

Late Chindhuji Laxmanrao Purke Shikshan Prasarak Mandal's



**INDIRA GANDHI KALA MAHAVIDYALAYA**

Ralegaon, Dist- Yavatmal, Maharashtra

*Affiliated to*

**Sant Gadge Baba Amravati University, Amravati**



**2<sup>nd</sup> Cycle**

**Assessment & Accreditation by NAAC**

### **Criterion-III**

#### **Research, Innovations and Extension**

**Q<sub>n</sub>M 3.3.2 Number of books and chapters in edited volumes/books published and papers published in national/ international conference proceedings per teacher during last five years**



Late Chindhuji Laxmanrao Purke Shikshan Prasarak Mandal's

# **Indira Gandhi Kala Mahavidyalaya, Ralegaon - 445402, Dist. Yavatmal (M.S.)**

Affiliated to Sant Gadge Baba Amravati University

Website : [www.igkmralegaon.org](http://www.igkmralegaon.org)

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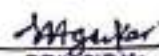
Ref: NAAC 2024/IGKM/Cr-3.3.2

Date-03/09/2024

|                         |                                                                                                                                                                                                                                                                                                          |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Criteria 3.3.2          | Number of books and chapters in edited volumes/books published and papers published in national/ international conference proceedings per teacher during last five years                                                                                                                                 |
| Findings of DVV         | Provide Cover page, content page and first page of the selected publication. Provide Web-link of books for the year 2019-2020,2020-21,2021-22,2022-23 & 2023-24                                                                                                                                          |
| Response/ Clarification | Provided cover page , content page and first page of published books and chapters in edited volumes/books and papers published in national/ international conference proceedings per teacher and Web-link of books are attached herewith during 2019-2020,2020-21,2021-22,2022-23 & 2023-24 (Appendix I) |

  
**Co-ordinator**  
Internal Quality Assurance Cell  
Indira Gandhi Kala Mahavidyalaya  
Ralegaon



  
**PRINCIPAL**  
Indira Gandhi Kala Mahavidyalaya,  
Ralegaon, Dist. Yavatmal



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Dis. No-

Date 03/09/2024

**Declaration**

The information, reports, true copies of the supporting documents, numerical data, etc. related to the NAAC process furnished in this file is verified by IQAC and found correct. Hence this certificate.

**Co-ordinator**  
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**PRINCIPAL**  
Indira Gandhi Kala Mahavidyalaya,  
Ralegaon, Dist. Yavatmal

# Appendix I



Late Chindhuji Laxmanrao Purke Shikshan Prasarak Mandal's  
**Indira Gandhi Kala Mahavidyalaya,**  
**Ralegaon - 445402, Dist. Yavatmal (M.S.)**

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**3.3.2 Number of books and chapters in edited volumes/books published and papers published in national/ international conference proceedings per teacher during last five year**

| Sl. No.        | Name of the teacher | Title of the book/chapters published                                                                                                   | Title of the paper                                           | Title of the proceedings of the conference     | Name of the conference | National / International | Calendar Year of publication | ISBN number of the proceeding | Affiliating Institute at the time of publication | Name of the publisher |
|----------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|------------------------------------------------|------------------------|--------------------------|------------------------------|-------------------------------|--------------------------------------------------|-----------------------|
| <b>2023-24</b> |                     |                                                                                                                                        |                                                              |                                                |                        |                          |                              |                               |                                                  |                       |
| 1              | Dr.S.D.Dawada       | A Text Book Of Zoology, Cell Biology and Developmental Biology                                                                         |                                                              |                                                |                        | National                 | 2023                         | 19435-80-7                    | I.G.K.M.,Ralegaon                                | DnyanPath Publication |
| 2              | Dr.S.D.Dawada       | Study On Planton Biodiversity With Respect To Fish Production In Borgaon Dam Yavatmal Taluka Yavatmal District Maharashtra State India |                                                              | Multidisciplinary approach to higher education |                        | National                 | 2023                         | 978-81-972505-0-7             | I.G.K.M.,Ralegaon                                | DnyanPath Publication |
| 3              | Mr. A.C. Ade        | A text book of Zoology B.Sc II sem III                                                                                                 |                                                              |                                                |                        | National                 | 2023                         | 978-93-93940-21-6             | I.G.K.M.,Ralegaon                                | Nabha prakashan       |
| 4              | Ms. B.K. Lohakar    | Concept of gene                                                                                                                        |                                                              |                                                |                        | National                 | 2023                         | 978-93-93940-38-4             | I.G.K.M.,Ralegaon                                | Nabha prakashan       |
| 5              | Mr.V.D. Samarth     | Climate Change and Impact on Agriculture                                                                                               | A Multidisciplinary Approach to Higher Education Volume - II |                                                |                        | National                 | 2024                         | 978-81-972505-0-7             | I.G.K.M.,Ralegaon                                | DnyanPath Publication |

|    |                    |                                                                                       |                                                                             |  |                                                                                    |          |      |                   |                   |                                       |
|----|--------------------|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|--|------------------------------------------------------------------------------------|----------|------|-------------------|-------------------|---------------------------------------|
| 6  | Mr. N. M. Deshmukh | Climate Change and Impact on Agriculture                                              | A Multidisciplinary Approach to Higher Education Volume - II                |  |                                                                                    | National | 2024 | 978-81-972505-0-7 | I.G.K.M.,Ralegaon | DnyanPath Publication                 |
| 7  | Mr.M.V.Wankhade    | Textbook of Angiosperm Systematic, Anatomy and Embryology                             |                                                                             |  |                                                                                    | National | 2024 | 978-8119435-95-1  | I.G.K.M.,Ralegaon | DnyanPath Publication                 |
| 8  | Mr. B.H.Bhatti     | Photovoltaic applications of SnO <sub>2</sub> gas sensor                              |                                                                             |  | UGC Sponsored National Conference on Recent Advancements in Science and Technology | National | 2024 | 978-81-19931-25-5 | I.G.K.M.,Ralegaon |                                       |
| 9  | Mr.B.H.Bhatti      |                                                                                       | Humidity Sensors: AlCl <sub>3</sub> -Dipped Nanocrystalline Magnesium Oxide |  | UGC Sponsored National Conference on Recent Advancements in Science and Technology | National | 2024 | 978-81-19931-25-5 | I.G.K.M.,Ralegaon |                                       |
| 10 | Mr. B.H.Bhatti     |                                                                                       | Advances and Perspectives in Nanotechnology : A Short Review                |  | UGC Sponsored National Conference on Recent Advancements in Science and Technology | National | 2024 | 978-81-19931-25-5 | I.G.K.M.,Ralegaon |                                       |
| 11 | Mr. A. S. Lihitkar | Emerging interdisciplinary areas of Physics in Higher Education and Job Opportunities |                                                                             |  |                                                                                    | National | 2024 | 978-81-972505-6-9 | I.G.K.M.,Ralegaon |                                       |
| 12 | Dr. A.Y.Shaikh     | Dynamic Analysis of Renyi Holographic Dark Energy with Hubble's IR Cut-off            |                                                                             |  | Recent Advancements in Science                                                     | National | 2024 | 978-81-19931-25-5 | I.G.K.M.,Ralegaon | VidyaBharati Mahavidyalaya , Amravati |

|    |                |                                                                                                                 |                                                                |  |                                                                  |               |      |                   |                   |                                             |
|----|----------------|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|--|------------------------------------------------------------------|---------------|------|-------------------|-------------------|---------------------------------------------|
|    |                |                                                                                                                 |                                                                |  | and<br>Technology                                                |               |      |                   |                   |                                             |
| 13 | Dr. A.Y.Shaikh | Exploration of Barrow Holographic Dark Energy in Modified Theory of Gravitation                                 |                                                                |  | Recent<br>Advancement<br>s in Science<br>and<br>Technology       | National      | 2024 | 978-81-19931-25-5 | I.G.K.M.,Ralegaon | VidyaBharati<br>Mahavidyalaya ,<br>Amravati |
| 14 | Mr.S.V.Gore    | Exploration of Barrow Holographic Dark Energy in Modified Theory of Gravitation                                 |                                                                |  | Recent<br>Advancement<br>s in Science<br>and<br>Technology       | National      | 2024 | 978-81-19931-25-5 | I.G.K.M.,Ralegaon | VidyaBharati<br>Mahavidyalaya ,<br>Amravati |
| 15 | Dr.A.Y.Shaikh  | Panoramic Behaviour of Magnetized Strange Quark Matter in Modified Theory of Gravitation                        |                                                                |  | Recent<br>Advancement<br>s in Science<br>and<br>Technology       | National      | 2024 | 978-81-19931-25-5 | I.G.K.M.,Ralegaon | VidyaBharati<br>Mahavidyalaya ,<br>Amravati |
| 16 | Dr. A.Y.Shaikh | Accelerating Magnetized Strange Quark Cosmological model for Bianchi type I (Kasner metric) in modified gravity |                                                                |  | Emerging<br>Trends in<br>Computational Science and<br>Technology | National      | 2024 | 978-81-19435-61-6 | I.G.K.M.,Ralegaon | Shri Shivaji Science<br>College , Amravati  |
| 17 | Dr. A.Y.Shaikh | Dynamic Analysis of Renyi Holographic Dark Energy                                                               |                                                                |  | Emerging<br>Trends in<br>Computational Science and<br>Technology | National      | 2024 | 978-81-19435-61-6 | I.G.K.M.,Ralegaon | Shri Shivaji Science<br>College , Amravati  |
| 18 | Dr. A.Y.Shaikh | Holographic Dark Energy Model by Sharma andMittal with Bouncing Scenario                                        |                                                                |  | Emerging<br>Trends in<br>Computational Science and<br>Technology | National      | 2024 | 978-81-19435-61-6 | I.G.K.M.,Ralegaon | Shri Shivaji Science<br>College , Amravati  |
| 19 | Dr. A.Y.Shaikh | Introduction to Cosmology                                                                                       |                                                                |  |                                                                  | International | 2024 | 978-620-748606-9  | I.G.K.M.,Ralegaon | Lambert Academic<br>Publishing              |
| 20 | Dr. V.L. Barde | A Multidisciplinary Approach to Higher Education                                                                | New Education Policy (NEP-2020) and Role of Academic Libraries |  |                                                                  | National      | 2024 | 978-81-972505-6-9 | I.G.K.M.,Ralegaon |                                             |

|                |                   |                                                                  |                                                                  |                                                                        |                                                                                                                                                            |               |      |                   |                   |                                                                       |
|----------------|-------------------|------------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------|-------------------|-------------------|-----------------------------------------------------------------------|
| 21             | Mr. Y. I. Biradar | Modern Emerging Trends In Chemical Sciences                      | UV- Visible Spectroscopy: Basic Concepts                         |                                                                        |                                                                                                                                                            | National      | 2024 | 978-93-94766-90-7 | I.G.K.M.,Ralegaon |                                                                       |
| 22             | Dr.K.G. Pawar     | A multidisciplinary approach to higher education                 | Nutritional requirements if athletes and pre and post match diet |                                                                        |                                                                                                                                                            | National      | 2024 | 978-81-972505-6-9 | I.G.K.M.,Ralegaon | DnyanPath Publication                                                 |
| <b>2022-23</b> |                   |                                                                  |                                                                  |                                                                        |                                                                                                                                                            |               |      |                   |                   |                                                                       |
| 1              | Dr. V.L. Barde    |                                                                  | National Education Policy 2020: Impact on the Library pp1-8      | International Conference on Multidisciplinary Research & Studies 2023  | International Conference on Multi-disciplinary Research and studies , organized by SPM Science & Gilani Arts, Commerce College , Ghatanji on 21st Jan 2023 | International | 2023 | E-ISSN: 2582-2160 | I.G.K.M.,Ralegaon | International Conference on Multidisciplinary Research & Studies 2023 |
| 2              | Mr.A.C.Ade        | Effect of glyphosate based herbicide on development of earthworm | Effect of glyphosate based herbicide on development of earthworm |                                                                        |                                                                                                                                                            |               | 2022 | 2319-4979         | I.G.K.M.,Ralegaon |                                                                       |
| 3              | Dr. V.L. Barde    | Future of Academic Libraries and Library                         | -                                                                | Conference Proceedings Seventy Five Years of Indian Library Profession | 'Seventy - Five Years of Indian Library Profession' NATIONAL CONFERENCE OF INDIAN LIBRARY ASSOCIATION, NEW DELHI AND MAHARASHTRA UNIVERSIT                 | National      | 2023 | 978-81-19118-22-9 | I.G.K.M.,Ralegaon | Atharva Publications                                                  |

