expression 'postulated scientific discovery' refers to inventions such as the submarine, which was postulated in Jules Verne's *20000 Leagues Under the Sea* (1872), where we for the first time come across Nautilus, the prototype of the modern Submarine. The aspect of 'spectacular environment changes' can be seen in Science Fiction like Frank Herbert's *Dune* (1965). Science Fiction deals with strange laws and people who are situated either in future or on some other planet. Space travel has also long been a postulated scientific discovery. The idea of travel through Time Machine has been made popular by H.G wells. The OED definition does not mention robots, computers, strange people like aliens etc. However it underlines the fact that Science Fiction is based on the 'difference'[4] - the otherness of the land and the environment. It is concerned with the world unfamiliar to the reader, the world not of his immediate experience. The New Encyclopedia Britannica defines Science Fiction as follows

> Science Fiction, a literary genre, developed primarily in the 20th century, dealing with scientific discovery or development that, whether set in the future, in the fictitious present, or in putative past, is superior to or simply other than that known to exist. [5]

This definition emphasizes the content of Science Fiction which is a scientific discovery or development and its unrealistic time frame. It also situates the emergence of the genre in the 20th century. The OED definition does not specifically say when the Science Fiction began as a form. Britannica's definition, however, does not mention space travel or other planets. It refers to superiority of the Science Fiction, and scientific discoveries. Space travel, for example, is a later possibility. The present

day science is still struggling with it, but in the Science Fiction it is a vogue. This definition does not note the 'otherness' of the land and the people in the Science Fiction.

Darko Suvin's Definition

The aforesaid definitions do not tell us specifically how we can differentiate Science Fiction from other imaginative works of fiction. For example, fairytales are imaginative fiction dealing with either fictitious present or supposed past. Tolkien's *Lord of the Rings* deals with an imaginative land and the people in the putative past that can be called imaginative fiction. In Kafka's novel, *Metamorphose* (1915), the hero is transformed into a giant insect. Can this be called Science Fiction? Similarly in *The Strange Case of Dr. Jekyll and Mr. Hyde* (1886) by Stevenson, Dr. Jekyll transforms himself into a chemical.

Darko Suvin (1979) has provided a criterion to distinguish Science Fiction from the scientific romance like *Frankenstein* and *Dr. Je and Mr.H*. He has coined the term 'novum' (a new thing) to bring out the point of difference between Science Fiction and Scientific Romances. According to Suvin, Science Fiction is based on 'novum' such as the device like the Time Machine in H. G Wells' novel *The Time Machine* in which the hero is enabled to travel through Time. In Mary Shelley's *Frankenstein* a corpse is reanimated to become a monster. But how this monster is manufactured in the laboratory is only a matter of speculation. There are no details about how this was achieved. It is true that *Frankenstein* exerted great influence on the later Science Fiction. Essentially it is a Gothic Romance, in the tradition of the 19th century gothic novel, which can be the forerunner of the Science Fiction, but not Science Fiction proper. Similarly Kafka in *Metamorphose* (1915) does not explain how his protagonist was transformed into a giant insect. Besides, in this novel, Kafka is mainly interested in the alienation of his hero who suffers and not in the agents of physical transformation he undergoes. On the other hand, Ian Watson in his novel *The Jonah Kit* (1975) uses a new technology which maps the brainwave patterns of a human on to the mind of wheat. Here, as Suvin would say, there is a postulated scientific agent of action that brings about a change, the alterative factor, a Novum, in his terminology. Thus Watson's novel can be classified as Science Fiction but not Kafka's. There is an emphasis on postulated scientific discovery or

development, some mechanisms, which take into account the present principles of Science, which Science Fiction should use in the story. H.G.Wells in his *The First Men on the Moon* (1901) shows a scientist who invents a metal, which resists gravitation. He constructs a vehicle of this metal, in which he and his friends float off to the moon. Jules Verne objects to this as a Science Fiction. He points out that in his own novel *From Earth to the Moon* (1865) his protagonist achieves escape velocity from gravitation having been fired from an enormous cannon ball. He claims to have used present day physics to postulate such a cannon ball. But Wells's 'Metal', according to Suvin was sheer impossibility.

Suvin's idea of 'Novum' tells us that Science Fiction can be distinguished from other forms of imaginative fiction. There can be more such novum- the novas- which can explain particularities of Science Fiction.

There are definitions of Science Fiction by well-know critics like Darko Suvin, Robert Scholes and Darrién Broderick, which have exerted great influence on the study of Science Fiction. Darko Suvin defines Science Fiction as

> A literary genre whose necessary and sufficient conditions are the presence and interaction of estrangement and cognition, and whose main formal device is an imagination frame world alternative to the author's empirical environment. [6]

The terms 'estrangement', 'cognition', and 'alternative' are the key terms in the definition. Estrangement refers to the element of difference in Science Fiction, which alienates us from our day-to-day world. Cognition refers to rational logical understanding of the landscapes and people of a strange world, totally unfamiliar to readers. According to Suvin both these are necessary in Science Fiction to make it relevant to our world. Secondly, Science Fiction presents to us the 'alternative' world which should be within the range of possibility. It should obey the principles of science. Jules Verne, as pointed out above, rules out the metal that resists gravitation in Wells's novel *The First Men on the Moon*.

Suvin makes it very clear that in Science Fiction scientific possibility is one of the key aspects. He requires Science Fiction to present

scientific method, 'the logical working throughout a particular premise'. A new device or a new landscape that Science Fiction presents must have cognitive logic. For example a number of Science Fiction writers wrote about canals or lakes. These Science Fiction works are acceptable because the main point about them is rational discourse. They present the alien worlds in terms which impress us as scientific discourse.

Robert Scholes: Discontinuity from the Known World

Robert Scholes looks at Science Fiction as 'Structural Fabulation'. He defines Fabulation as "any fiction that offers us a world clearly and radically discontinuous from the one we know, yet returns to confront that known world in some cognitive way". [7]

Here, Scholes emphasizes that the world of Science Fiction is different from our actual world but at the same time Science Fiction comes back to this world of ours in some cognitive way. In other words, he means that Science Fiction is not an escape from this world. It is on the other hand part of the system to which this world belongs. Science Fiction is aware of the universe as a system of systems, a structure of structures: This Structural Fabulation may not follow scientific methods and it is also not a substitute for actual science. According to him Science Fiction or Structural Fabulation explores human situations, which have brought to light the invention of recent science. Scholes has thus given Science Fiction a deeper meaning and has placed it in the mainstream of 20th century literature.

Post-Modern View of Science Fiction

The latest effort of defining Science Fiction is by Damien Broderick, who himself is a writer of Science Fiction as well as a critic looking at this genre from a theoretical point of view. His definition of Science Fiction runs as follows

> Science Fiction is that species of Story-telling narrative to a culture undergoing the epistemic changes implicated in the rise of supersession of technical- industrial modes of production, distribution, consumption, and disposal. It is marked by (i) metaphoric strategies and metaphoric tactics, (ii) the

> foregrounding of icons and interpretative schemata from a collectively constituted generic 'mega- text' and the concomitant de-emphasis of 'fine writing' and characterization and (iii) certain priorities more often found in scientific and post modern texts than in literary models: specifically attention to the object in preference to the subject. [8]

Broderick places Science Fiction within the story-telling genres of the novel and the short-story, and traces its emergence to the changes brought about by techno-industrial revolution of the 20th century. He explains the writing techniques of Science Fiction broadly as metaphoric and metonymic-Metaphoric in the sense that the world of Science Fiction metaphorically presents the real world and metonymic in the sense that elements in Science Fiction partly stand for the real world. For example, the time-machine, as a novum, is the part of the imagined world of Science Fiction. The whole novel is a metaphor for the real world. Another important aspect of Broderick's definition is his mention of 'de-emphasis on fine-writing' in Science Fiction. He recognizes Science Fiction as a popular mode of writing. The authors of Science Fiction pay more attention to the presentation of the object rather than the literary style of writing. A Science Fiction writer cannot spend his time and space in presenting well developed round-characters, because in Science Fiction the characters are part of the equipment of Science Fiction, not the real people. Most Science Fictions have very thin plot, artistic style and shallow characterization. Broderick, here, tries to accommodate popular pulp Science Fiction. He appears to suggest that Science Fiction is not 'serious' or high art. Some practitioners may not agree with him.

Wells and Heinlein: the Methodology of Presentation

Earlier, H.G.Wells, who greatly contributed to the evolution of Scientific Romance into modern Science Fiction, believed that

> the living interest in the Science Fiction lies in their non-fantastic elements and not in the invention itself. The thing that makes such imaginations interesting is their translation into commonplace term and a rigid exclusion of the other marvels from the story. Then it becomes human….As soon as the magic

> trick has been done the whole business of the fantasy writer is to keep everything else human and real. [9]

Wells, here, is trying to restrict the element of invention (pseudo-scientific device or mechanism) in Science Fiction and then explores its consequence in a rigorous realistic manner. Robert a Heinlein, a writer and a critic, also believes in presenting an essentially realistic picture of social development through Science Fiction. He calls Science Fiction 'Realistic Future-Scene Fiction' and defines it as:

> A realistic speculation about future events based solidly on adequate knowledge of the real world, past and present, and an understanding of the nature and significance of the scientific method. [10]

Both, Wells and Heinlein underline 'human problems' and 'a realistic picture of social development' in their definition of Science Fiction. After 1960, in the new wave Science Fiction, the new generation of writers took liberty with the speculation elements in Science Fiction. The Post-modern writers Thomas Pyncheon, John Barth and others considered all experiences to be science fictional. This post-modern attitude influenced the New Wave Science Fiction writers.

Alien Encounter or the Other World

The aforesaid definitions of Science Fiction emphasize the encounter with a world that is different. It is the 'otherness' of the aliens, of the landscape; of the flora and fauna, which, Science Fiction explores with the help of a "novum''. McCracken says that "at the root of all Science Fiction lies the fantasy of alien encounter…the meeting of self with the other is perhaps the most fearful, most exciting and most erotic encounter of all". [11] This explains the tremendous interest of Science Fiction readers in Science Fiction dealing with aliens from Mars and other planets. The planets, the terrestrial land, also function as the alterity-the otherness of the earth. What is more, Science Fiction provides a form to deal with the otherness, or alterity of gender, race, and even alternative ideology. Science Fiction can give symbolic expression to female experience or the experience of being black in the white majority, or in the Indian situation belonging to the low-caste.

Novas: the Subjects and Themes

Now with reference to these definitions, it is possible to categorize the subjects and themes, which differentiate Science Fiction from fantasy and other kind of literary fiction. Adam Roberts makes it very clear that it the element of theme that differentiates Science Fiction from other literary genre due to metaphoric and symbolic presentation. The themes comprise spaceships, interplanetary or interstellar travel, aliens and the encounters with aliens, mechanical robots, genetic engineering, biological robots, androids, computers, advanced technology, virtual reality, time travel, alternative history and fantastic utopias or dystopias.