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|    |                  |                                                                                         |                                                                                                                                                       |    | Y AND<br>COLLEGE<br>LIBRARIAN<br>S<br>ASSOCIATI<br>ON                                                                                        |                   |      |                                   |                   |                                           |
| 4  | Dr. S.D.Dawada   | Cell biology and Developmental<br>Biology                                               |                                                                                                                                                       |    |                                                                                                                                              |                   | 2023 |                                   | I.G.K.M.,Ralegaon |                                           |
| 5  | Dr. K.G.Pawar    | Physical education and sports issue ,<br>challenges and oppurnities                     | Impact of<br>advanced<br>training using<br>technology after<br>pandamic                                                                               |    |                                                                                                                                              |                   | 2023 | 978-81-<br>19435-<br>00-5         | I.G.K.M.,Ralegaon | Dynapath<br>Publication                   |
| 6  | Dr. K.G.Pawar    | Higher education issue , challenges<br>and oppurnities                                  | Recent<br>advances in<br>education<br>technology                                                                                                      |    |                                                                                                                                              |                   | 2023 | 978-81-<br>19435-<br>01-2         | I.G.K.M.,Ralegaon | Dynapath<br>Publication                   |
| 7  | Mr.S.V. Jadhav   | Hand book of B.Sc.First year Course<br>in Chemistry Sem-I &II                           | All Physical<br>chemistry<br>Practical                                                                                                                | -  | -                                                                                                                                            | National          | 2022 | ISBN<br>978-81-<br>933884-<br>1-9 | I.G.K.M.,Ralegaon | DnyanPath<br>Publication                  |
| 8  | Mr. P. R. Jagnit | Innovative Scientific, Bussiness and<br>Social Practices for Sustainable<br>Development | Environment<br>and Strategies<br>for Sustainable<br>Development                                                                                       | -- | --                                                                                                                                           | Internatio<br>nal | 2023 | 978-93-<br>85882-<br>65-4         | I.G.K.M.,Ralegaon | Harshwardhan<br>Punblication Pvt.<br>Ltd. |
| 9  | Mr. P. R. Jagnit |                                                                                         | Challenges and<br>Opportunities<br>for Online<br>Education in<br>India                                                                                |    | International<br>Conference on<br>Multidisciplin<br>ary Research<br>& Studies<br>2023<br>(ICMRS23)                                           | Internatio<br>nal | 2023 |                                   | I.G.K.M.,Ralegaon |                                           |
| 10 | Mr. P. R. Jagnit |                                                                                         | Thermal Studies<br>of Co(II), Ni(II)<br>and Cu(II)<br>Complexes<br>Derived from<br>Thiazole Schiff<br>Base with<br>Microwave<br>Irradiation<br>Method |    | International<br>Multidisciplin<br>ary<br>Conference on<br>Environment:<br>Issues,<br>Challenges,<br>Impact &<br>Steps Toward<br>Sustainable | Internatio<br>nal | 2023 |                                   | I.G.K.M.,Ralegaon |                                           |

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|                |                 |                                                                                  |                                                                                               |  | Development( ICESD22)                                                |                   |      |                   |                   |                                                      |
| 11             | Mr.S.V.Gore     | Introductory to Linear Algebra                                                   |                                                                                               |  |                                                                      | National          | 2023 | 978-81-88763-30-6 | I.G.K.M.,Ralegaon | Sonu Nilu Publication                                |
| 12             | Mr.K.D.Jagtap   | Text Book of B.Sc. First Year Course in Physics                                  |                                                                                               |  |                                                                      | National          | 2023 | 978-93-94661-66-0 | I.G.K.M.,Ralegaon | DnyanPath Publication                                |
| 13             | Mr.V.D. Samarth | Innovative Scientific, Business and Social Practices for Sustainable Development | Environment and strategies for sustainable development                                        |  |                                                                      | Internatio<br>nal | 2023 | 978-93-85882-65-4 | I.G.K.M.,Ralegaon | Harshwardhan Punblication Pvt. Ltd.                  |
| 14             | Mr.N.M.Deshmukh | Innovative Scientific, Business and Social Practices for Sustainable Development | Environment and strategies for sustainable development                                        |  |                                                                      | Internatio<br>nal | 2023 | 978-93-85882-65-4 | I.G.K.M.,Ralegaon | Harshwardhan Punblication Pvt. Ltd.                  |
| 15             | Mr.V.D. Samarth |                                                                                  | Ethnobotanical and Phytochemical study of member cucurbitaceae from Ralegaon Region- A Review |  | International Conference on Multidisciplin<br>ary Research & Studies | Internatio<br>nal | 2023 | E-ISSN: 2582-2160 | I.G.K.M.,Ralegaon | International Journal for Multidisciplinary Research |
| 16             | Mr.N.M.Deshmukh |                                                                                  | Ethnobotanical and Phytochemical study of member cucurbitaceae from Ralegaon Region- A Review |  | International Conference on Multidisciplin<br>ary Research & Studies | Internatio<br>nal | 2023 | E-ISSN: 2582-2160 | I.G.K.M.,Ralegaon | International Journal for Multidisciplinary Research |
| 17             | Dr.A.Y.Shaikh   | Introduction to Graph Theory                                                     | Introduction to Graph Theory , Volume II                                                      |  |                                                                      | National          | 2021 | 978-9391331368    | I.G.K.M.,Ralegaon | DnyanPath Publication                                |
| <b>2021-22</b> |                 |                                                                                  |                                                                                               |  |                                                                      |                   |      |                   |                   |                                                      |
| 1              | Dr.A.Y.Shaikh   | Impact of Covid-19 Pandemic on Education and Students in India                   |                                                                                               |  |                                                                      | Internatio<br>nal | 2022 | 978-93-81247-80-8 | I.G.K.M.,Ralegaon | Shriyanshi Prakashan                                 |

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| 2  | Dr.A.Y.Shaikh   | Impact of ICT in Teaching, Learning and Evalution Process                                   |                                                                                              |  |  | National          | 2021 | 978-93-85882-33-4       | I.G.K.M.,Ralegaon | Harshwardhan Publication. Pvt. Ltd.                      |
| 3  | Dr. V. L. Barde | Impact of Covid-19 Pandemic on Education and Students in India                              |                                                                                              |  |  | Internatio<br>nal | 2022 | 978-93-81247-80-8       | I.G.K.M.,Ralegaon | Shriyanshi Prakashan                                     |
| 4  | Dr. K. G. Pawar |                                                                                             | Maturity level among the inter college level high and low performing Kabaddi Players         |  |  | Internatio<br>nal | 2021 | ISSN 2231-3265          | I.G.K.M.,Ralegaon | Indian Federation of Computer Science in Sports          |
| 5  | Mr.V.D.Samrath  | Environmental studies                                                                       |                                                                                              |  |  | National          | 2021 | 978-93-91331-71-9       | I.G.K.M.,Ralegaon | DnyanPath Publication                                    |
| 6  | Mr.V.D.Samrath  | Chemistry And Biological Activities of Quercetin : A Bioactive Flavonoid                    |                                                                                              |  |  | Internatio<br>nal | 2022 | E-ISSN : 2348-7143      | I.G.K.M.,Ralegaon | RESEARCH JOURNEY                                         |
| 7  | Mr.V.D.Samrath  | Biodiversity: Concept, Threat and Conservation                                              |                                                                                              |  |  | Internatio<br>nal | 2021 | ISSN: 2322-0015         | I.G.K.M.,Ralegaon | IRJSE                                                    |
| 8  | Mr.S.V.Jadhav   | Impact of ICT in Teaching, Learning and Evalution Process                                   |                                                                                              |  |  | Internatio<br>nal | 2021 | 978-93-85882-33-4       | I.G.K.M.,Ralegaon | Harshwardhan Publication. Pvt. Ltd.                      |
| 9  | Mr.S.V.Jadhav   | Study of Water Quality Parameters of Pimpalkhuti Dam in Taluka Ralegaon, District- Yavatmal |                                                                                              |  |  | Internatio<br>nal | 2022 | ISSN 2349-638x          | I.G.K.M.,Ralegaon | Aayushi International Interdisciplinary Research Journal |
| 10 | Mr.S.V.Gore     | Impact of Covid-19 Pandemic on Education and Students in India                              |                                                                                              |  |  | Internatio<br>nal | 2022 | 978-93-81247-80-8       | I.G.K.M.,Ralegaon | Shriyanshi Prakashan                                     |
| 11 | Mr.K.D.Jagtap   | Current Trends In Higher Education/Role of Social Media on Higher Education                 |                                                                                              |  |  | National          | 2022 | ISBN: 978-93-91331-34-4 | I.G.K.M.,Ralegaon | DnyanPath Publication                                    |
| 12 | Mr.P.R.Jagnit   |                                                                                             | “Thermokinetic Studies of Cr(III), Mn(III), and Fe(III) Complexes from thiazole Schiff base” |  |  | Internatio<br>nal | 2022 | ISSN 2349-638x          | I.G.K.M.,Ralegaon | Aayushi International Interdisciplinary Research Journal |

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|----|---------------------|-----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------|---------------|------|-------------------------|-------------------|---------------------------------------------------------------|
| 13 | Mr.P.R.Jagnit       |                                                                             | Study of Water Quality Parameters of Pimpalkhuti Dam in Taluka Ralegaon, District-Yavatmal |  |                                                                                 | International | 2022 | ISSN 2349-638x          | I.G.K.M.,Ralegaon | Aayushi International Interdisciplinary Research Journal      |
| 14 | Mr. P.R.Jagnit      |                                                                             | Thermokinetics studies of Co(II), Ni(II), and Cu(II) with tetradentate Schiff base         |  | National E-Conference on "Role of Chemical Sciences in Sustainable Development" | National      | 2022 | ISSN: 2319 9318         | I.G.K.M.,Ralegaon | Vidyawarta Peer-Reviewed International Journal                |
| 15 | Mr.A.C.Ade          |                                                                             | Biodiversity: Concept, Threat and Conservation                                             |  |                                                                                 | International | 2021 | ISSN: 2322-0015         | I.G.K.M.,Ralegaon | IRJSE                                                         |
| 16 | Mr.A.S.Lihitkar     | Impact of ICT in Teaching, Learning and Evalution Process                   |                                                                                            |  |                                                                                 | National      | 2021 | 978-93-85882-33-4       | I.G.K.M.,Ralegaon | Harshwardhan Publication. Pvt. Ltd.                           |
| 17 | Mr.A.S.Lihitkar     | Current Trends In Higher Education/Role of Social Media on Higher Education |                                                                                            |  |                                                                                 | National      | 2022 | ISBN: 978-93-91331-34-4 | I.G.K.M.,Ralegaon | DnyanPath Publication                                         |
| 18 | Mr.B.H.Bhatti       | Impact of ICT in Teaching, Learning and Evalution Process                   |                                                                                            |  |                                                                                 | National      | 2021 | 978-93-85882-33-4       | I.G.K.M.,Ralegaon | Harshwardhan Publication. Pvt. Ltd.                           |
| 19 | Ms. S. S. Dhage     |                                                                             | Nutrition of Infants                                                                       |  | World Conference on Startup in India and Education with Placement in Abroad     | International | 2022 | ISSN 2278-7984          | I.G.K.M.,Ralegaon | Scholars Vision and Abasaheb Parvekar Mahavidyalaya, Yavatmal |
| 20 | Dr. Santosh Agarkar | Fundamental concept of Chromatography                                       |                                                                                            |  |                                                                                 | International | 2022 | 978-62-04210-08-7       | I.G.K.M.,Ralegaon | Lambert Academic Publishing                                   |
| 21 | Dr.S.D.Dawada       |                                                                             | Basics of Genetic Engineering and                                                          |  | Resent research at the Intersection of                                          | National      | 2022 |                         | I.G.K.M.,Ralegaon |                                                               |

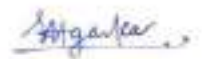
|          |                   |                                                         |                                                                                                                             |  |                         |          |      |                          |                   |                          |
|----------|-------------------|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|--|-------------------------|----------|------|--------------------------|-------------------|--------------------------|
|          |                   |                                                         | application in<br>Recent Era                                                                                                |  | Science &<br>technology |          |      |                          |                   |                          |
|          | <b>2020-21</b>    |                                                         |                                                                                                                             |  |                         |          |      |                          |                   |                          |
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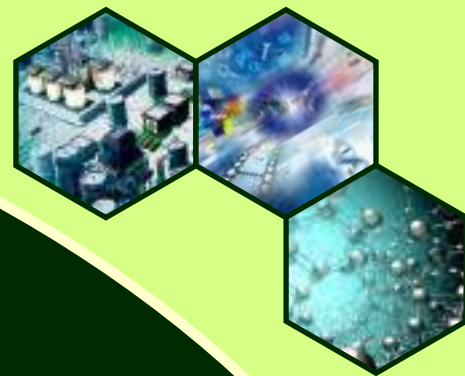
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## Electrical Conductivity of Co(II), Ni(II), Cu(II) and Cr(III) Complexes derived from thiazole Schiff base

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Department of Chemistry, Indira Gandhi Mahavidyalaya Ralegaon

### Abstract:

A thiazole Schiff base has been prepared by the condensation of 2-hydroxy-5-chloro-3-nitro acetophenone and thiazole. The ligand was characterized by elemental analysis and spectral methods. The coordinating ability of the ligand is investigated by preparing its metal complexes with Co(II), Ni(II), Cu(II) and Cr(III) have been prepared and characterized by elemental analysis, molecular weight determinations, conductance measurements, spectral and thermal studies. All the complexes have been studied and evaluated by electrical conductivity. The isolated products are coloured solids, soluble in DMF, DMSO and THF.

**Keywords:** Schiff base, Magnetic susceptibility, Electrical conductivity

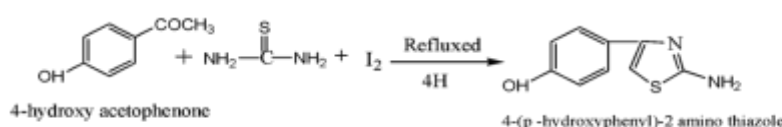
### Introduction:

The electrical conductivity of metal complexes varies with their nature and temperature. The variation of electrical conductivity of the metal complexes with temperature is the basis of their classification as semiconductors or metallic conductors. They are reported the possible use of such systems in biological applications for their antifungal properties and antioxidant activities<sup>1</sup>. The Schiff base prepared by using variety of aldehydes and amines or any other amines possessed antitubercular, antitumor, anticancer, fungicidal medicinal and agrochemical activities. Schiff base and their metal complexes are becoming increasingly important in recent years due to their biological activity and their used as catalysts photoluminescent, electroluminescent properties Antimicrobial screening, biological great significance of Schiff base metal complexes research and play a significant role in the area of coordination chemistry. Antimicrobial evaluation of 2-amino pyridine-derived Ligand Schiff base and its complexes with Cu (II), Hg (II), Ni (II), Mn (II) and Co (II)<sup>2</sup>. Synthesis and Characterisation of new Heterocyclic Schiff base ligand derived from 4-Amino Antipyrine<sup>3</sup> Synthesis Spectral, Thermal Stability and Bacterial Activity of Schiff Bases Derived From Selective Amino Acid and Their Complexes<sup>4</sup> The present Research paper focus on synthesis, characterisation and various methods of Schiff base derived from sulphanilic acid and salicylaldehyde and Comparative study of Schiff base using various synthesis methods and their theoretical prediction of activities<sup>5</sup>.

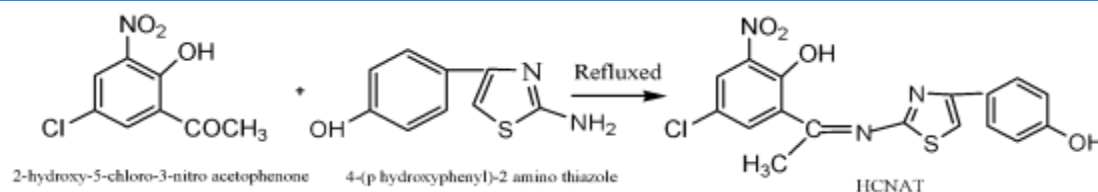
### Experimental :

All the chemicals were of A.R. grade and used as received. 2-hydroxy-5-chloro-3-nitro acetophenone (HCNA) and 4-(p-hydroxyphenyl)-2 amino thiazole was prepared by known methods<sup>6-9</sup>. The solvents were purified by standard methods<sup>10</sup>.

Synthesis of 4-(p-hydroxyphenyl)-2aminothiazole;



Synthesis of 2-hydroxy-5-chloro-3-nitro acetophenone 4-(p-hydroxyphenyl)-2 imino thiazole [HCNAT]: A solution of 4-(p-hydroxyphenyl)-2 imino thiazole (0.02M) in 25ml of ethanol was added to an ethanolic solution(25ml) of 2-hydroxy-5-chloro-3-nitro acetophenone (0.02M) and the reaction mixture was refluxed on a water bath for 4h. After cooling a pale yellow coloured crystalline solid was separated out. It was filtered and washed with ethanol, crystallized from DMF and dried under reduced pressure at ambient temperature. The purity of ligand was checked by elemental analysis and m.p. It was also characterized by IR and <sup>1</sup>H NMR spectral studies. Yield:70%; m.p. 310<sup>o</sup>C

**Table1. Analytical data of the Ligand.**

| Ligand | Molecular Formula                                                 | Formula Weight | Color and nature   | Elemental Analysis |                  |                 |                  |
|--------|-------------------------------------------------------------------|----------------|--------------------|--------------------|------------------|-----------------|------------------|
|        |                                                                   |                |                    | C%                 | H%               | Cl%             | S%               |
|        |                                                                   |                |                    | found<br>(Cal.)    | Found<br>(Cal.)  | Found<br>(Cal.) | Found<br>(Cal.)  |
| HCNAT  | C <sub>17</sub> H <sub>13</sub> N <sub>3</sub> O <sub>4</sub> SCl | 390.6          | Yellow Crystalline | 52.34<br>(52.22)   | 03.26<br>(03.32) | 9.02<br>(9.08)  | 08.12<br>(08.21) |

Preparation of complexes: All the metal complexes were prepared in a similar way by following method. To a hot solution of ligand HCNAT (0.02M) in 25ml of ethanol a suspension of respective metal salts was added drop wise with constant stirring. The reaction mixture was refluxed on a water bath for 4-5 h. The precipitated complexes were filtered, washed with ethanol followed by ether and dried over fused calcium chloride. Yield : 50-55%

The complexes are soluble in DMSO and DMF but insoluble in water and common organic solvents. The metal chloride content of complexes were analyzed by standard methods<sup>12</sup> The <sup>1</sup>H NMR spectra of ligand was recorded and obtained from RSIC Chandigarh. IR spectra of the compounds were recorded on Perkin Elmer 842 spectrophotometer in the region 400-4000cm<sup>-1</sup>, Carbon, Hydrogen and Nitrogen analysis were carried out at RSIC, Punjab University, Chandigarh. The molar conductance of the complexes at 10<sup>-3</sup> M dilution in DMF were determined using equiptronic digital conductivity meter EQ-660 with a cell constant 1.00 cm<sup>-1</sup> at room temperature. The magnetic moment measurement were made on a Gouy balance at room temperature using [HgCo(SCN)<sub>4</sub>] as the calibrant. The thermogravimetric analysis were performed on laboratory set up apparatus in air atmosphere at 10<sup>0</sup> C min<sup>-1</sup> heating rate. The molecular weights of the complexes were determined by Rast method.

**Table 2. Analytical data and molar conductance of the compounds.**

| Ligand                                                               | Formula weight<br>g mole <sup>-1</sup> | Colour | Elemental Analysis<br>Found (Calcd.) |                  |                |                  | $\mu_{\text{eff}}$<br>B.M | $\Lambda_{\text{M}}$<br>( $\Omega^{-1}\text{cm}^2$<br>mol <sup>-1</sup> ) |
|----------------------------------------------------------------------|----------------------------------------|--------|--------------------------------------|------------------|----------------|------------------|---------------------------|---------------------------------------------------------------------------|
|                                                                      |                                        |        | M%                                   | C%               | H%             | Cl%              |                           |                                                                           |
| [CoL <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] H <sub>2</sub> O | 892.1                                  | Brown  | 6.25<br>(6.60)                       | 44.86<br>(45.73) | 3.25<br>(3.36) | 7.70<br>(7.95)   | 4.6                       | 6.8                                                                       |
| [NiL <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] H <sub>2</sub> O | 891.9                                  | Green  | 6.30<br>(6.58)                       | 45.58<br>(45.74) | 3.16<br>(3.36) | 7.72<br>(7.96)   | 3.1                       | 7.6                                                                       |
| [CuL <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] H <sub>2</sub> O | 896.7                                  | Brown  | 6.90<br>(7.08)                       | 45.26<br>(45.50) | 3.12<br>(3.34) | 7.72<br>(7.91)   | 1.6                       | 8.2                                                                       |
| [CrL <sub>2</sub> (H <sub>2</sub> O)Cl] H <sub>2</sub> O             | 902.7                                  | Green  | 5.32<br>(5.76)                       | 44.90<br>(45.19) | 2.36<br>(2.88) | 11.08<br>(11.79) | 3.8                       | 18.6                                                                      |

**Result and Discussion :**

The Schiff base HCNAT and its complexes have been characterized on the basis of <sup>1</sup>H NMR, IR spectral data, elemental analysis, molar conductance, magnetic susceptibility measurements and thermogravimetric analysis data. All these values and analytical data is consistent with proposed molecular formula of legend. All the compounds are coloured solid and stable in air. They are insoluble in water but soluble in coordinating solvents like DMF and DMSO. The molar conductance values in DMF (10<sup>-3</sup> M) solution at room temperature (Table2) shows all the complexes are non electrolytes.