The success of the Science Fiction lies in balancing the elements of 'estrangement', (alienation or otherness) and 'cognition' (scientific rationale behind the Science Fiction, the 'novum' introduced by it). Samuel Delaney looks at Science Fiction as a 'symbolist genre because it seeks to represent the world instead of reproducing it'.[12] Darko Suvin also calls Science Fiction "a symbolic system…centered on a novum which is to be cognitively validated within the narrative reality of the tale". [13] The symbolism in Science Fiction is however different from the one used in mainstream literature. It is akin to realistic mode of fiction in giving details of the new world. It is so because 'novum', in Science Fiction must be explained convincingly in concrete terms.

With the help of these definitions of Science Fiction, themes and subjects it deals with and its methodology, the researcher undertakes to study the history of Science Fiction, briefly, to understand its genesis and progress throughout the 19th and 20th centuries.

Science Fiction: A Brief Historical Review

To find the evidences of parametric structure of the form, it is essential to conduct a detailed historical review of the genre.

The Question of the Origination

In tracing the history of a popular literary genre, the first question that we face is about its origin. This question is tied up with the definition of the genre, or its characteristic features. Some scholars, who try to study

the history of the novel, begin with Plato's *Republic*. Aristotle's observation about gravitational force cannot be denied. The case of Science Fiction is not different. If we take the element of 'estrangement' or 'alterity' as a focal point, a Utopian Fiction can be classed as Science Fiction. The travels of Gulliver to Laputa or to the land of horses can also be called Science Fiction. This problem arises because Science Fiction is also a part of literature in general and as a result of it shares some generic features of literature with other forms. It has affiliation with other sub-classes of literature.

All definitions of Science Fiction emphasize the element of science in it. There are, of course, differences of opinion about what counts as science and how the elements of science figure in Science Fiction. If we examine the critical research articles on Science Fiction, we find that Science Fiction, as a recognized literary genre, is the phenomenon of the 20th century. Peter Nicholls, a critic of Science Fiction, says that "Science Fiction proper requires a conscious outlook which did not emerge until the 19th century". **[14]** In the *Epic of Gilgamesh* and in the *The Bible*, there are fantastic scenes and miraculous occurrences. In Indian mythological history '*The Ramayana´* there is a mention of stones floating on the water and the miraculous 'Pushpak' a plane in which Rama travels from Lanka to Ayodhya. But the criteria given by Nicholls rules out such works from Science Fiction. Though scientific outlook emerged in the 17th century western society, the background for Science Fiction came into existence in the second half of the 19th century, during the industrial and technological development. Space travel or travels to the planet has been the dream of man, but it received the scientific and technological outlook only in the industrial age i.e. the 19th century. Though the texts such as Mary Shelley's *Frankenstein* and the fiction of H.G.Wells and Jules Verne appeared in the 19th century there was no awareness of Science Fiction as a literary genre. However, we must note that literary forms evolve from earlier practices.

A form does not emerge all of a sudden in a particular year, nor does a publication of a particular book launch a form of literature. Characteristics and conventions which have been noted in 1.08 appear isolated in one or the other literary work. For example, voyage to the moon had become a convention in literature from the 17th century onwards. Similarly future wars, aliens from other planets, strange people, and

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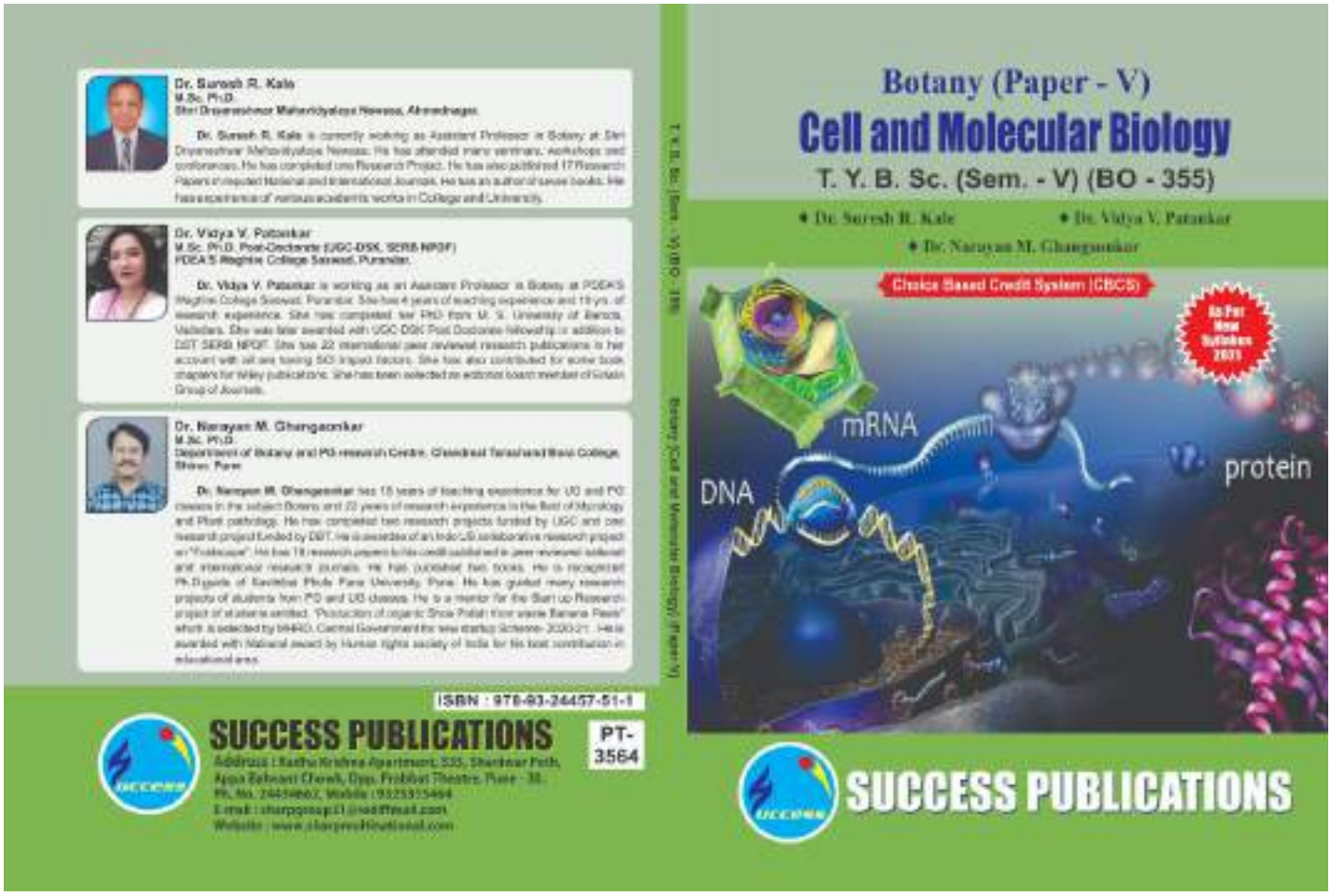
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SWOT Analysis of Management Education in India

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Abstract:

The management education has played on important part in the social uplift and overall development of the society. It's the responsibility of Management Institutes and business schools to give qualitative, applicable, current, and streamlined knowledge to the scholars in the competitive world. Unfortunately the business schools face several challenges in terms of conducting quality education. Moment, in the age of globalization external environmental forces and stakeholders continuously put pressure on the business seminaries to acclimatize the changes passing in the business world. Significance of Management education has increased in numerous crowds; hence it's a need of Business directors to modernize their chops due to unforeseen changes in the external terrain. In order to meet the challenges in advanced education, the business schools need to maintain their standard of excellence by paying attention to performance dimension. In order to maintain the quality education, business schools to remain in close contact with the assiduity. It's also important that the Education Institutions need to strive to achieve balance between the education cost and the quality. Management education in India is going through changes. The changing script offers scholars more openings, lesser tone- confidence and out of the box ways to more hones their chops. The current trends include increased focus on transnational hookups, externships, pupil exchange programs, common degrees etc. Also, the use of new technologies in operation tutoring is a trend that's catching up presto. The role of management Education in national development is well established. The objectives of management Education can be achieved only through qualitative change in the system. This paper focuses light on Strength, Weakness, Opportunities and Threats of management education in Indian scenario.

Keywords: Management Education, Strength, Weaknesses, Opportunities, Threats

Introduction:

Management education includes undergraduate, post graduate and PhD courses in operation. The courses may be full- time, part time, superintendent, distance literacy or specialized. The subject of focus of this study is post graduate courses in operation. These courses come with a variety of names- Master of Business Administration (MBA), Master of Management Studies (MMS), Master in Finance Control (MFC), Master of Public Administration (MPA), PG Diploma in Operation (PGDIM), PG Diploma in Human Resource Management (PGDHRM), PG Diploma in Financial Management (PGDFM), PG Diploma in Operations Management (PGDOM), PG. Parchment in Marketing Management (PGDMM) etc. Education is developing essential capacities and power of scholars. It's the process by which society designedly transmits its accumulated knowledge, skill and values from one generation to another. Education in the largest sense is any act or experience that has a constructive effect on the mind, character or physical capability of an existent. The current trend in the education is, it offers the actors more openings and lesser tone- confidence to enthrall high managerial positions. Eventually, it enables them to profit from the colorful School networks which can also be a precious support throughout professional life.

Management education, nearly unknown in the nineteenth century, has come a dynamic force for change in numerous universities, in the workplace, and in the societies of both industrialized and developing countries. Its part in the professionalization of enterprise operation is extensively honored, though it has been blamed by some for placing emphasis upon short- term profit criteria. Management education is considered as snoots as it attracts youthful men and women who are generally motivated by the positive consequences associated with operation education. In India advanced education especially management education is witnessing an exponential growth in terms of number of institutes conducting operation education which are generally nominated as business academy. Management Education is each about learning different chops and to apply them for collective and multi faceted growth and value creation.

Objectives of Study:

1) To study the concept Management Education and its importance in India.
2) To study the recent trends in Management Education in India.
3) To make SWOT analysis i.e. Strength, Weaknesses, Opportunities and Threats in Management Education in India.
4) To suggest necessary measures for growth Management Education in India.

Research Methodology:

The methodology adopted for present study is descriptive. For the purpose of study, secondary sources of data collection viz. various Magazines, journals and internet websites have been accessed.

Importance of Management Education in India:

Management education helps students to encourage them to think differently and add value to the existing qualification. It enhances managerial and leadership skills by sharing of ideas, through healthy, meaningful and case study discussions. Management education provides requisite skills and abilities to get the going smoothly at the corporate world; an opportunity is provided to network with others and promote cross-cultural diversities. The management education helps in equipping the executives with competencies and capabilities further empower to accept the corporate challenges with confidence. We are in the era knowledge which is expanding at an unprecedented rate. Our management schools could not meet this challenge even today. Therefore there it is a need to change our management education. To take the advantage of this demand, lots of people have opened educational institutions to educate students in the field of Commerce and Management. Management education has grown tremendously over the period of time. Even though there are certain challenges in management education, which need to be addressed through appropriate policy formulation and its effective implementation.

Strength of Management Education in India

1) Indian business/management/higher education system has been integrated globally by virtue of English as a medium of instruction.
2) Our business /management education is internationally competitive.
3) Declaration of several institutions of excellence as Deemed University and Autonomous Institution is a significant milestone.
4) Establishment of apex bodies like UGC, AICTE etc.
5) Significant steps taken by UGC, ALCTE, NAAC & NEA to achieve quality of management education.
6) India is considered as one of the richest countries and many skilled workers from India work abroad with the help of our higher education/management and human resource skills.
7) Indian business/management education when compared with foreign countries is highly subsidized; thus it is accessible to the poorest of the poor of the India.
8) Establish of laboratories with global standards in IITs, IIMs, RECs, CEIR and some Central universities is significant strength of Indian education system
9) Establishment of Regional Engineering Colleges (RECs) to the status of IITs is added advantage to the education system.
10) Setting up of offshore campuses abroad by Indian universities is clear evidence of the strength of Indian education.