The <sup>1</sup>H NMR spectra of ligand HCNAT shows signals at  $\delta$  12.11, (1H, s phenolic OH),  $\delta$  9.52 (1H, s, phenolic OH),  $\delta$  7.56, 7.54, 7.53 and 7.52 (4H, m, phenyl)  $\delta$  6.81, 6.80, and 6.78(3H, s Phenyl), 6.68 (1H s thiophene),

and 2.56(3H, s, methyl)<sup>11,13-15</sup>. IR spectra of ligand and metal complexes shows  $\nu(\text{C}=\text{N})$  peaks at  $1620\text{ cm}^{-1}$  and absence of  $\text{C}=\text{O}$  peak at around  $1700 - 1750\text{ cm}^{-1}$  indicates the Schiff base formation<sup>16-19</sup>.

**Table 3. IR spectra of ligand and metal complexes**

| Compound                                                               | $\nu(\text{O}-\text{H})$ hydrogen bonded | $\nu(\text{C}=\text{N})$ imine | $\nu(\text{C}-\text{O})$ phenolic | $\nu(\text{M}-\text{O})$ | $\nu(\text{M}-\text{N})$ | $\nu(\text{C}-\text{S})$ |
|------------------------------------------------------------------------|------------------------------------------|--------------------------------|-----------------------------------|--------------------------|--------------------------|--------------------------|
| HCNAT (LH)                                                             | 3119                                     | 1620                           | 1514                              | --                       | --                       | 1122                     |
| $[\text{CoL}_2(\text{H}_2\text{O})_2] \cdot \text{H}_2\text{O}$        | --                                       | 1608                           | 1506                              | 472                      | 432                      | 1098                     |
| $[\text{NiL}_2(\text{H}_2\text{O})_2] \cdot \text{H}_2\text{O}$        | --                                       | 1585                           | 1464                              | 469                      | 423                      | 1090                     |
| $[\text{CuL}_2(\text{H}_2\text{O})_2] \cdot \text{H}_2\text{O}$        | --                                       | 1610                           | 1503                              | 508                      | 412                      | 1110                     |
| $[\text{CrL}_2(\text{H}_2\text{O})\text{Cl}] \cdot \text{H}_2\text{O}$ | --                                       | 1590                           | 1505                              | 475                      | 410                      | 1115                     |

Electrical conductivity: The conduction in solid crystalline Inorganic and organic compounds takes place by the exchange of charges from a molecule to another molecule through the overlapping of nearest molecules. For broad intermolecular potential barriers the overlap is poor and the band width is narrow. Electrical conductivity of the complexes lies in the range of  $2.10 \times 10^{-9}$  to  $6.69 \times 10^{-7}\ \Omega^{-1}\text{cm}^{-1}$  at 373 K. The electrical conductivity of these complexes at 373 K follows the order  $\text{Ni} > \text{Cu} > \text{Cr} > \text{Co}$ . The electrical conductivity and activation energy of complexes<sup>20-24</sup> are shown in table 4. The activation energy of electrical conduction of the complexes has been found to increase in the order  $\text{Ni} < \text{Cr} < \text{Cu} < \text{Co}$ .

**Table 4. Electrical Conductivity ( $\sigma$ ) at 373 K and Activation Energy ( $E_a$ ) of the complexes**

| Metal |                                       | Co(II)                | Ni(II)                | Cu(II)                | Cr(III)               |
|-------|---------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| HCAT  | $\sigma\ (\Omega^{-1}\text{cm}^{-1})$ | $2.20 \times 10^{-9}$ | $1.18 \times 10^{-8}$ | $4.12 \times 10^{-8}$ | $4.86 \times 10^{-8}$ |
|       | $E_a\ (\text{eV})$                    | 0.0724                | 0.0247                | 0.0499                | 0.066                 |

## Conclusions:

In conclusion we have synthesized new ligand 2-hydroxy-5-chloro-3-nitro acetophenone 4-(p-hydroxyphenyl)-2 imino thiazole and their metal complexes. Ligand was found to bind the metal ion monobasic (ON) bidentate manner. The electrical conductivity of the synthesized complexes were measured in the temperature range 298-423 K. All the complexes indicating their semiconducting behavior.

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## Synthesis and Thermokinetic studies of Co(II), Ni(II) and Cu(II) with tetradentate Schiff Base

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### Abstract:

The newly tetradentate Schiff base have been synthesized by condensing 2-hydroxy-5-bromo acetophenone with ethylene diamine. The metal complexes were obtained as a result of interaction of Schiff base ligand and metal ions Co (II), Ni (II) and Cu (II). The complexes have been characterized on the basis of elemental analysis, infrared, molar conductance, magnetic Susceptibilities, electronic spectra and thermogravimetric analysis. Thermodynamic activation parameters were computed from the thermal data using Broido, Horowitz-Metzger and Freeman-Carroll method, which confirm first order kinetics and kinetic compensation effect.

**Keywords:** Tetradentate Schiff base, Molar conductance, Thermal.

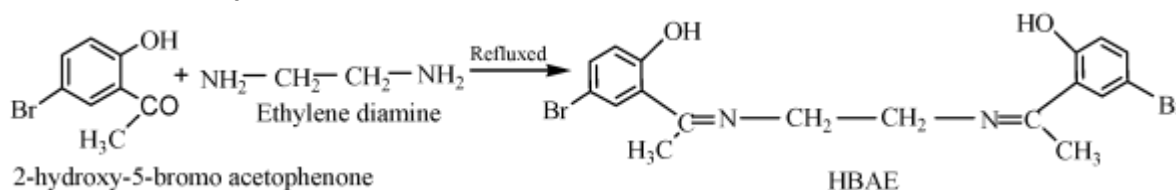
### Introduction:

The Schiff bases play a significant role in the area of coordination chemistry. The thermogravimetric technique has been great significance research method on thermal stabilisation and thermal decomposition. Thermogravimetric could provide theory for material heating treatment and application.<sup>1</sup> Synthesis, characterization and antifungal activity of manganese (II) complex with Schiff Base derived from acetylacetone and leucine<sup>2</sup> The newly synthesized Schiff bases, 2-acetylthiophene thiosemicarbazone and thiophene-2-aldehyde thiosemicarbazone and their metal complexes with Co(II), Cu(II), Zn(II) and Ni(II) complexes and Their Schiff bases metal complexes were tested for antibacterial activity<sup>3</sup> and Spectral and thermal characterization of metal complexes containing schiff Base ligands.<sup>4</sup> Compounds containing an azomethine group (CH=N), known as Schiff bases, were formed by the condensation of a primary amine with a carbonyl compound. Schiff bases of aliphatic aldehydes were relatively unstable and were readily polymerizable. Schiff bases and their complexes are shows good progress in thermal analysis<sup>5</sup>. Photoluminescent and electroluminescent properties.<sup>6</sup> The Schiff base prepared by using variety of aldehydes and amines possessed antitubercular, antitumor, anticancer, fungicidal medicinal and agrochemical activities<sup>7,8</sup> Thermogravimetric in an easy, quick, precies measure method. The mathematical calculating thermogravimetric data, thermal decomposition activation parameters can be obtained.<sup>9,10</sup> Schiff bases and their complexes have a variety of applications in biological clinical and analytical fields.<sup>11</sup> Recently there has been a considerable interest in the chemistry of hydrazine and hydrazone compounds because of their potential pharmacological applications.<sup>12</sup> This paper discusses the kinetic of the thermal decomposition and the accompanying compensation effect for Schiff base complexes of Co (II), Ni (II) and Cu (II)

**Experimental:** All the chemicals were of A.R. grade and used as received ethylene diamine and 2-hydroxy-5-bromo acetophenone (HBA) was prepared by known methods.<sup>13</sup> The solvents were purified by standard methods.<sup>14</sup>

Synthesis of 2-Hydroxy-5-bromoacetophenone-N,N'-ethylenediimine (HBAE).

A hot ethanolic solution of ethylene diamine (0.05 mol) was added to an ethanolic solution of respective acetophenone (0.05 mol). The reaction mixture was refluxed in a water-bath for 4-5 h. The colour product was filtered off and recrystallised. Yield 70%. M. P. 270°C



**Preparation of complexes:**

All the metal complexes were prepared in a similar way by following method. To a hot solution of ligand HBAE (0.02M) in 25ml of ethanol a suspension of respective metal salts was added drop wise with constant stirring. The reaction mixture was refluxed on a water bath for 4-6 h. The precipitated complexes were filtered, washed with ethanol followed by ether and dried over fused calcium chloride. Yield : 45-50% .

Table 1. Analytical data and molar conductance of the compounds.

| Compounds                                                      | Colour | Mol.wt | Analysis %<br>Found<br>(calc.) |                  |                |                | $\mu_{\text{eff}}$<br>B.M. | $\Lambda_M$<br>( $\Omega^{-1}\text{cm}^2$<br>$\text{mol}^{-1}$ ) |
|----------------------------------------------------------------|--------|--------|--------------------------------|------------------|----------------|----------------|----------------------------|------------------------------------------------------------------|
|                                                                |        |        | M                              | C                | H              | N              |                            |                                                                  |
| $\text{C}_{18}\text{H}_{18}\text{N}_2\text{O}_2\text{Br}_2$    | Yellow | 453.8  | --                             | 47.83<br>(47.59) | 3.85<br>(3.96) | 6.07<br>(6.17) | --                         | --                                                               |
| $[\text{CoL}(\text{H}_2\text{O})_2] \cdot \text{H}_2\text{O}$  | Brown  | 564.7  | 10.32<br>(10.43)               | 38.12<br>(38.25) | 3.72<br>(3.89) | 4.80<br>(4.95) | 4.27                       | 6.1                                                              |
| $[\text{NiL}] \cdot \text{H}_2\text{O}$                        | Black  | 528.5  | 11.02<br>(11.10)               | 40.72<br>(40.87) | 3.25<br>(3.40) | 5.17<br>(5.29) | Dia                        | 5.6                                                              |
| $[\text{CuL}(\text{H}_2\text{O})_2] \cdot 2\text{H}_2\text{O}$ | Brown  | 587.3  | 10.61<br>(10.81)               | 36.61<br>(36.77) | 3.95<br>(4.08) | 4.62<br>(4.76) | 2.02                       | 18.8                                                             |

The complexes are soluble in DMSO and DMF but insoluble in water and common organic solvents. The metal chloride content of complexes were analyzed by standard methods<sup>11</sup>.