Weaknesses and Challenges of Management Education in India:

Some of the important weaknesses, drawbacks and challenges of Management Education in India are as follows;

1) The course contents are too theoretical and do not equip students with the right Attitudes, Skills and Knowledge to make them employable immediately after completion of the course.
2) In the present system of examination students are not properly educated to fit them as per industry requirements or to be businessman to start and grow up small and medium business enterprise

3) Students only get a degree without industry-required qualifications.
4) No institutions or students are clear as to what type of "product specification" is achieved at the end of the completion of the course.
5) More than 85% of the students who complete their MBA/PGDM degree are not ready for industry.
6) Inadequate availability of specialized, talented experts and qualified faculty
7) The syllabi of management education lack industry based specializations
8) Heavy burden with irrelevant and traditional subjects
9) No proper guidance to the students due to insufficient qualified faculty
10) Lack of Inter-disciplinary approach in overall management education System
11) For quality research in management studies absence of specified authorities
12) Most of the management schools are on non-grant basis hence no sufficient grant is available for research
13) Industry would like to know and be assured of the product specification quality of the Graduates as like customers to know about the specifications and quality before buying the product
14) Indian Management Education appears to be a wide gap between what is needed on the jobs & what is taught in the management schools.
15) The other weakness pertains to teaching techniques that are concentrating on lecture method only
16) There is no provision of academic audit in educational institutions including universities/management schools/ B-schools
17) Quality of business/management education provided by majority of Indian universities/management schools is questionable
18) Student's assessment and feedback are not made and used by management schools.
19) The current syllabi of management education do not teach students how the problems are braved in changing business environment.
20) In management subject, most of the concepts are thought with case studies which are too old and not suitable for references in current scenario
21) Management education does not focus on the challenges arising out of rapid growing new technology and the challenges involved in day to day running of an enterprise.
22) The best talented management graduates have joined industries where salaries are attractive
23) For most of the Indian companies it is not possible to give better salary package to employees with comparison to other Multinational companies
24) Academic heads for management schools/universities/B-school are not selected based on global merit. Indian Universities/management schools/B-schools are considered as islands of excellence as academic have no interactions with society and their global counter-parts.
25) Indian universities/management schools/B-schools are highly centralized.
26) In the decision-making process, the concept of participatory management is not adopted.
27) Complicated office procedures are adopted in Indian business /management institutions.
28) Administrative staffs working in management schools/universities are not professionally qualified/trained.
29) Indian universities/management institutions/B-school follows absolute methods of administration
30) Over lapping functions of Multiple Apex Agencies-UGC, AICTE, NAAC, NCTE, NIEPA, NBA, HMRD etc. Lack of equality of education opportunities among different segments of learners
31) The ratios of employment of management graduates with creation of management graduates is too high therefore every management graduate could not be absorbed in the industry or those who come to this profession by chance are not capable to accept the challenges in business sector.

Opportunities of Management Education in India:

The following are some of the opportunities of Indian management /Business education system.

1) Curriculum design and development, examinations pattern should be done in consonance with the pattern of UPSC/PSC/NET/SET examinations
2) Indian students are to be encouraged for further studies like PG/Ph.D at other universities to avoid inbreeding and to encourage cross fertilization of academics and knowledge
3) Information Technology (I.T) is to be used largely in management education. Latest technologies like web education, Internet, videoconferences are to be fully utilized to bring access

4) As in the case of trade and industry, provisions are to be created/or bottlenecks are to be removed to open educational institutions
5) The management education is to be internationalized and while doing so the relevance and quality should be the prime consideration
6) Private Universities/Institutions are to be encouraged to impart commerce/management education while Govt./its agencies facilitates and monitor their function
7) Business/management schools/universities are required to react at pace with the global changes in other sector
8) Business/Management schools/universities have to work with a view to satisfying the students who are their clients
9) More Endowments are to be created and Alumni/Teacher Association/Industry can be tapped in this respect
10) Business/management education should be made a key element of national development activity by necessary tie ups with other sectors like health care, poverty alleviation, infrastructure development etc.
11) Autonomy to Indian school of Business/management education should be given only after higher rating for it besides NAACs accreditation
12) Assessment expert committees of UGC/AICTE and accreditation peer teams of NAAC/NBAs should be clubbed in areas of similarity
13) Acts, Statutes and Regulations of UGC/AICTE/Universities are to be in conformity with one another and follow a broadly similar pattern
14) The results percentage of NET/SET of universities may be taken as one of the key parameters of performance of universities/management institutions.

Threats of Management Education in India:

Like trade and industry, business/management education faces many threats. The selected threats of Business/management education are summarized below:

1) State Governments do not take much care about quality of business /management education in their respective areas
2) In the field of commerce/management education, most of the doctoral research dose not contribute to knowledge but only creates additional data.
3) The quantitative expansion of management schools creates the surplus of teachers.
4) In spite of Government/its agencies' intervention to regulate/control, all professional education including management education to a longer extent has been commercialized in India.
5) Liberal arts and science education have endangered business /management education.
6) The majority of the Indian learners are forced to learn only traditional courses due to compulsion and lack of opportunity.
7) Presently several courses are run just for the sake of survival of those departments and to sustain the jobs of teachers.
8) Indian business/management education suffers due to lack of academic audit mechanism.
9) The management institutions are assessed for financial assistance in terms of numerical parameter rather than academic quality, academic output etc.

Remedies to improve quality of Management Education in India:

1) Organization should be formed of specific industries to discuss, analyze advantages, disadvantages and opportunities with different dimensions of that particular sector standing on a common platform and find out concrete requirement from management Institutes.
2) Proper collaboration and cooperation among domestic and foreign companies is required to explore new opportunities in several fields of operations
3) To improve the infrastructure as per the standards of global level
4) Government should take initiatives to advertise opportunities in different field to attract Foreign Direct Investment and Foreign Portfolio Investment
5) Making direct link of educational institutes with business organizations to provide direct industry interference in large scale with practical approach to students and get easy employment.

Conclusion:

In this paper an attempt is made to SWOT analysis i.e. Strength, Weaknesses, Opportunities and Threats in management education. A student creativity is mostly depends upon his experience and subject knowledge which is relating to his effective learning. The future needs for business/management education will be

significantly different from the past, but that today's business schools are too rigid & traditional to respond with innovative solutions. There are so many forces blocking change that movement on any singly front will prove inadequate for overcoming the other source of resistance. Moreover many of these blocks are beyond the control of most business schools, which are embedded in a wider university and professional culture. If the management schools/universities are always alert, it can easily overcome its weakness and threats by its strengths and opportunities. It is also true that practical implementation of some of the above issue are debatable. However, they alert us with the need to thwart the obstacles and thereby help the development of intelligent strategies for clear perspectives towards achieving prominence for Indian business/management education in global scenario.

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Chapter 13

Valorization of Secondary Metabolites in Plants

Vidya Patil-Patankar, Pallavi Yadav-Bhagwat, Pradnya Kedari

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Summary

Plants have been used as traditional medicine to cure diseases as well as a substitute for synthetic raw materials in the food, perfumery, cosmetic and pharmaceutical industries, etc. The essential oils extracted from the plants have also been shown to have antimicrobial (antifungal and antibacterial) and antioxidant activities. The biomass produced by such plants is utilized as food for human consumption or fodder for domestic animals. The pharmaceutical and agriculture industry also utilizes plants for the production of important chemicals. Production of biomass can be achieved by the use of elicitors in tissue culture and mutation breeding. Mutation breeding is a suitable method for plant breeding as the new mutant varieties and the original variety have the same genetic background with the only difference being the mutated genes. Therefore, new mutant varieties can be used for cultivation under the same conditions as their parental varieties, which is not always the case for new varieties developed through crossbreeding where new agronomies have to be developed for the new forms. This approach also

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Valorization of Secondary Metabolites in Plants

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Abstract

Plants have been used as traditional medicine to cure diseases as well as a substitute for synthetic raw materials in the food, perfumery, cosmetic and pharmaceutical industries, etc. The essential oils extracted from the plants have also been shown to have antimicrobial (antifungal and antibacterial) and antioxidant activities. The biomass produced by such plants is utilized as food for human consumption or fodder for domestic animals. The pharmaceutical and agriculture industry also utilizes plants for the production of important chemicals. Production of biomass can be achieved by the use of elicitors in tissue culture and mutation breeding. Mutation breeding is a suitable method for plant breeding as the new mutant varieties and the original variety have the same genetic background with the only difference being the mutated genes. Therefore, new mutant varieties can be used for cultivation under the same conditions as their parental varieties, which is not always the case for new varieties developed through crossbreeding where new agronomies have to be developed for the new forms. This approach also increases the important secondary metabolite content of the plant. This chapter focuses on the valorization of secondary metabolites using various techniques including tissue culture and mutation breeding.

Keywords: Biomass, valorization, antioxidants, elicitors, mutation breeding

13.1 Introduction

Plants have been used as traditional medicine to cure diseases as well as a substitute for synthetic raw materials in the food, perfumery, cosmetic and pharmaceutical industries, etc. Plants form an important part of our daily diet. Their constituents and nutritional values have been intensively studied for decades. Plants produce a huge range of biomolecules that are classified as primary and secondary metabolites. Primary metabolites are compounds that have essential roles associated with photosynthesis, respiration, and growth and development of the plant. Secondary metabolites are the compounds playing an important role in the interaction of the plant with its environment however have no contribution to the fundamental life processes of the plant itself. Primary metabolites are compounds that are

Chapter 11

Photocatalytic Biomass Transformation into Valuable Products

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Summary

Biomass is available in large quantity and from a wide variety of sources which include plants, animal waste and microorganisms, and it is a significant part of renewable energy production. The effective development and use of biomass will play a very crucial role in energy and ecological aspects. The nature of biomass is complex, and traditional methods for the transformation and fragmentation of biomass exploits higher energy consumptions and severe reaction conditions which are hazardous to the environment. Therefore, still there is scope for development of clean, eco-friendly and efficient methods of biomass transformation into useful products. The photo catalytic valorization of biomass is an excellent alternative strategy and has received substantial attention

11
Photocatalytic Biomass Transformation into Valuable Products

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Abstract

Biomass is available in large quantity and from a wide variety of sources which include plants, animal waste and microorganisms, and it is a significant part of renewable energy production. The effective development and use of biomass will play a very crucial role in energy and ecological aspects. The nature of biomass is complex, and traditional methods for the transformation and fragmentation of biomass exploits higher energy consumptions and severe reaction conditions which are hazardous to the environment. Therefore, still there is scope for development of clean, eco-friendly and efficient methods of biomass transformation into useful products. The photo catalytic valorization of biomass is an excellent alternative strategy and has received substantial attention because it is simple, mild and environmentally benign method. We wish to describe photocatalytic biomass valorization as an excellent, efficient and green alternative route over the existing conventional methods for biomass transformation in useful products.

Keywords: Lignin, biomass, valorization, catalysis, titanium oxide

11.1 Introduction

Fossil fuel use has been increasing exponentially over the past few decades. Worldwide, more and more people are becoming concerned about global warming. The focus is now on improving the use of natural and renewable energy sources, and in search of innovative alternatives. Scientists around the world are searching for eco-friendly, low-impact technology substances that have equal productivity when compared to conventional non-renewable fuels [1]. Since non-renewable energy sources such as petroleum oil are used regularly, the demand and market for them is strong. Although, it is widely considered a significant contributor to a prosperous industrial society, it is a major source of greenhouse gas pollution which can be reduced if society's reliance is moved from oil fuels to biomass energy [2]. As the substitute of these non-renewable sources, biomass offers an attractive

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Chapter 15 - Nanoherbicides: A sustainable option for field applications

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Abstract

Herbicides are chemicals that are toxic for plants and are mainly used to destroy unwanted plants like weeds in the crop. Herbicides have got immense importance in the agriculture sector and production of it is one of the biggest business industries. Nanoherbicides are formed by nano-based particles used for the synthesis of herbicides and, on the other hand, by effective application for synthesis of herbicide through nano particles-based delivery system. Advantages of nanoherbicides are reduction in the quantity of synthetic chemicals, effective delivery system, the safety of personals, and effective reaction time. Nanoherbicides are novel technology to address all the shortcomings of traditional herbicides. One of the biggest problems that conventional herbicides are facing is resistance developed in weeds which requires strategic planning for its complete removal. Nanoherbicides with properties like high penetration capacity and an effective delivery system can be helpful to solve such problems. This chapter aims to pitch lights on nanoherbicides and its application in agriculture.

Keywords

Herbicides; Nanoherbicides; Pesticides; Applications; Agriculture

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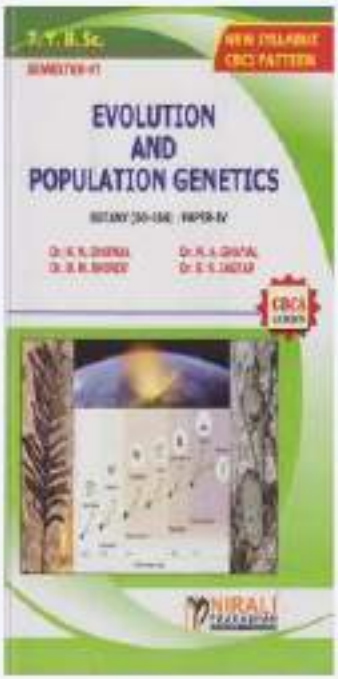

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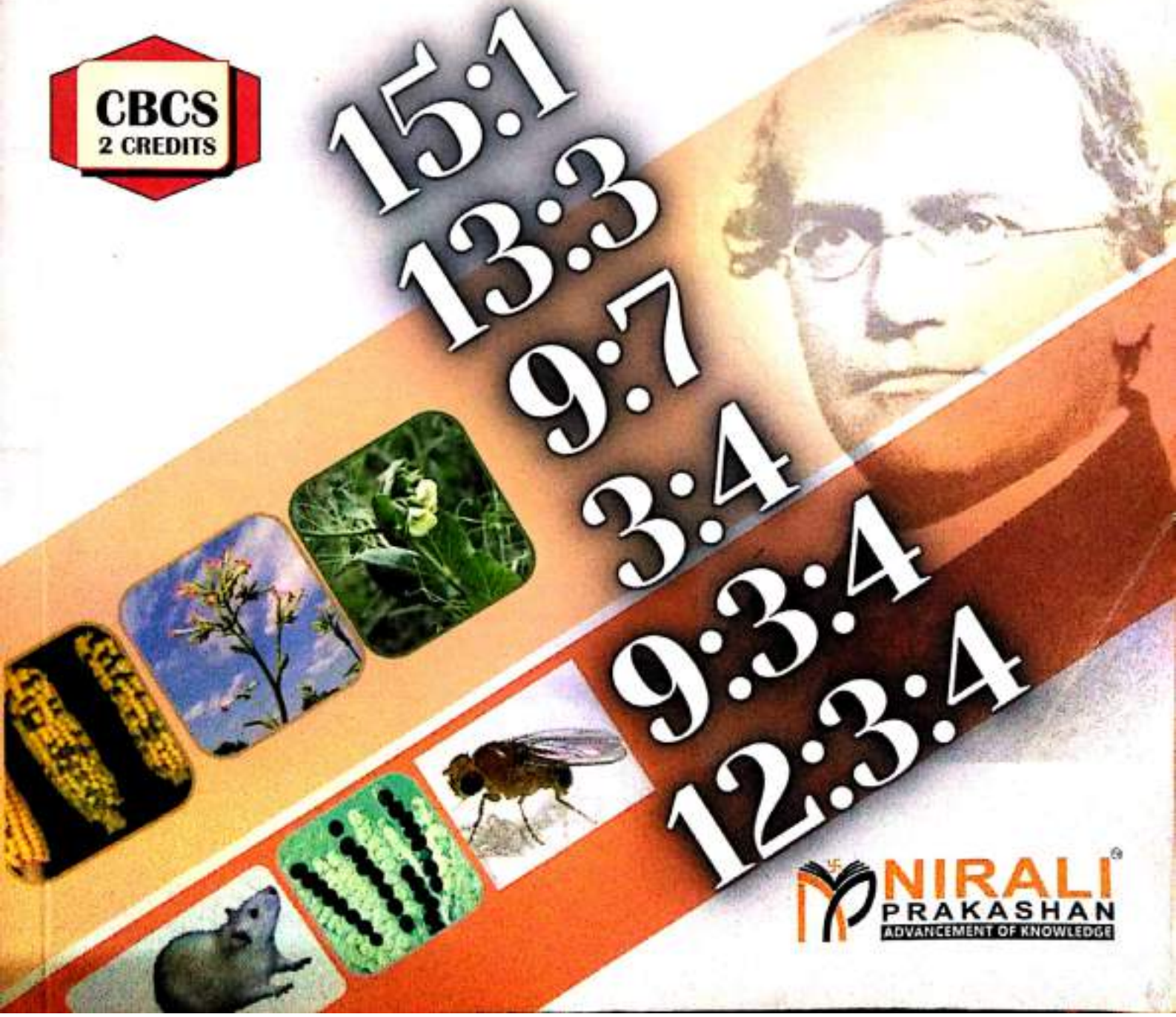

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CHALLENGES AND OPPORTUNITIES OF DIGITAL MARKETING IN INDIA

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Abstract

Digital Marketing is the result of important advancement in technology and inventions. Marketers are faced with new challenges and openings within this digital age. We examine the effect of digital marketing on the enterprises' deals. Digital marketing helps in perfecting services at low cost and are liked by customers. The results of the study indicates that the digital marketing increase the effectiveness of business and services. It reduces the time and cost as well as increases the fiscal capacity of the association. Technology, digitization, social media and mobility etc changed our life style drastically. Digital marketing is a more feasible option than traditional media. In this paper an attempt has been made to understand the conception of digital marketing, its challenges and its opportunities. The paper focus on thesis that, Digital marketing helps in perfecting services at low cost and are liked by customers

Keywords-Digital Marketing, Challenges, Opportunities

Introduction:

Digital marketing has surfaced as a buzz word in last half decade. There's a paradigm of shift in how business is conducted from traditional model to E-commerce model. There's under expansion of products and requests and at the same time challenges are arising to make the players; more competitive in the field. Moment, utmost companies are moreover allowing about or pressing ahead with digital change enterprise. Every company has a website, and many marketing strategies are inked off without incorporating social media. Clearly, social media is a critical element of any digital strategy, but a holistic response to the digital shift must go much further.

Objectives of the study:

1. To study the concept and features of Digital Marketing in Indian scenario.

2. To study the necessity of Digital Marketing.
3. To point out challenges and opportunities of Digital Marketing in Indian scenario.
4. To provide necessary suggestions for better future of Digital Marketing in India

Research Methodology:

The present research is Descriptive Research. For the purpose of the study, data have been collected through secondary sources such as reference books, journals, articles published on internet websites etc.

Digital marketing: Concept and Meaning

Digital marketing is the application of electronic media to promote the business services into the request by the organization. The end of digital marketing is to attract customers and allowing them to interact through digital media. Chaffey (2000) simply define internet marketing as "the operation of the internet and related digital technologies to achieve marketing objects Digital Marketing principally involves following crucial features;

1. Contact customers by e-mail or fax
2. Use business-to- business buying and selling
3. Defies all walls of time and space
4. Online Advertising, Dispatch-marketing, Affiliate marketing Social Media Marketing
5. Produce client data bank
6. Give for business-to- business exchange of data

Necessity of Digital Marketing:

With rapid-fire technological developments, digital marketing has changed customers buying behavior. It has brought colorful advantages to the consumers as given below;

24/7 Shopping

Since internet is available all day long, there's no time restriction for when client wants to buy a product online.

Enables instant purchase:

With traditional marketing, customers first watch the announcement and also find applicable physical store to buy the products or services. Still, with digital marketing, customers can buy the products or services incontinently.

Greater engagement:

With digital marketing, consumers can engage with the company's colorful conditioning. Consumers can visit company's website, read information about the products or services and make purchases online and give feedback.

Easy comparison with others:

Since numerous companies are trying to promote their products or services using digital marketing, it's getting the topmost advantage for the client in terms that customers can make comparison among products or services by different suppliers in cost and time friendly way. Customers don't need to visit a number of different retail outlets in order to gain knowledge about the products or services.

Challenges of Digital Marketing:

In malignancy of the below advantages, following are the challenges of Digital Marketing

High Competition of Brands:

Digital Marketing has a disadvantage when a client quests for a specific product of a specific company on internet, numerous contending goods, and services having same marketing strategies appear on the client's home runner. This conflicts the guests and provides an indispensable option to choose cheaper and better quality product of another company. As a result, some consumers warrant the trust on a lot of announcements that appear on a website or social media and consider it as fraud and look like a dishonest brand.

Threat of Hacking Strategies:

The threat of playing creation strategies of a company always rests on digital channels (internet) that's one of the downsides of digital marketing. The hackers or challengers can fluently track and copy the precious promotional strategies of a well famed company and can use for their purposes.

Anti-Brand Conditioning:

Another drawback of digital marketing is that indeed a person or group of persons can harm the image of a honored brand through 'Ringer'. Anti-brand activists, bloggers, and opinion leaders spread the term 'Doppelganger 'to disapprove the image of a certain brand.

Announcement for Limited Products:

Another practical debit of Digital Marketing is that it's only salutary for consumer goods. The artificial goods and pharmaceutical products cannot be retailed through digital channels. The forenamed information may help digital marketers to understand the strengths and sins of Digital Marketing.

Limitation of Internet Access:

The Digital marketing is nearly reliant on internet. The Digital Marketing can be unprofitable in those areas having no or limited internet availability.

Limited Consumer Link and Discussion:

As digital marketing is largely dependent on internet, so the marketers may find it hard to make their announcements more comprehensive and start a discussion with their consumers about the company brand image or products.