The  $^1\text{H}$  NMR spectra of ligand was recorded and obtained from RSIC Chandigarh. IR spectra of the compounds were recorded on Perkin Elmer 842 spectrophotometer in the region  $400\text{--}4000\text{cm}^{-1}$ , carbon, hydrogen and nitrogen analysis were carried out at RSIC, Punjab University, Chandigarh. The molar conductance of the complexes at  $10^{-3}\text{M}$  dilution in DMF were determined using equiptronic digital conductivity meter EQ-660 with a cell constant  $1.00\text{ cm}^{-1}$  at room temperature. The magnetic moment measurement were made on a Gouy balance at room temperature using  $[\text{HgCo}(\text{SCN})_4]$  as the calibrant. The thermogravimetric analysis were performed on laboratory set up apparatus in air atmosphere at  $10^0\text{ C min}^{-1}$  heating rate. The molecular weights of the complexes were determined by Rast method.

**Result and Discussion:**

The Schiff base ligand HBAE and its complexes have been characterized on the basis of  $^1\text{H}$  NMR, IR spectral data, elemental analysis, molar conductance, magnetic susceptibility measurements and thermogravimetric analysis data. All these values and analytical data is consistent with proposed molecular formula of ligand . All the compounds are coloured solid and stable in air. They are insoluble in water but soluble in coordinating solvents like DMF and DMSO. The molar conductance values in DMF( $10^{-3}\text{M}$ ) solution at room temperature (Table 1) shows all the complexes are non electrolytes<sup>11</sup> The  $^1\text{H}$  NMR spectra of ligand HBAE shows signals at:  $\delta$  15.97 (1H, s, phenolic OH); 8.06(1H, s, phenyl); 7.67 and 7.31 (2H, m, phenyl), 3.29(4H, s,  $\text{CH}_2\text{--CH}_2$ ); 2.51 ppm (3H, s, methyl)<sup>15-24</sup>

Table 2. IR spectra of ligand and metal complexes.

| Compound                                                       | $\delta$ (O--H)<br>hydrogen<br>bonded | $\delta$ (C=N)<br>imine | $\delta$ (C--O)<br>phenolic | $\delta$ (M--O) | $\delta$ (M--N) | $\delta$ (M--O)      |
|----------------------------------------------------------------|---------------------------------------|-------------------------|-----------------------------|-----------------|-----------------|----------------------|
| $\text{C}_{18}\text{H}_{18}\text{N}_2\text{O}_2\text{Br}_2$    | 2900                                  | 1614                    | 1480                        | --              | --              | -----                |
| $[\text{CoL}(\text{H}_2\text{O})_2] \cdot \text{H}_2\text{O}$  | --                                    | 1589                    | 1440                        | 520             | 455             | 3400, 1640, 815, 770 |
| $[\text{NiL}] \cdot \text{H}_2\text{O}$                        | --                                    | 1586                    | 1460                        | 510             | 495             | 3326, 1630           |
| $[\text{CuL}(\text{H}_2\text{O})_2] \cdot 2\text{H}_2\text{O}$ | --                                    | 1595                    | 1440                        | 590             | 490             | 3406, 1642, 818, 780 |

**Thermogravimetric studies:**

The nature of thermograms of HBAE and its metal complexes indicates that the complexes of Co(II), Ni(II), Cu(II), decompose in three stage All the complexes are stable upto 70°C. Elimination of one water molecule from Co(II) and Ni(II)) upto 130°C and two water molecules from the Cu(II) complexes upto 150°C have been observed (%wt loss obs./calcd. : Co(II) : 3.26/3.18; Ni(II) : 3.52/3.40; Cu(II) : 6.26/6.12; Further loss in weight upto 220-240°C indicating presence of two coordinated water molecule in CO(II) and Cu(II) each. The half decomposition temperature and the basic parameters calculated for the compounds are given in (Table 3). Thermal activation energy was calculated by Freeman-Carroll,<sup>25</sup> Horowitz-metzger<sup>26</sup> and Broido<sup>27</sup> method. On the basis of half decomposition temperature, the relative thermal stability order is found to be The relative thermal stability on the basis of half decomposition temperature is found to be Cu(II)> Co(II)>Ni(II)> HBAE.

Table 3. Thermal decomposition data of HBAE and its complexes.

| Compound                                                                      | Half Decomposition Temperature (°C) | Activation Energy (kJ mole <sup>-1</sup> ) |       |        | Frequency Factor Z (sec <sup>-1</sup> ) | Entropy Change -ΔS (J mol <sup>-1</sup> K <sup>-1</sup> ) | Free Energy Change ΔF (kJ mol <sup>-1</sup> ) |
|-------------------------------------------------------------------------------|-------------------------------------|--------------------------------------------|-------|--------|-----------------------------------------|-----------------------------------------------------------|-----------------------------------------------|
|                                                                               |                                     | B*                                         | H-M** | F-C*** |                                         |                                                           |                                               |
| C <sub>18</sub> H <sub>18</sub> N <sub>2</sub> O <sub>2</sub> Br <sub>2</sub> | 260.51                              | 3.27                                       | 5.45  | 4.36   | 87.25                                   | 212.55                                                    | 117.75                                        |
| [COL (H <sub>2</sub> O) <sub>2</sub> ] H <sub>2</sub> O                       | 395.17                              | 3.41                                       | 8.54  | 8.54   | 170.89                                  | 208.83                                                    | 148.07                                        |
| [NiL] H <sub>2</sub> O                                                        | 265.33                              | 2.77                                       | 5.55  | 4.99   | 98.63                                   | 211.61                                                    | 118.94                                        |
| [CuL (H <sub>2</sub> O) <sub>2</sub> ] 2H <sub>2</sub> O                      | 591.16                              | 11.41                                      | 14.27 | 11.41  | 228.33                                  | 206.62                                                    | 189.78                                        |

\* Broido, \*\* Horowitz-Metzger and \*\*\* Freeman-Carroll

**Conclusion:**

The thermal decomposition of the complexes is not simple and involves different stage decomposition. It is assumed that dehydration of the complexes containing water occurs within an active reaction interface. The compensation effect of thermal decomposition of the complexes indicating the change of sample mass on the estimated values of activation energy .

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| <b>Unit 2: Gene Expression</b><br>1. Genetic Code.<br>2. Transcription in Prokaryotes.<br>3. Translation in Prokaryotes.<br>4. Gene Expression: Regulation of Protein Synthesis and Lac Operon Model.<br>5. Split Gene, Overlapping Gene, Pseudogene.                                                                                | <b>Unit 2: Gene Expression</b><br>(Pages 75 – 107)                     |
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# Innovative Research Trends in Science and Humanities

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Dr. Suruchi R. Kadu  
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## **Panorama Scenario of Recent Trends in Science and Technology**

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### **Abstract**

The role and effect of technology in both our peculiar and dealing lives is ever emergent. Accepting how people outline technology and thus the way technology shapes people's interactions with each other and therefore the wildlife is substantial not only for people who research, develop and implement new technologies but also for all those people and organization's that require to use those technologies in their operational and particular lives. Technology could also be a hands on, can do profession where people got to be skilled in many of the subsequent; engineering, collaborating, manipulative, emerging, modernizing, dealing, industrialized, modelling, and systems thinking. But technology also gives us various products which can be used forever or ill or where the welfares are uncertain and similarly the procedures intricate in constructing and using technology means we should always all take an interest in whether it provides us and everyone else with a maintainable future.

### **I. Introduction**

The field of education has seen an extreme change within the past 20 years. The moving development of world frugality and progression in evidence and announcement equipment has occasioned within the beginning of the many new trends in education. Trends- are all-purpose guidelines of knowledge, like an inclusive escalation in comprehensive temperature. Outlines don't necessarily involve data going a method or the opposite, but rather describe a recapping reflection [1-2]. Exploration purely means checking out that which already exists. It's an act in detection of Veracity. We not only consider the Research Methods but also the reasoning behind the procedures we use within the background of our research study and explain why we are employing an actual method or practice. As the domain is hurriedly spiraling into an evidence period, science and technology are meticulously accompanying with us, heartrending our daily lives. So, in inclusive pitches of society and ethos require hominoid eccentric having acquaintance domain designed with general science education. The relation between instruction, tutoring and erudition arises whenever models of the philosophy-knowledge process [3]. Information technology may be a drive for educational modification, also as a way of indorsing

communal awareness in society generally. Instruction is being misshapen in both formal and informal learning situations by new digital knowledge.

## **II. Scope of the Innovative Research**

Overall, a number of these foremost modernizations and the way they're shifting instruction are habitually concise into the consequent parts:

- Our academic aims and objectives;
- Educational ecologies and contexts of learning;
- The processes of learning;
- The processes of teaching; and
- Educational governance and policy.

## **III. Methodology used in Innovative Research**

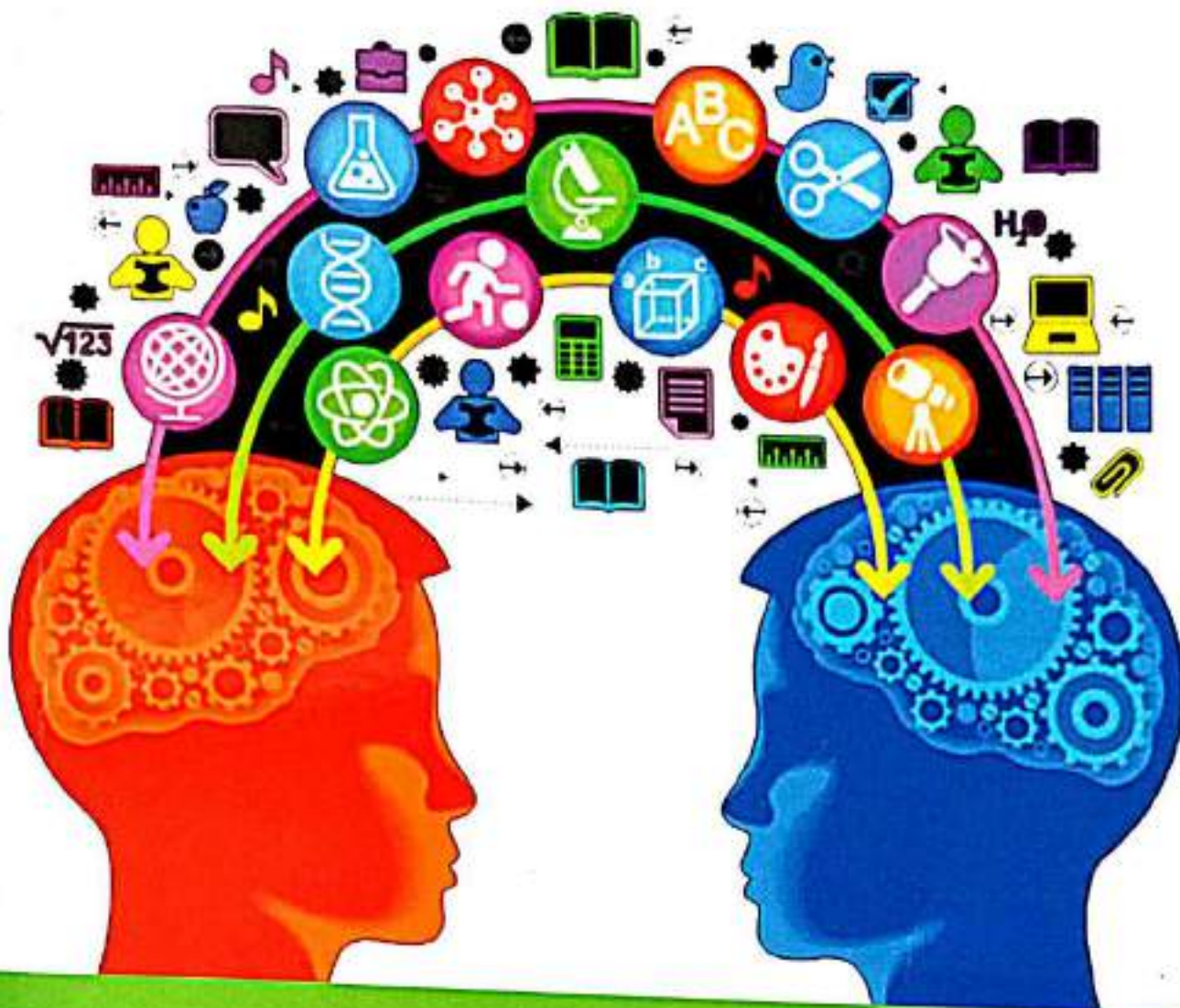
The innovative research trends in science and technology can be viewed in the following parts as The Connected Educator, Edmodo TedEd, Google+, Facebook, Twitter, Instagram, Vimeo, WordPress, Blogger, Skype, YouTube, Pinterest, Research Gate, Culture Inside, HootSuite.

## **IV. Conclusions**

Science and Technology is chief if an economy or nation is to resource for the vigor, richness and retreat of its citizens. One amid the organized visualizations was the plot of research developments connected with the difficulty of technology management. The aspect of data management was established to an exceptional magnitude[4]. Aside from origination, it turns out to be one among the chief movements in the interior the considered period. Know-hows embrace a governing element in raising attractiveness of the creativities that apply them. Educational assessment with technology could also be either decisive assessment or cumulative assessment. Tutors use both sorts of taxation to know student improvement and learning within the classroom. Technology has helped teachers create better assessments to assist understand where students who are having trouble with the fabric are having issues. To make sure technological progress itself otherwise mediocrity in basic sciences will create a vicious circle within the field of research and development.

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# INNOVATIVE RESEARCH TRENDS IN SCIENCE AND HUMANITIES

Volume I



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## **Technology and Innovation in Sports**

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### **1. Introduction**

In India traditionally, only a handful of channels had access to a variety of sports. Cable television had restrictions. But the use of technology has proved to be a big boon for sports in India. With the Covid-19 disease laying a halt on all sporting action around the world in early 2020, fans examined how long they will have to wait before seeing their favorites stars in action. Crickets, football, rugby, basketball, athletics, badminton, golf – all sports (except UFC) were put on hold as Covid-19 wreaked havoc all around the world. The bureaucrats chalked out plans for the return of sports in mid-2020. Eventually, it was absolute that sporting action will resume with some alterations. The biggest one being the non-participation of fans inside the arena. With Covid-19 still a big worry around the world, athletes played in empty arenas with the use of technology enhancing the viewing experience. Different leagues, different sports used different methods to increase engagement with fans. More live updates, social media updates, food delivery picking up, additional camera angles, VR headsets led to enhanced viewing experience and engagement. Testing times led to innovation. And innovation led to a boost in viewership. It is said in a Capgemini Research Institute report that 69% of fans report that the use of emerging technologies has enhanced their viewing experience – both inside and outside the stadium with India leading the way.

In India traditionally, only a couple of channels had access to supply sports events. Cable television had restrictions. But the use of technology has proved to be an enormous boon for sports in India. There is a wide variety of sporting action available for the fans on their mobile phones as well as television. It is just not cricket that has seen a rise in viewership but football, MMA, wrestling, badminton, or basketball have also seen enhanced engagement. The Indian Premier League also saw a boost in the use of technology to increase the viewing experience for the fans. Stadium sounds were used, screens were put inside the stadium with fans cheering for their favorites teams while more content was available. It proved to be a hit as IPL 2020 became the most viewed tournament in its history. With the focus now shifting to all things digital, sports tech-based companies like FanCode benefited from the evolving fan preferences. For a company that was launched in March 2019, FanCode has already amassed over 1.5 crore+ app installs and is expected to continue its growth. "2020 has been a rollercoaster for sports federations and fans. The suspension of events across the world as necessary safety precautions has required federations and leagues to adapt like never before," Yannick Colaco, co-founder of FanCode, said. The outcome could be seen in the successful comeback of some of the biggest sporting events like IPL, Bundesliga, CPL, MLB, NBA who transformed the holistic experience offered to sports fans, which went beyond just the live broadcast on television. Simple yet impactful personalization like interactive live streaming and live scores, digital fan walls in stadiums, the launch of dedicated fan clubs and activations, online fantasy sports contests, and a lot of social media activity kept the fervor and brand recall consistent. These initiatives had some leagues and teams even claiming to have received the highest fan engagement levels experienced in their history. We expect this trend to continue even during a post-pandemic world, where sports fans and match-experience will go hand-in-hand, thereby remaining critical to the growth and

success of sports," he continued. "With organizations going all in on providing personalized content alongside match scores, interactive streaming combined with data and statistics, fans are certain a treat in 2021. Creativity is thinking up new things. Innovation is doing new things." Unions German American economist Theodore Levitt said, and

The pandemic brought about an opportunity to miss out on traditional experiences were given a jolt. Everyone latched onto the technological innovation, and it has proved to be a smashing success for all parties involved.

## **II. Fan Relationship Management**

The computerized age has just seen clubs that were customarily not followed by neighborhood fans, extend their reach globally. Matches and events are now beamed all over the world on television and the internet. The web in particular has allowed sports fans to enjoy virtually any sporting event around the globe in real time. Further, thanks to mobiles, iPads and readily available wi-fi, it is not even necessary to be in the home, and updates on the activities of your team are constantly at the ready. Social media has also provided them a platform on which they will interact with others in real time, and even the players themselves. Giving the fan a participatory role in order that they feel as involved within the team as possible is significant, and by analyzing social media activity, it is easy to look at how people are interacting with the team on a day-to-day-basis. Clubs can more importantly use Big Data to improve the fan experience, gathering information about how they are watching and their enjoyment. As the home viewing experiences becomes more and more advanced, with 3D TVs, clubs will have to enhance the stadium experience to guard against any drop off in numbers. For many teams and sporting events, ticket sales are a massive part of their income, and they will have to ensure that these continue to come in.

The wealth of real-time statistics isn't only a boon for performance; it also makes the sport more compelling for fans, with their often-obsessive nature meaning that many will pore over them. Few demographic groups place as high a premium on loyalty as sports fans. They remain loyal to their teams and they like to have their loyalty rewarded. Hence, it is imperative to leverage technology to manage relationships with fans to maximize benefits. Local area devices like sites and applications make it simpler for fans to get and devour crucial event information. This includes any kind of information about an upcoming game from start times to information on food and beverage options within the stadium. Chatbots and voice technology can also play a key role by guiding fans through the website or app and addressing their concerns quickly and efficiently. GPS-powered devices are another key technology that can provide such features as geofencing to either offer rewards points or send targeted offers to fans within a designated region. Loyalty programs provide great rewards for fervent fans who attend games and follow teams by other means in addition to enticing them to attend games more frequently. Loyalty programs are fairly simple to implement and can be deployed via web sites or mobile apps. Leveraging technology helps make the fan experience convenient and generally more pleasant — which leads to increased fan engagement and a better relationship between fans and teams.

Virtual Reality is being used both on and off the field to help improve player performance and give fans a better viewing experience. From a player perspective, imagine a quarterback that practices his passing in a virtual space that looks and feels like a holodeck version of *Madden Football*. Coaches (and quarterbacks) don't need to worry about injuries and that they can review the info captured to refine the players training. From a fan

Perspective VR will get you closer to the game, and even on the field. FOX Sports handed together with NextVR to communicate live games, utilizing VR innovation, and with ticket prices still headed toward the stratosphere, VR might be the best (and most affordable) think-to-enjoy a game within the future. For example, don't like your seat? With VR, you can move your view closer to the field or even take in the national anthem while standing right next to a player on field. Imagine having the ability to require that home run lap together with your favorite pre-courtesy of the VR cam mounted into his batting helmet.

### III. Entertainment

Augmented Reality (AR) and Virtual Reality (VR) are increasingly being used in the sports industry to create new experiences for audiences allowing fans sitting at home to feel like they have a front row seat. Interactive games within your team's arena or stadium can even put the fan in the middle of the action as a participant — albeit a virtual one. There are many great examples currently available, such as NBA AR Basketball, which enables users to designate an "AR Portal" and subsequently walk through it into a 3D video recorded from an earlier game. The MLB Ballparks app uses AR to allow fans to access live data while they watch a baseball game in a stadium, gaining the ability to interact with detailed stats and data visualizations. When it comes to VR, the Golden State Warriors are one of the first teams to jump into the "viewing vantage point" technology by placing virtual reality cameras in a courtside seat to supply a premium experience to dedicated fans.

The concept of the "smart stadium" is additionally gaining steam. These are stadiums that completely optimize the fan's user experience — they will offer directions to the stadium, live updates on stats, and other information vital to improving the in-game experience. One of the leaders during this space is Amsterdam Arena, home of the soccer team AFC Ajax. By the time the stadium hosts the 2020 UEFA European Football Championship, officials decide to transform stage into a futuristic building. Amsterdam Arena will have self-driving cars parking themselves, face recognition tools controlling entry to the stadium, an artificial intelligence solution guiding fans to their seats, and thousands of sensors attached to things like chairs, gates, and stairs to watch usage and optimize overall stadium management. Take Tokyo's plan for the 32nd Olympic Games in 2020 for instance. They plan to roll out smart stadia that incorporate real-time data and artificial intelligence to give fans more information in a timely manner.

### IV. Conclusion

Gone are the days when engaging the fans meant offering them a program with all the players numbers as they walk in the door. Sports fans are passionate and inquisitive. They want to find out more about their favorite team and that they want to try to it within the time it takes to snap their fingers. That's why it makes sense for sports teams to engage these fans using mechanisms and platforms fans will use and understand. As the manner the fashionable fan engages with sports changes, so too must change the way teams engage with these fans.

To get the foremost out of this technological evolution, teams should partner with a trusted expert who understands both the sport and therefore the technologies needed to spice up fan engagement. Innovative technology solutions will increase both the enjoyment and engagement your fans will experience whether they are watching at home or in the stadium.