Opportunities of Digital Marketing:

Digital Marketing can be successful and openings after exercising different tools and ways. These tools help marketers to get maximum benefits of digital marketing similar as:

Cost Effective Channel:

Using the internet, Digital Marketing is plant cost-effective and cheaper source of advertising as compared to traditional marketing channels like T.V, Radio, Magazines, Journals, and Banners etc.

Helping Marketers' Career:

Digital Marketing has come a salutary career for the individualities that are familiar with enforcing digital marketing strategy and helping companies to expand their brands to target guests through internet.

Easy Consumer Reach: Digital Marketing is an effective way of communication for companies to target a large number of implicit consumers at the same time. Using the internet channel for marketing is a quick approach to

target a number of implicit consumers and prospects at same time each over the world.

Direct Advertising:

Digital Marketing enables direct advertising and creates mindfulness about a product or a brand. Now the companies can fluently show their announcements for products and services on different digital channels. But a good online advertising strategy and promotional tools can help digital marketers to perform well in largely competitive marketing terrain.

Global Announcements:

This is one of the most effective benefits of Digital Marketing that enables the companies to make announcements internationally and expand their client reach to other countries across geographical boundaries.

Consumer's Convenience to Shop Online

Due to further fashion ability and capabilities of digital marketing, customers have come more accessible to shop online at any time (24/7 base) whether the shops are over or across the borders. Digital Marketing has opened-up an occasion for companies and retailers to direct its customers to an outlet of the online store.

Responsibility of Marketing Exertion:

Digital Marketing enables the companies to measure their marketing conditioning similar as digital marketing is working or not, the quantum of exertion, and the discussion that's involved. Digital marketing also helps marketers to estimate and review their online contents for quality purposes.

Easy Brand Promotion:

With the development of new technologies and use of internet in business, the brands may take a great advantage of Client's reach and communicate its guests successfully.

Suggestions for better future of Digital Marketing in India

1. Provide a transparent and good service to the consumer before and after purchase.
2. Creating awareness among the people about digital marketing

3. Complete description need to provide about the product to the online shoppers
4. Improve technical advancement in promotion of digital marketing.
5. Collect and implement the feedback provided by the consumer in the right way.

Conclusion:

Digital activities are a decreasingly important part of any marketing and deals strategy. There's a paradigm of shift in how business is conducted from traditional model to E-commerce model. There's under expansion of products and requests and at the same time challenges are arising to make the players; more competitive in the field. Moment, utmost companies are moreover allowing about or pressing ahead with digital change enterprise. Every company has a website, and many marketing strategies are inked off without incorporating social media.

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CHAPTER

8

SCREEN PRINTING: AN EFFECTIVE TOOL FOR THICK FILM TECHNOLOGY

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Abstract:

Thick film technology potentially epitomizesaneconomical production method for large scale devices making. The meritorious properties of thick film technology are its packaging, flexibility and mass production with desired dimensions. Thick film approach can produce multifunctional devices which can possibly utilize in diverse application fields. In thick film technology, screen printing is inexpensive compared to rest of techniques. To make it more feasible to develop thick films, scientists developed ample prototypes in last some decades.Due to tremendous need of denser packaging and anefforttowards greater pin count, screen printing technique has been polished to producehigh definition prints.

The present book chapter deals with the in-depth information about thick film preparation using screen printing method. In addition, it discusses about overview of the further developments in screen printing methods.

1. Introduction:

'Thick film' (more correctly 'printed-and-fired') technology, uses conductive, resistive and insulating pastes containing glass frit, deposited in patterns defined by screen printing and fused at high temperature onto a ceramic substrate. The thickness of films is typically varying in the in the range 5 μm to 20 μm, with theresistivity range is in-between 10Ω/square to 10MΩ/square [1].

The thick-film process is a relatively simple concept. A substrate is silk-screened with a pattern using the required ink, and the ink is dried and fired to produce a hardened version of the desired pattern. Multilayer thick-film ceramic substrates are of paramount importance in the thick-film processes. The rough surface helps to raise the adhesion of paste or ink on base substrate (alumina). The screen with desired patternmust be tightly held in equalextents and in tightness. The inks or material pastes are made of the solvents, binder material and functional powders mixed together into slurry. The prepared paste must look to possess the properties of paint. In order to produce conductors, resistors, or dielectrics films, we have to utilize the powdersof metals, metal oxides, and low-melting-point glasses [2]. The prime step in processing paste or ink is deposition by forcing ink through openings in the patterned display with the help of a wiping arm or squeegee. To

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3 Library and Information Science Education: NEP 2020 Scenario

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Abstract :

This paper reviews the revisions included in NEP 2020 in general and investigates it's impact on LIS education in particular. This paper reviews present LIS education at UG and PG level and proposes changes in its framework in line with it's preparedness for NEP 2020. The paper discusses history of LIS education and illustrates the International LIS training. The adoption of NEP 2020 and its impact on LIS education is illustrated. This paper draws a framework on design of LIS education.

Keywords : Education Policy, Library and Information Science Education, LIS Curricula

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Introduction :

Internationalisation of Education is attempted in the NEP 2020 (India). The curricula and its pattern need to be updated with immediate effect to adapt the policy across the disciplines and at various educational levels. Introduction of multiple Entry and exit, choice-based credit system is evident of the same. Abdullahi et al. (2007) poses the prime challenge in developing a curriculum so as to serve globally rather than ensuring national priorities. The curriculum in that case "does not rely on prior knowledge of local provenance" adds Abdullahi et. al., 2007. It also introduces stay-at-home so as to meet the global demands. Curriculum restructuring of Indology, Indian languages, AYUSH systems of medicine, yoga, arts, music, history, culture, and modern India, etc subjects are identified so as to meet the global quality standards, attract international students, and achieve the goal of **'internationalisation at home'.** NEP 2020 promotes creativity and autonomy to

innovate on curriculum, pedagogy, and assessment. It is suggested to integrate its academic plans (ranging from curricular improvement to quality of classroom transaction) into its larger Institutional Development Plan (IDP). All HEIs need to seek funding for clubs and events dedicated to science, mathematics, poetry, language, literature, debate, music, sports, that has to be organized by students with the help of faculty and other experts as needed. Universities and colleges will set up high-quality support centres. Adequate funds and academic resources will also be given to carry this out effectively. ODL programmes equivalent to the highest quality in-class programmes will be introduced. There will be norms, standards, and guidelines for defining framework for quality of ODL. Through which, HEIs will aim to achieve global standards of quality irrespective of mode of education.

Library and Information Science Education :

LIS education at various levels, viz. Certificate, diploma, degree, postgraduate to the research degrees. It is noteworthy that, in 1937 Dr. S. R. Ranganathan introduced one-year post-graduate diploma course for academic librarians., Aman & Sharma, 2005. Earlier there was three months' duration certificate course, which was also introduced by Ranaganathan. Approach to Teacher Education is elaborated in the NEP 2020. However, the approach to LIS Education to prepare competent LIS professionals is not addressed in the NEP 2020.

2.1 LIS education at UG level (Present Practice) :

NEP 2020 adapts to cope with the international education pattern of four years degree. In this scenario, there is a requirement of revision in LIS Education at UG and PG level. At present there are two options

Option 1 : UG 3 years and BLISc (1 Year), MLISc (1 Year)

Option 2 : UG 3 years and MLISc (2 Years Integrated).

The above options do not fit into the new education system, however there is nothing mention about LIS education in NEP 2020. Therefore, the following structure can be adopted in National Education policy 2020.

2.2 Proposed structure for LIS education as per NEP 2020 Guidelines:

Unlike teachers training, NEP has not suggested any structure for librarians training in the NET 2020 document. The sole objective of bringing the education policy was because of change of earlier information-based society to today's knowledge-based society. Ironically knowledge resource centres and knowledge workers are not given enough importance in the policy. The future of any profession depends on the quality of education given to those

professionals. Considering this view, following structure is proposed for LIS education based on NEP general recommendations.

2.2.1 UG degree with multiple entry and exits with multiple options:

A. Option one: Three years degree with Library Science Major

This course should be introduced at undergraduate level like other subjects. In first year, students will study other subjects as well with library science subjects. After first year they will get certificate in Library Science, if they want to exit the program at this stage then they can take exit but they need to complete project in library science. After some years student can come anytime take admission and continue studies. After completing second year along with the project, student will gets Diploma Degree, at this stage also he/she can exit the course and come back after few years. As per NEP guidelines students are allowed to complete the degree in 7 years. As student needed to complete degree in 7 years counting needed to be done backwards e.g a student exits in first year needs to re-enter in 6th year. After completing the students will get awarded graduate degree

Total Number of Credits required to get final degree are 120. Out of these 120 credits student needs to secure 60 credits from Library Science Major Subjects. Students are allowed to take optional subjects from other disciplines to earn remaining 60 credits.

B. Option Two: Four Year Integrated Degree

In this first three years will be the same as in the three-year degree. In fourth year, research component will get added. To get admission in fourth year students' needs to secure 7.5 CGPA. The post graduate degree will the awarded after completion of fourth year along with dissertation.

2.2.2 PG Degree:

At present any graduate is eligible to take admission in post graduate program of Library and Information Science (LIS) which is not par with other professional programs. To improve the quality of LIS education our programs should at par with other professional programs. In present 2 years masters degree MLIS and one year bachelor's degree enable provide the skills required for library professionals. Many times, students need to undertake other courses to improve communication skills and ICT skills. Therefore, it is important for library science department to design post graduate program based on the undergraduate program recommended earlier

One year master degree program after completing for year PG program and two years master's degree after three-year degree program. Again, entry

and exit facility should be provided after completion of first year of two years masters program.

Total Number of Credits required to get one year master's degree should be 40 credits, 20 from core subjects and 20 from electives chosen by students to maintain flexibility suggested in NEP 2020. Here also project should made compulsory so the exit from first year becomes possible.

However, for two years master's degree where eligibility should be completion of three years Bachler degree from LIS. Total number of credits required to get one year master's degree should be 80 credits, 40 from core subjects and 40 from electives chosen by students to maintain flexibility suggested in NEP 2020.

Certain expectations from libraries are reflected in NEP 2020. The libraries need to be equipped with the resources, as mentioned in NEP 2020. Human resources (library personnel) in that case are not discussed in the policy document. However, the need to upgrade the library personnel is needed for implementing the policy. To meet these demands, the library personnel need to attain the skills and knowledge at the particular educational levels. Turner & Gorichanaz (2016) mentioned several skills to be developed and applied by the library personnel and identified the need to redesign collection development skills. These include communication skills, managerial skills, collection management skill.

2.2.3 Ph.D and Research:

Four year integrated PG degree holder can directly be enrolled for Ph.D program along with one year and two year master's degree holders. The policy (NEP 2020) made it clear that, Ph.D students are supposed to have an actual teaching experience as a partial fulfilment of the degree. National education puts lot of emphasis on research at university level and in general. Government announced Rs. 20000 crore budget for research in NEP 2020. The policy suggested three types of universities 1) Teaching 2) Teaching and Research and 3) Research University. Equal opportunities and funding should be provided to LIS professionals especially working librarians so that they can contribute to the development of subject and society.

Aspects of LIS Curriculum

Curriculum is very important aspect of any education policy NEP 2020 is no exception to that. NEP 2020 emphasis industry connect, internship, taring and skill-based education. Involvement of industry people in curriculum development is very

important aspect. Only industry knows what type of skills are required to run the industries. Similarly, while developing LIS curricula involvement of practicing LIS professionals is very important. Therefore, good number of practicing librarians should be nominated on Board of Studies (BOS).

3.1 National Level Board of Studies LIS and all other courses.

Since National educational policy is for entire nation therefore there should have national board of studies for all courses. This board will decide the major and minor subjects for all the courses. This will bring the uniformity and equivalence to all the degrees. This will also help in updating syllabus more frequently as per national needs so that out students can compete with international students.

In the era of ICT and data science, there is a need of inclusion of Artificial Intelligence (AI) and Expert Systems (ES) in LIS curriculum. Kranch (1992) claims that, "the expectation for AI/ES involvement in the library profession within the next ten years increases from low to moderate as the level of degree offered by the institution increase". The policy document also insists on the digitization and automation of the library services. Tis board should also study syllabuses of developed countries and incorporate the useful concepts from those syllabuses.

3.2 Offering Library Science Courses as electives for UG and PG Programmes

New education policy emphasises the multidisciplinary approach to education. Library and information science (being a multidisciplinary domain) is very significant subject/discipline in knowledge driven society. These courses need to be introduced at very early stage of their career so that awareness about importance of reading, economics of information and knowledge, Importance of Intellectual property, and its rights, where and how to find the knowledge, how to use the knowledge, academic integrity etc. One 4 credit course should be made compulsory at undergraduate level in all disciplines so that students will get to know basic concepts of library management and the modern technologies associated with the library processes.

3.3 Alignment of library personnel with qualifications:

3.3.1 Academic Libraries: The LIS personnel in academic libraries need to be equipped with relevant skills and knowledge.

Table 1: Library personnel in academic libraries

Sr.	Designation	Qualification
1.	Attendant (College)	Certificate (Completion First Sem. BLIS)
2.	Attendant (University)	Diploma (Completion First Year BLIS)
3.	Library Clerk (College)	Certificate (Completion First Year BLIS)
4.	Junior Library Assistant (University)	BLIS
5.	Assistant Librarian (College)	BLIS
6.	Assistant Librarian (University)	MLIS, NET/SET
7.	Librarian (School)	BLIS
8.	Librarian (College)	MLIS, NET/SET
9.	Director, Knowledge Resource Centre (University)	MLIS, NET/SET, Ph.D

Trained Library personnel is essential to ensure the strengthening of the libraries and library services. The cadres identified in the Table 1, need to be trained as per their job description. The learning levels also indicated in the table. As suggested in the policy their training would consist of the internships and other vocational credits also. The curriculum of the certificate, diploma, UG and PG programs need to be upgraded considering the academicians'/ researchers' information needs and the advent of the technology, AI, ES. The libraries play a pivotal role in quality of education, social awareness, as a centre of cultural heritage and the containers of culture, which is preserved and embedded in the such centres. Therefore, training the library personnel to boost the library movement in a planned direction is need of the hour. Similarly, concerned stakeholders or policy makers need to ensure the adequate recruitment for the libraries.

3.3.2 Public Libraries: The public libraries need to be started and supported to preserve and spread the culture, science, and knowledge at larger scale in the community.

LIS personnel in public libraries		
Sr.	**Designation**	**Qualification**
1.	Librarian (Village Library)	Certificate (Completion first Year BLIS)
2.	Librarian (Tehsil Library)	Diploma (Completion first Year BLIS)
3.	Librarian (District Library)	BLIS
4.	Librarian (State Public Library)	MLIS

The policy notes about strengthening the public libraries. To strengthen the public libraries, it is proposed to support and establish public libraries at every village, tehsil, district, and state level. Appointing the adequate library personnel (as shown in Table 2) is also proposed by the researchers. The learning levels are also indicated in the table.

3.3.3 Special Librarians: The cluster of colleges will be a university in other words. The library of the main campus of the clusters would be naturally demanded subject specific information sources from the several segments of the users. For this library personnel with specialised expertise are needed. It is advisable to train the specialised library personnel with relevant cadre in this scenario.eg. Medical Librarian; Humanities Librarian; Physical Sciences Librarian; Law, Commerce and Management Librarian; Music and Arts Librarian; Public Librarian; Reference Librarian; Librarian of Special Libraries for Differently Abled Persons (with Assistive Technologies) likewise specializations may be added as the situation demands.

Suggestions and Recommendations :

1. Multidisciplinary Credits suggested in the policy need to be availed in LIS domain by the LIS departments on regular as well as ODL mode.
2. It is advised to introduce separate 4 credit course in with LIS curriculum having job potential.
3. The specialized library personnel with ICT literacy need to be created by the LIS schools
4. The older LIS program needs to be revised as per the other discipline programs.
5. Strengthening the public and school libraries is also considered in the policy. Accordingly, the special courses need to be designed for the public library personnel.

6. Framework of LIS education may be redesigned as proposed in this paper.
7. The action plan to strengthen the libraries (as foresighted in the NEP 2020 policy) may be defined by the apex bodies of the library professionals and proposed to the government; which includes:
    a. Establishing the libraries with good infrastructure including ICT facilities (that for differently abled persons also) and providing financial assistance for digitization and infrastructure
    b. Developing the collection, that is expected in IKS
    c. Framing the Staffing Pattern to ensure the delivery of the services
    d. Training the library personnel at various learning levels as per the staffing pattern
    e. Designing the curriculum as per the learning levels

Conclusion :

Need of well-equipped libraries, collection development policy and strengthening the library infrastructure is reasonably addressed in the NEP2020 policy. Strengthening the public and school libraries is also considered in the policy. The other potential factors to boost the use of libraries can be enumerated as; redesigning the staffing pattern, introducing the special libraries and training specialised librarians, appointing trained library personnel at various levels, etc. The framework of LIS education needs to be redesigned and same has proposed in the present paper. Standardisation of education and degrees is also important and National level board of the studies may be helpful in that. Early introduction of library science subjects as electives in other programmes can help students in gaining knowledge and understanding the importance knowledge. The action plan in this regard would help strengthening the libraries, both academic, public, special, etc.

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About MUCLA

The Maharashtra University and College Librarians Association (MUCLA) was established in the year 2012 and registered under Trade Union Act 1926 on 3rd May 2014 to discuss the professional issues collectively from the common platform. MUCLA has its headquarter at Jalgaon. For details, you may refer to the association's web site having URL www.mucla.in. Till date, the association has attempted to solve many issues of librarians through correspondence or by a discussion with the Government. It is a great pleasure to inform you all that in many cases we have succeeded to a larger extent. The association works on three levels, viz. Sectional Council, Executive Council and Central Council. The association and its associated councils conduct various activities, conferences and invite proposals for various awards from the LIS fraternity.

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Emerging Materials and Technologies

POLYMER NANOCOMPOSITES IN SUPERCAPACITORS

Edited by
Soney C George, Sam John and Sreelakshmi Rajeevan

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Polymer Nanocomposites in Supercapacitors

Supercapacitors are energy storing devices, gaining great scientific attention due to their excellent cycling life, charge-discharge stability, energy, and power density. The central theme of this book is to review the multiple applications of polymer nanocomposites in supercapacitors in a comprehensive manner, including discussions pertaining to various unresolved issues and new challenges in the subject area. It illustrates polymer nanocomposite preparation and working mechanisms as electrodes, binders, separators, and electrolytes. This edited volume also explains different components of supercapacitors, including theory, modelling, and simulation aspects.

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Contents

13
Valorization of Secondary Metabolites in Plants

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Abstract

Plants have been used as traditional medicine to cure diseases as well as a substitute for synthetic raw materials in the food, perfumery, cosmetic and pharmaceutical industries, etc. The essential oils extracted from the plants have also been shown to have antimicrobial (antifungal and antibacterial) and antioxidant activities. The biomass produced by such plants is utilized as food for human consumption or fodder for domestic animals. The pharmaceutical and agriculture industry also utilizes plants for the production of important chemicals. Production of biomass can be achieved by the use of elicitors in tissue culture and mutation breeding. Mutation breeding is a suitable method for plant breeding as the new mutant varieties and the original variety have the same genetic background with the only difference being the mutated genes. Therefore, new mutant varieties can be used for cultivation under the same conditions as their parental varieties, which is not always the case for new varieties developed through crossbreeding where new agronomies have to be developed for the new forms. This approach also increases the important secondary metabolite content of the plant. This chapter focuses on the valorization of secondary metabolites using various techniques including tissue culture and mutation breeding.

Keywords: Biomass, valorization, antioxidants, elicitors, mutation breeding

13.1 Introduction

Plants have been used as traditional medicine to cure diseases as well as a substitute for synthetic raw materials in the food, perfumery, cosmetic and pharmaceutical industries, etc. Plants form an important part of our daily diet. Their constituents and nutritional values have been intensively studied for decades. Plants produce a huge range of biomolecules that are classified as primary and secondary metabolites. Primary metabolites are compounds that have essential roles associated with photosynthesis, respiration, and growth and development of the plant. Secondary metabolites are the compounds playing an important role in the interaction of the plant with its environment however have no contribution to the fundamental life processes of the plant itself. Primary metabolites are compounds that are essential for cellular functions as they are associated with the primary metabolism; as such they are ubiquitously found in all plants. Secondary metabolites are by-products or intermediates of the primary metabolism process and are more specific in their functions. They are often plant species-specific and can be nonessential under many conditions. Secondary metabolites do not generally enhance plant fitness, but in the natural environment they might be essential for resistance against environmental stress, survival and reproduction. They are thus mostly made under controlled conditions for a specific purpose such as defense against pathogens and herbivores, improved tolerance to abiotic stresses, the attraction of insects and animals for fertilization and/or seed dispersal, or repellence of unwanted feeders. Secondary metabolites can also exhibit activities like antimicrobial, antioxidant, anticancer, etc. Numerous types of phytochemicals are secondary metabolites and are used for various purposes.

As plants are sources of many secondary metabolites, there is great interest in enhancing their production in biosynthetic pathways as part of green biotechnology, which includes the use of mutation breeding by radiation and elicitation, transgenic plant production or other photosynthetic organisms for industrial purposes. Such an approach allows for the synthesis of a wide range of products including secondary metabolites, recombinant proteins, biologically active compounds, paper and biofuels. Secondary metabolites also can be used to enhance the nutritional quality of a plant and help in the advancement of environmentally-friendly agricultural solutions.

One of the key strategies enabling the enhanced production of valuable plant secondary metabolites *in-vitro* cultures is the manipulation of existing metabolic pathways by over-expressing or silencing select elements involved in their biosynthesis [1–4]. A wide range of plant vectors have been designed that allow simple and quick introduction of synthetic expression cassettes, allowing for easier and more effective creation of *in-vitro* transgenic plant cultures [28–30]. Several studies confirm that such modulation of metabolic pathways increases the yield of naturally occurring biologically active compounds which have potential use in medicine [31–33].

The aim of this work is to review the valorisation of secondary metabolites using various techniques including tissue culture, mutation breeding and to review the latest achievements in transgenesis-based biosynthesis of selected secondary metabolites produced in various types of *in-vitro* plant cultures.

13.1.1 Plant Secondary Metabolites

"Plant secondary metabolites are numerous chemical compounds produced by the plant cell through metabolic pathways derived from the primary metabolic pathways" [4] (Figure 13.1).