## *Innovative Research Trends in Science and Humanities*

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# *Graph Theory*

*Volume 1*

- Dr. Alfred Y. Shaikh

- Dr. Vinay M. Raut



*An Introduction to*

# *Graph Theory*

*Volume 1*

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*In mathematics, graph theory is the study of graphs, which are mathematical structures used to model pairwise relations between objects. A graph in this context is made up of vertices (also called nodes or points) which are connected by edges (also called links or lines). A distinction is made between undirected graphs, where edges link two vertices symmetrically, and directed graphs, where edges link two vertices asymmetrically; see Graph (discrete mathematics) for more detailed definitions and for other variations in the types of graph that are commonly considered. Graphs are one of the prime objects of study in discrete mathematics.*

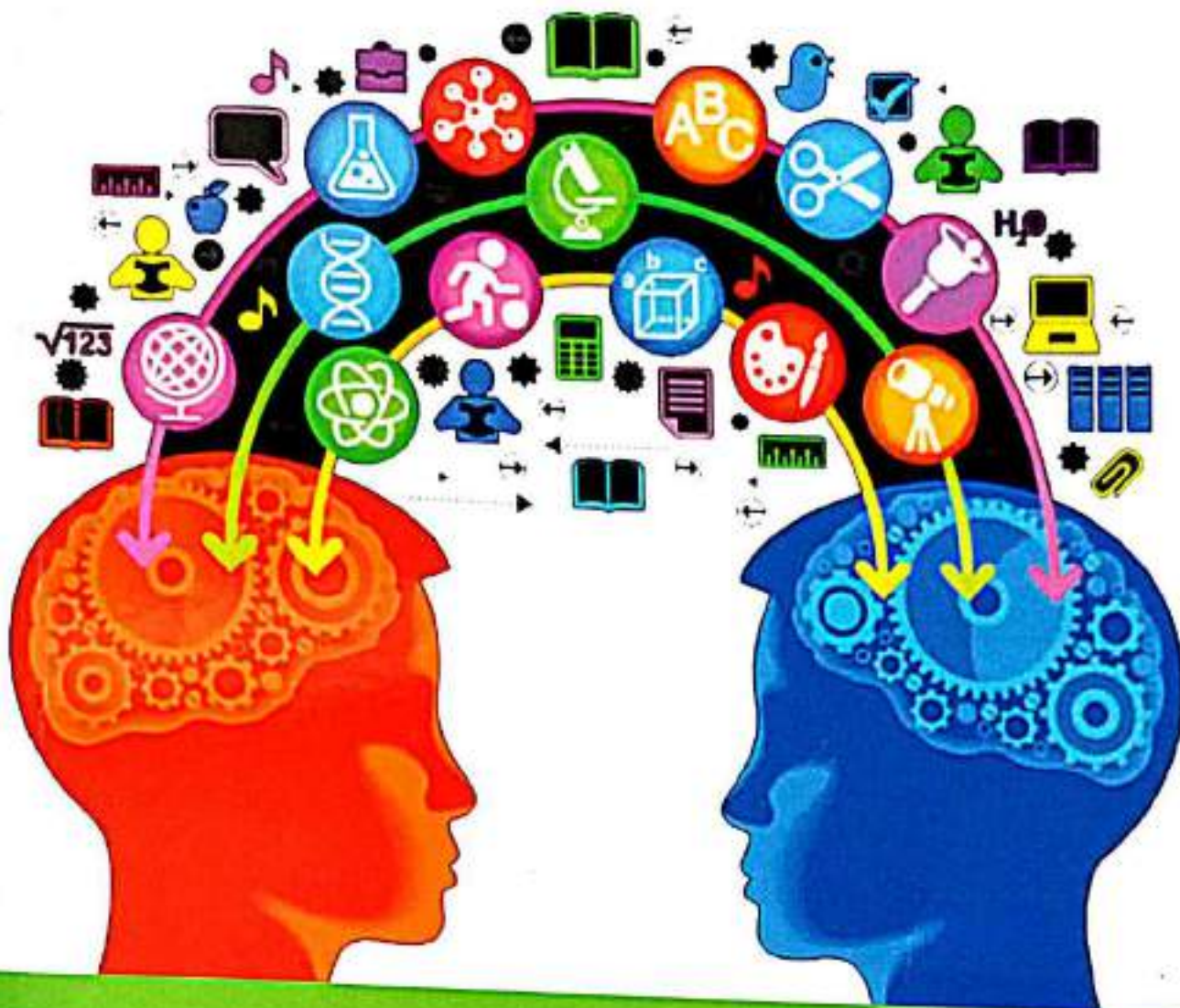
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## **Evaluation of Abortifacient Activity of Some Tribal Folklore Medicinal Plants in Female Albino Rats**

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### **Abstract**

The aim of this review was to provide a comprehensive summary of medicinal plants used as antifertility agents in females throughout the Yavatmal region by various tribes and ethnic groups. We undertook an extensive bibliographic review by analyzing classical text books and peer reviewed papers, and further consulting well accepted worldwide scientific databases. Plants, including their parts and extracts, that have traditionally been used to facilitate antifertility have been considered as antifertility agents. In this, various medicinal plants have been reviewed for thorough studies of these medicinal plants appear to act through an antizygotic mechanism. This review clearly demonstrates that it is time to expand upon experimental studies to source new potential chemical constituents from medicinal plants; plant extracts and their active constituents should be further investigated for their mechanisms. This review creates a solid foundation upon which to further study the efficacy of plants that are both currently used by women as traditional antifertility medicines, but also could be efficacious as an antifertility agent with additional research and study.

**Key Words:-**antifertility, Yavatmal, tribes, ethnic

### **I. Introduction**

The extraordinary growth of the world population stands as one of the significant event of the modern era to think over. The current world population is around 6-7 billion. One of the critical problems of the developing countries like India and other countries are its geometrical increase in human population. This population explosion will have negative impact on our economic, social policies and would simultaneously misbalance our socio-economic infrastructure. Thus the control of human fertility in sense of its limitation is the most important and urgent of all biosocial and medical problems. So to control fertility, drugs in the forms of hormones and other compound have been developed. To avoid the inevitable advanced effects of drugs prepared from chemical sources, indigenous plants are given preferences, which are also cheap, easily available and harmless. (Leswar and Widjata, 1992). Development of safe orally effective, fertility regulating agents from higher plants, for use in human, is not a new idea. From centuries, virtually every indigenous culture has utilized plants in one form or another in an attempt to limit the population of culture. Many plants have fertility regulating properties. Recently continuous efforts are ongoing to develop antifertility products form plants. Plants based contraceptive measures such as crude plant extract or composite preparation with scientifically proven efficacy could be beneficial and appreciable to the poor population of country, as the cost of such contraceptive choices would be within their affordability. Indeed extensive researches are being carried out to evaluate the putative abortifacient and other antifertility activities of different plant as well as traditionally used folk contraceptive all over the world (Muruganet *al.*, 2000).

Antifertility agents prevent the fertility by interfering in various normal reproductive mechanisms, in both males and females. The ideal contraceptive agents are one which possesses 100% efficacy, reversibility of action, free from side effects and easy to use (John, 1981). These traditional knowledge systems have started to degraded with the passage of time due to scarcity of written documents, lack of scientific basis and relatively low income in these traditions.

Such traditional knowledge form is present in tribal's dominating areas of Maharashtra; one is Yavatmal district. Some tribals of this region like Gawali, Halbi, Gond, Korku, Nihal and Wanjari have been using various plants for fertility regulation. In Yavatmal district there are three forest divisions Yavatmal, Pusad and Pandharkawda which are rich in medicinal plants. Some tribals like Gond, Kolam, Pradhan, Lohar and Banjara of the area have been using various plants and their parts as medicine to check the fertility. Fortunately, the ethanobotanical enumerations of Yavatmal district for antifertility regulation were recorded or documented by several researchers for this region. Also, the scientific evaluation of antifertility activity of medicinal plants was carried out. Therefore, the present study is small effort to gain insight in the knowledge of traditional medicine of this region and also focus on the screening of some meaningful medicinal plants from this region and establishing their contraceptive potentials.

**Interdisciplinary relevance:** This work will have immense interdisciplinary relevance if the active components responsible for abortifacient activity are isolated from different plant extract. Thus can be formulated as abortifacient drug by pharmaceutical sector.

## **II. Main Objectives of the Study**

In the present work some indigenous medicinal plants from Yavatmal region will be screened for Abortifacient activity.

### **Our Major Objectives**

- To explore the Abortifacient potential in medicinal plant resources in Yavatmal region.
- To understand the Challenges and opportunities with the traditional medicinal plants and also establish scientific basis to traditional knowledge of rural Vidarbians.
- To suggest recommendations based upon the present state of knowledge for the establishments and smooth functioning of medicinal plants sector along with improving the living standard of the under privileged communities in Vidarbha by providing income source from this medicinal therapy .

**The study Area:** The empirical study will carry out in the Ralegaontahsil of Yavatmal District. The selection of the Ralegaon tahsil will be purposive. The selection of this tahsil would be considered of convenience of the researcher in terms of possibility of getting required co-operation from the respondent. As the resident of Ralegaontahsil from more than 19 years, the researcher is relatively familiar with the physical, social, economical and political situation of Ralegaontahsil. Ralegaontahsil in Yavatmal district are economically very backward, but in view of traditional knowledge about ethno medicine. In view of the above consideration, the RalegaonTahsil in Yavatmal District will selected for the present study. (The location map of the Ralegaontahsil enclosed with the proposal)

**Significance of Study:** Such screening will provide us the basis to develop novel herbal abortifacient agents without possible side effects and alternative to conventional drugs in the abortion. The potential of these plants will be perceived as attractive target for future studies to identify active constituents and possibly to uncover new alternatives to the existing therapies for abortion. The potent molecule isolated from natural origin represents an exiting advance in search for abortion, especially now when there is urgent need for new innovation drug leads such study will expand the existing limited therapeutic arsenal for abortion with side effects that limits their effectiveness. Ultimately the research will enumerate some indigenous plants have abortifacient properties which will be cultivated by tribal people of Ralegaon forest region of Yavatmal district of Maharashtra and will prove to be additional source of income to the people.

### **III. Materials and Methods**

A Survey will be carried in rural areas of Vidarbha to investigate the plant material commonly utilized as traditional medicine for Abortion.