Plants are known to produce a wide variety of secondary metabolites. Most of these compounds have evolved as chemical substances defending plants against infections or predators. The diversity of majority of these plant products is known to restrict themselves according to taxonomic distribution. These compounds have evolved to have complex and unique structures. As most of them possess various mechanisms for defense, they are compartmentalized inside plants either in the vacuoles or are stored in particular cells or organs. This prevents them from interfering with unrelated cellular processes. In plants, they are important as they contribute to various roles including signaling for various activities, monitoring, or controlling the metabolic activities, etc. Their role is very important during the normal development of plants as they coordinate various processes during plant development. Despite having pivotal roles in plant protection and defence, they are produced in scant amounts inside plants which indicate their effectiveness. Often the quantity of these metabolites is less than 1% of the total carbon content of the plants. Functions of these metabolites include providing resistance towards various pathogens [5, 6], protecting plants against harmful effects of herbivory [9, 10] as well as mutations due to UV radiation [7, 8]. Their importance cannot be neglected due to their contribution in maintaining plant propagation during pollination and seed distribution by animals and insects.

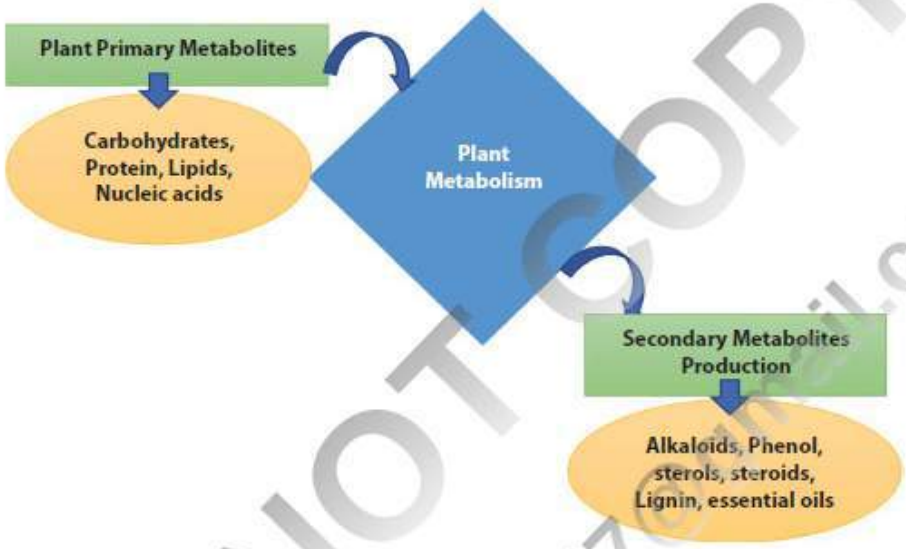

Figure 13.1 Plant metabolites involved in metabolism where primary metabolites important for primary pathways and secondary metabolites productions takes place in pathways.

These secondary metabolites have become a vital part of human life as their role in defence is not limited to plant cells or the plant kingdom. These compounds have proven their importance by extending their protective role in animal life.

13.1.2 Importance of Secondary Metabolites in Plants

Adaptations of plants to their external environment facilitate their survival. This survival is majorly possible due to secondary metabolites as they play a major role in the adaptation of plants to their environment by interacting with factors of the ecosystem. Such secondary metabolites have been observed to accumulate in specific organs, i.e., vacuoles of plant parts [11, 12]. Their antibiotic, antifungal and antiviral activities protect the plant from pathogens (phytoalexins). Their toxic nature does not allow other plants to grow in its vicinity and promotes survival of the plant by reducing competition (allelopathy) for growth resources.

They are also reported to prevent leaf damage by protecting them from UV radiation [13]. Few metabolites are known to act on animal gut systems or insects to prevent herbivory or insect attack [14, 15]. In the case of animal cells, they can interfere with cell division by altering the expression of specific genes or interfering with the

11
Photocatalytic Biomass Transformation into Valuable Products

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Abstract

Biomass is available in large quantity and from a wide variety of sources which include plants, animal waste and microorganisms, and it is a significant part of renewable energy production. The effective development and use of biomass will play a very crucial role in energy and ecological aspects. The nature of biomass is complex, and traditional methods for the transformation and fragmentation of biomass exploits higher energy consumptions and severe reaction conditions which are hazardous to the environment. Therefore, still there is scope for development of clean, eco-friendly and efficient methods of biomass transformation into useful products. The photo catalytic valorization of biomass is an excellent alternative strategy and has received substantial attention because it is simple, mild and environmentally benign method. We wish to describe photocatalytic biomass valorization as an excellent, efficient and green alternative route over the existing conventional methods for biomass transformation in useful products.

Keywords: Lignin, biomass, valorization, catalysis, titanium oxide

11.1 Introduction

Fossil fuel use has been increasing exponentially over the past few decades. Worldwide, more and more people are becoming concerned about global warming. The focus is now on improving the use of natural and renewable energy sources, and in search of innovative alternatives. Scientists around the world are searching for eco-friendly, low-impact technology substances that have equal productivity when compared to conventional non-renewable fuels [1]. Since non-renewable energy sources such as petroleum oil are used regularly, the demand and market for them is strong. Although, it is widely considered a significant contributor to a prosperous industrial society, it is a major source of greenhouse gas pollution which can be reduced if society's reliance is moved from oil fuels to biomass energy [2]. As the substitute of these non-renewable sources, biomass offers an attractive renewable alternative. Biomass is a carbon-neutral renewable energy resource for biofuels and valuable chemicals. Using biomass as substrate, energy production has the advantage of forming less overall greenhouse gases than fossil fuel.

Lignin is a lignocellulosic biomass that accounts for more than thirty percent of sequestered carbon in the biosphere and has strong potential for use as a fossil fuel substitute in areas of chemical and fuel processing. Lignin strengthens the cellulose and middle lamellas, and helps the plant to grow. Water and lipids condense in the solid matrix of lignin. This complex structure coating acts as a barrier against bacteria and viruses. Lignin is a plant substance that also exists in the form of pulp and paper industry by-product [3, 4]. Including cellulose and hemicellulose, lignin often includes a diverse amount of industrial applications. About 70 million tons of lignin are produced every year, and all of this is burnt to generate energy by mills. The profane carbonyl oligomers are building blocks to produce high-value long-chain aromatic compounds which cannot be produced from plant starch.

Usually, lignin content differs from plant to plant. For example, conifer lignin makes up 25–40% of dry weight, while lignin contributes 18–25% of biomass dry weight in hardwood and grasses, and 10–20% of biomass dry weight in agricultural residues [5].

Research on lignin as a valuable organic chemical is extensive, but so far without notable success due to the complex structure of lignin. Lignocellulosic residues can be a high-potential feedstock if transformed to valuable useful product. However, the lignin usage in formulations accounts for only a minor application at this time. Therefore, lignocelluloses are abundant and biomass can be a renewable carbon source in the future. Today, considering wood as a chemical feedstock denotes a real challenge to sustainability and environmental protection. However, processing lignin is acknowledged as being vital to the economic sustainability of integrated biorefineries. The three key polymers in plants are lignin, cellulose, and hemicellulose (Figure 11.1) [6].

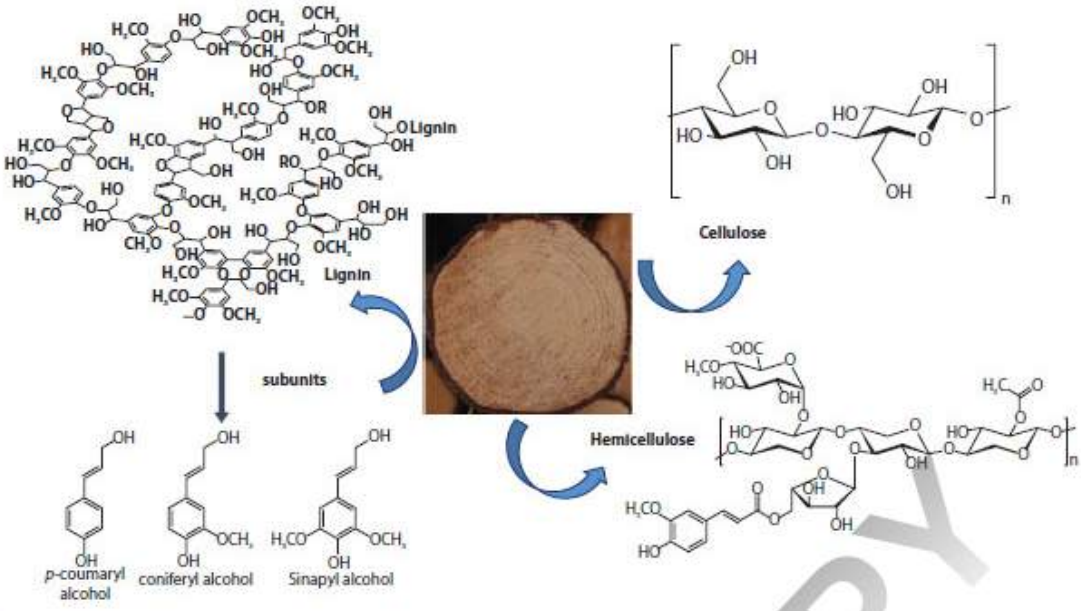

Figure 11.1 Figure shows three key polymers in plants are lignin, cellulose, and hemicellulose.

11.1.1 Composition and Structure

The polymeric structure of lignin is made up of substituted units at various positions, linked by ether and C–C bonds. There are three basic building blocks known as the H, G, and S structure, distinct in the number of methoxy groups on the aromatic ring respectively. The building blocks are the p-coumaryl, coniferyl, and sinapyl alcohols. The shikimate pathway produces all this basic alcohols for lignin structural makeup [7]. In the sequence of the reaction, Phenylalanine is first converted to cinnamic acid. The reaction is mediated by phenylalanine lyase (PAL). Cinnamic acid is further converted to one of the three most basic structures. The chain is formed by radical coupling of the building blocks enzymatically catalysed by oxidation. The initial step of this process is the oxidation of the phenol group of the monolignols [8]. Since they are conjugated systems, mesomeric effects will lead to the formation of several lignin polymers. The amount of the building blocks varies by type of biomass. The proportion of coniferyl (G) is the dominant factor in softwoods (90–95%) while the proportion of sinapyl (S) (45–75%) is greater than the coniferyl part (25–50%) [9]. Chlorophyll has significant amounts of coumaryl (H) (5–35%), which in contrast is low in both softwoods and hardwoods. Lignin degradation in nature is very slow.

11.1.2 Extraction and Architect

An enormous amount of lignin is used annually in the pulp and paper industry. The cooking process involves the absorption of water by lignin, which loosens it up and frees it from the fibre. The yearly amount of lignin produced in this manner is around 130 million tons [10], most of which is used on-site. There are several ways to use Kraft pulping (hot water, pressure, modified atmosphere, etc.). Non-woody biomass may be treated with alkaline cooking, which is more selective towards lignin removal. Lignin may be removed using organic solvents, e.g. ethanol or methanol. However, until the lignin which proved as economic, they must be tested at pilot and demo scale [11].

The structure of the technical lignin is different from the native lignin and differs in cooking method [12]. Since the C–O and C–C linkages are removed, the abundant C–O and C–C linkages present in the source will be different from those of the original lignin [13]. The experiment then affects the further depolymerization. Kraft extraction process involves adding sodium hydroxide (NaOH) and sodium sulphide (Na_2S) to softwood which produces –OH and –SH ions as active reactants. Water-soluble aromatic ether bonds are broken by hydroxide and hydrosulfide anions and smaller lignin fragments are formed. These low molecular mass molecules diffuse more rapidly into the cooking liquor (black liquor). The removal of lignin in the sulfite-cooking process can take place in either neutral or alkaline cooking conditions. After breaking the ether bonds, the sulfonation process proceeds. The resulting lignosulfonates dissolves in the reaction mixture [14]. Kraft and sulfite processes dominated the industry in the beginning of the 20th century, but has gradually been replaced by the recovery process. This process uses sodium hydroxide (NaOH) and a polyphenol (polyphenol) to make the paper surface more stable. Both PPM and DPM reactions use the cross-coupling approach to increase the stability of ethers [15].

Organosolv is the process in which the removal of lignin takes place with an organic solvent. In the Organocell phase, the ethanol/water combination is used instead of methanol/water. In addition, the substance is recovered with 20%

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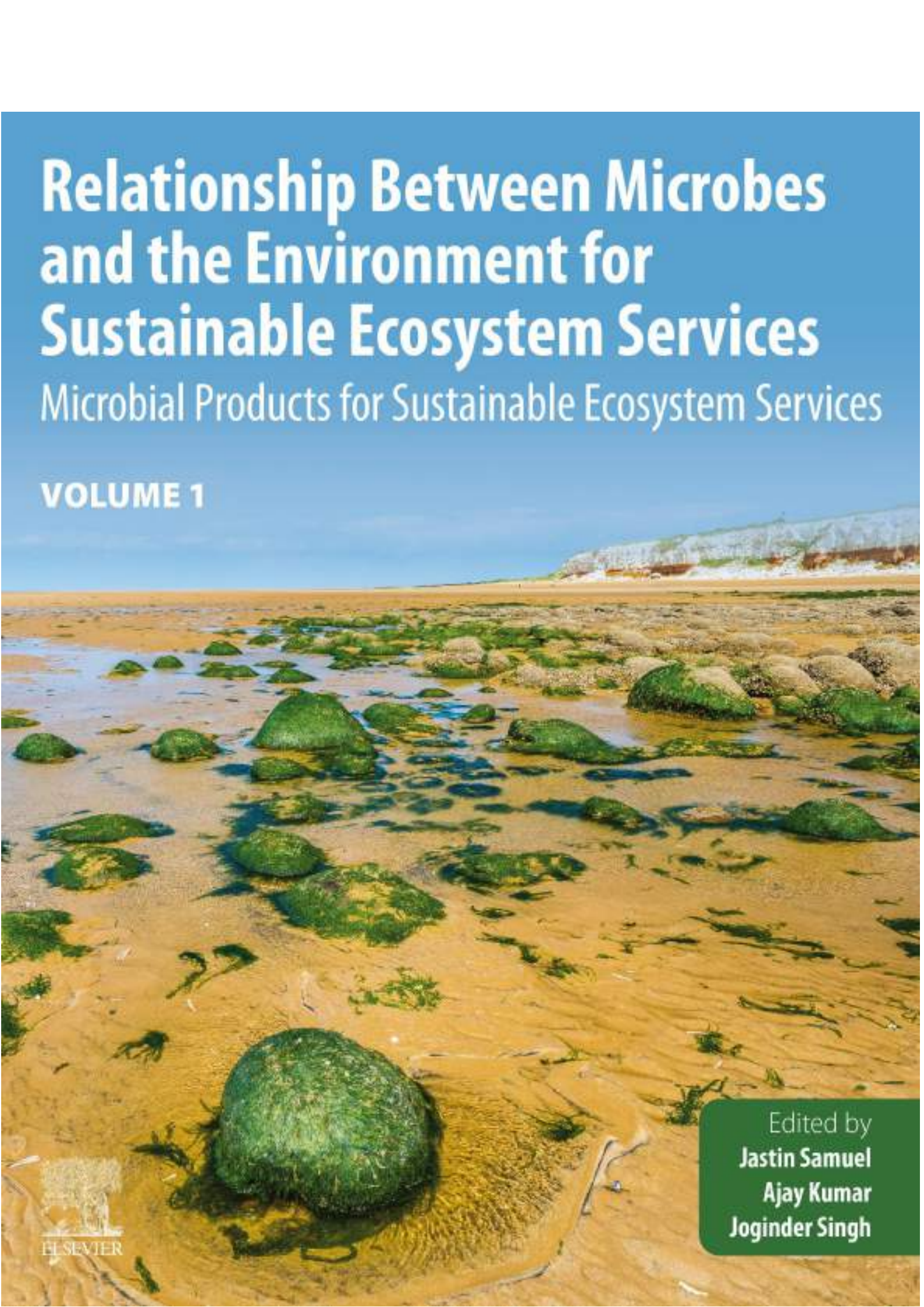

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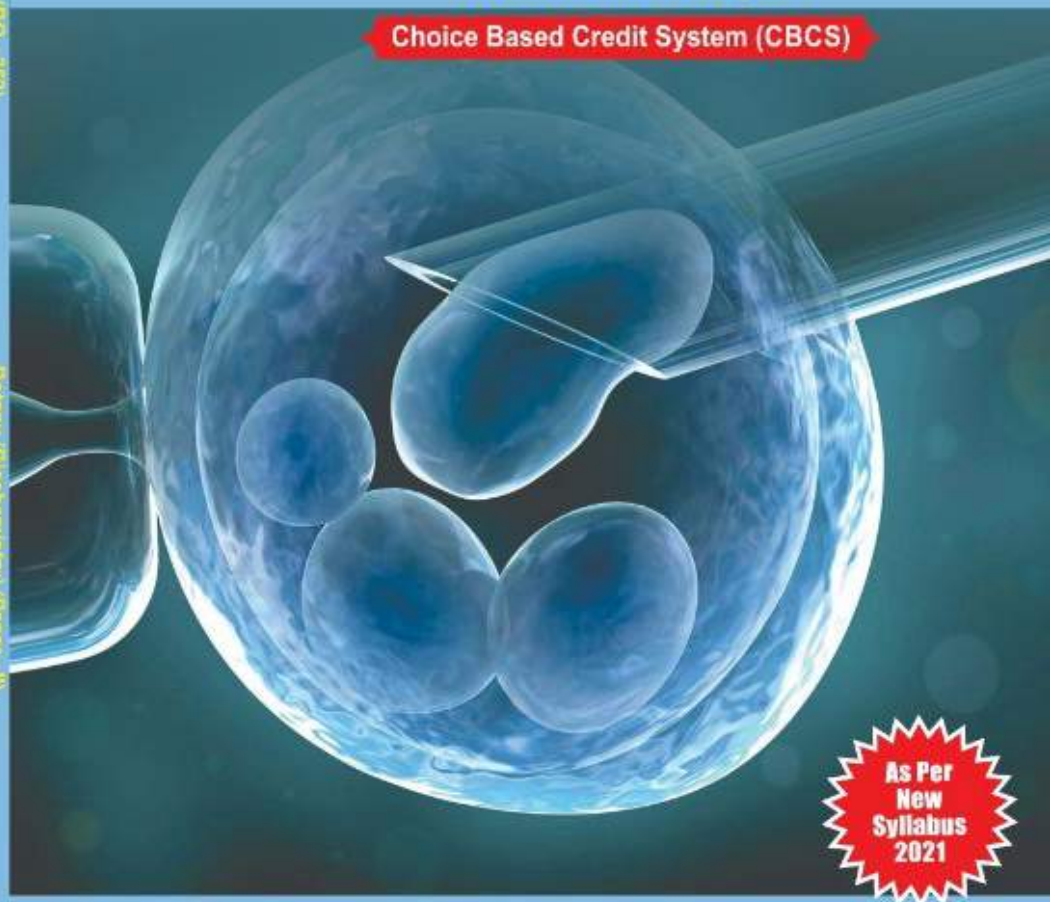

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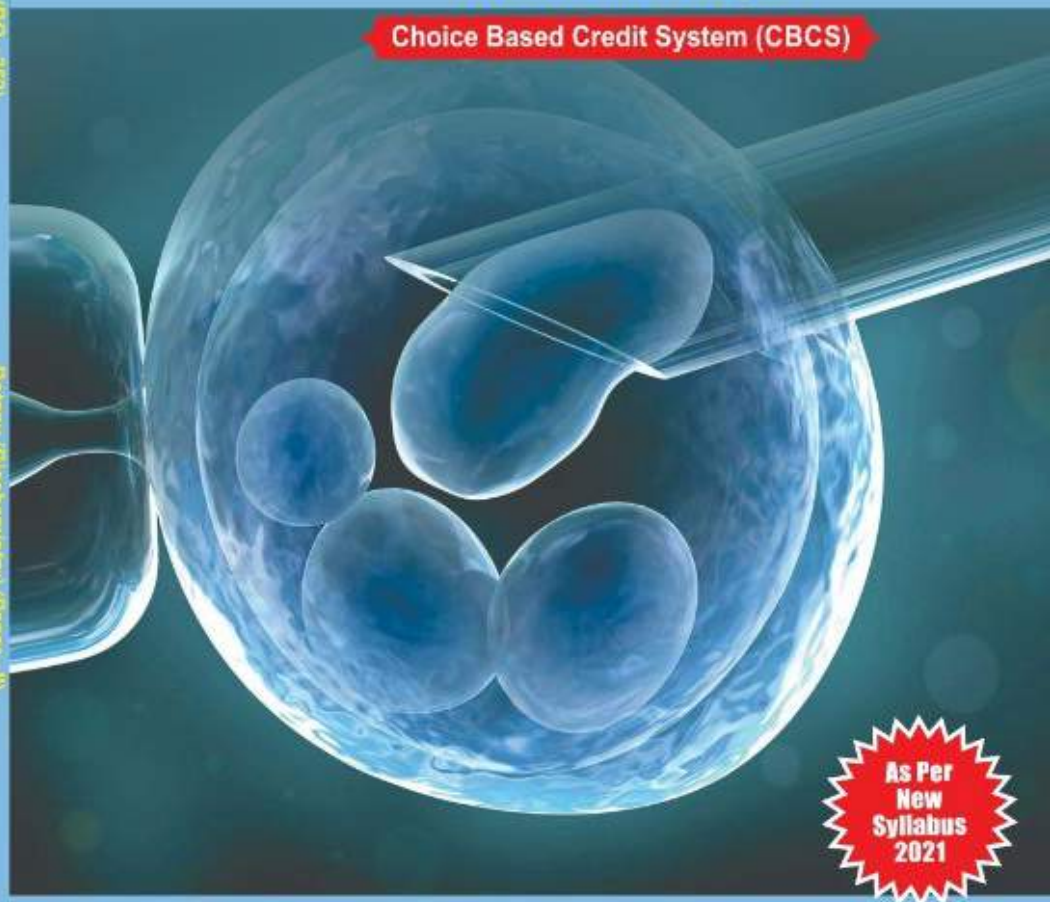

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