1. **Plant material:** The plant material in traditional use will be collected from different regions of Ralegaon tahasil and authenticated by the Botany Department Government Vidarbha Institute of Science and Humanities Amravati, the voucher specimen of the same will be deposited. The plant material will be shade dried at room temperature and then powdered and sieved through various meshes.
2. **Preparation of Extracts:** The powdered plant material will be extracted with petroleum ether & alcohol in Soxhlet apparatus and aqueous extract will be prepared by maceration process with water for 72 hours. The solvent will be removed under reduced temperature to form the concentrated extract.
3. **Phytochemical Screening:** Preliminary Phytochemical Screening of the extract will be carried out by standard procedures.
4. **Animals:** Wistar albino rats (150-200) will be purchased from Sudhakar Naik Institute of Pharmacy, Pusad (MS). Rats will be maintained in the Animals House of Indira Gandhi Mahavidyalaya Ralegaon for experimental purpose. Then all the animals will be acclimatized for seven days under standard husbandry condition. The animals will be habituated to laboratory conditions for 48 hours prior to the experimental protocols to minimize any non-specific stress.
5. **Drug, Chemicals & Biochemical Kits:** All requirements will be used; chemicals like anesthetic ether (CDH Mumbai) will be purchased through local dealers.
  - **Acute Toxicity Study:** The extract will be administered orally only once in dose of 100, 300, 1000 & 2000 mg/kg to group of mice ( $n=6$ ) and percentage mortality will be noted (Turner, 1971; Screening Method in Pharmacology, New York: Academic Press Vol. II.)
  - **Abortifacient activity:** The plant extracts will be tested in female albino rats for abortifacient activity as per Khanna *et al* [11]. The female rats in proestrous phase will be caged with males of proven fertility in the ratio of 2:1, in the evening and will be examined the following day for the evidence of copulation. Rats exhibiting thick clump of spermatozoa in their vaginal smear will be separated and that day was designated as day 1 of pregnancy. These rats will be randomly distributed into 13 groups, 1 control group and 12 experimental groups of 6 animals each. On the

day 10 of pregnancy animals will be laprotomised under light ether anesthesia using sterile conditions. The two horns of uteri will be examined to determine the implantation sites. Thereafter the abdominal wound will sutured in layers. The extract to be tested were then fed to operated pregnant rats i.e. aqueous extract, alcoholic extract, ethyl acetate extract and chloroform extracts of plant at doses of 100, 200, 400 mg/kg body weight (one tenth of the highest tolerable dose) once daily by an intragastric (i. g.) soft rubber catheter from day 11 up to the 15th day of pregnancy. The animals will be allowed to go full term. After delivery the pups will counted and the abortifacient activity of extract will be evaluated. The following parameters will be computed: number of live and dead fetuses; % survival ratio= (number of live fetus/number of live+ dead fetus)  $\times$  100; resorption index= (total number of resorption sites/total number of implantation sites)  $\times$  100; postimplantation loss= (number of implantations-number of live fetuses/ number of implantations)  $\times$  100. The anogenital distance (AGD) and crown rump length (CRL) of litters were measured by using a measuring tape. The variations in birth weight of litters and gestation period between control and experimental animal were also determined to check the abortive effect of plant extract.

All the above experimental protocol will be met with approval of Institutional Animal Ethics committee (1060/ac/07/CPCSEA/Dec2009).

#### IV. Conclusion

The abortifacient activity lends support to the claims for its traditional usage of plants as an abortive medicine. Thus, this study may prove to be an effective and safe alternative remedy for contraception. Further studies to identify the bioactive component.

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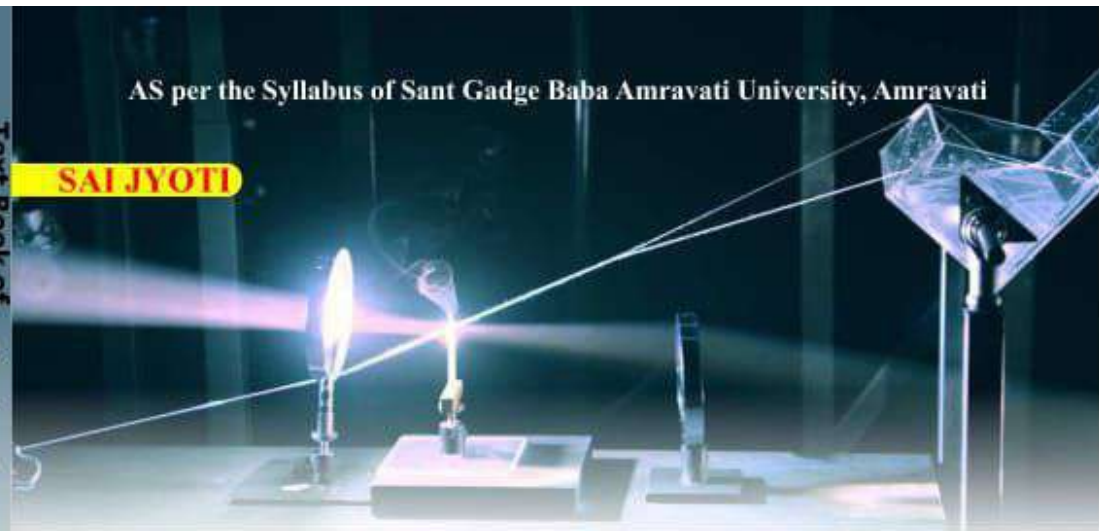
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# Innovative Research Trends in Science and Humanities

Dr. Ninad S. Dharkar  
Dr. Kishor P. Suradkar  
Dr. Suruchi R. Kadu  
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## **Innovation in Science and Technology to Achieve Sustainable Development Goals**

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### **Abstract**

United Nations Sustainable Development Summit adopted 17 Sustainable Development Goals to achieve by 2030. These United Nations is consisting of 193 nations i.e. almost a whole world is working towards to attain these goals. Doing so they invest in resources, funding, time and technology which generates opportunities for researchers and scientific community around these goals. This chapter talks about some key research trends that address some of these goals.

### **1. Introduction**

In September 2015, United Nations Sustainable Development Summit held in New York agreed on 17 global Sustainable Development Goals (SDGs) targeted to achieve by 2030 [1, 2]. The Sustainable Development Goals are the outline to attain an improved and viable future for living and non-living that ever exist on the earth. The goals include [3]:

- No poverty,
- Zero hunger,
- Good health and well being,
- Quality education,
- Gender equality,
- Clean water and sanitation,
- Affordable and clean energy,
- Decent work and economic growth,
- Industry innovation and infrastructure,
- Reduced inequalities,
- Sustainable cities and communities,
- Responsible consumption and production,
- Climate action,
- Life below water,
- Life on land,
- Peace, justice and strong institutions,
- Partnership.

These 17 SDGs can be classified into six categories based on their strong interdependencies. The categories are,

1. End of poverty and food securities (SDG 1 and SDG 2)
2. Health, education, gender equality and reduced inequality (SDG 3, SDG 4, SDG 5 and SDG 10).
3. Water, sanitation and affordable energy (SDG 6 and SDG 7).
4. Employment, economic growth, industrialization and infrastructure (SDG 8 and SDG 9).
5. Sustainable cities and communities with peace, justice and partnership (SDG 11, SDG 16 and SDG 17)
6. Responsible consumption and production for environmental development (SDG 12, SDG 13, SDG 14 and SDG 15)

These categories can further be merged in a three broad categories also known as the three pillars of SDGs as social, economic and environmental goals. [4]

Here we'll focus on the above mentioned six categories. Science and technology plays a key role to achieve these goals. It involves innovative thinking and research, thus setting a new trend in science and technology. Jeffrey D. Sachs et al says about attaining these goals "The world will need new technologies and new ways to organise human activity to combine improving living standards and ecological imperatives. Technological and social change will be paramount, in both rich and poor countries alike." [5]

The SDGs have started attracting attentions from science and technological domains due to their significant benefits, such as the strong incentives for technological innovation and development and passion for new research topics. Also the nations provide the funding to work on these 17 top global issues. Some of the recent trends to attain the SDGs are discussed below.

## **II. Recent trends in Science and Technology**

**Artificial Intelligence (AI):** AI can provide a system for growing population by managing the food transportation and logistics, water and sanitation, by assisting in the services like health and energy. AI helps in smart cities to use their resources more efficiently. For example, AI can stop the wastage of electrical energy in a metro station by sensing the weather, temperature and availability of service taker. It may be possible that in a metro coach there is no traveller present even then the lights, fans or air conditioner work on full. But an AI enabled metro coach will work only when it needed and thus reducing an overall consumption of the electricity. Same goes for water and sanitation. This thing affects to achieve clean water and sanitation.

AI can also support a low carbon emission cities, automated electrical vehicle transport system, smart appliances. AI support low-carbon energy systems with high incorporation of renewable energy and energy efficiency thus effectively support the reduction in climate change [6]. This indicates action in AI will affect the outcome is several SDGs and thus it is need to be explored.

### **III. Modern Biotechnology**

Increasing population, shrinking agricultural land, rising demand on limited water resources, creates a demand for water among domestic, agricultural and the industrial sectors. The ground water level dropping with each day which generates most severe alarms for Indian agriculture. H.P.M. Gunasena et al states that "in many parts of India the ground water level has gone many times lower so that the centrifugal tube well irrigation technology which was well within the means of the small farmers is beyond the investment capacity of even the larger farmers. These reasons have some effects on poverty, food security and water consumption. Similarly there are other issues like soil degradation, improbable rain schedule, crop diseases and less plant yielding. The challenge is to increase the production from the agricultural sector while satisfying the productivity potential of the available means.

Modern biotechnology is in trend where developed countries heavily investing in R&D and rapid progress have been made in the development of pest resistant crop varieties, bio pesticides, etc.[7]. The recent biotechnology trends involves, innovations for Food and Nutrition Security, application of novel plant breeding strategies, protection of plants from pathogens, plant disease diagnosis, extended shelf life for agricultural products, nutrient enrichment of food crops (Biofortification), microbial biotechnology in food production, etc. For example, microbial biotechnology in food production where a single cell protein refers to the edible unicellular microorganisms in which the biomass or the protein extracted from various organisms like bacteria, fungi, yeast or algae are used as protein supplements or replacement for the protein rich food[8]. The government also support research in Biotechnology for example the Centre for Cellular and Molecular Platforms (C-CAMP) under India's Biotechnology Industry Research Assistance Council (BIRAC), supports start-ups in the life sciences industry (C-CAMP, 2019)[9].

A safe, sufficient and nutritional food is important for a healthy life. Thus one can focus on agricultural related technologies ranging from basic science to research of food and nutrition for future food security and for better health.

### **IV. Affordable and Clean Energy**

As the population grows cheap energy demand also grows. In a country where energy and its utilization are high, the economy of that country naturally gets a strong boost. The uses of fossil fuels like, coal or natural gases create pollution and harm the environment. To accomplish SDG 7, investing and innovating in solar, wind and thermal power, improving energy productivity is crucial. Steven Chu et al provide recent trends and research opportunity provided in the field of energy production.

Internal combustion engines (ICEs)- With direct injection, lean burn and turbocharger technologies, the spark-ignition ICEs operating on premium octane ratings can increase the efficiency with lowering the emission. Battery-based electrification - An extraordinary progress in research has been made in battery cathodes, anodes and electrolytes. Embedding micro and nanostructure in designing of batteries lead to the reduction in mechanical stresses, improving the battery capacity. The production cost of these batteries very high and requires innovation in the sector. Also to improve over the current batteries requires a material research along the more sustainable electrolyte selection [10].

Apart from these there's lots of opportunity in sector like fuel cell based electrification, solar cell [11], wind energy [12] and nuclear energy [13]. Expanding infrastructure and elevation of technology to deliver clean and more effective energy to all will inspire growth and also help the environment.

### **V. Nuclear Science and Technology**

The use of nuclear science and technology (NST) contributes directly to nine of the seventeen SDGs namely, SDG 2, SDG 3, SDG 6, SDG 7, SDG 9, SDG 13, SDG 14, SDG 15 and SDG 17. The NST is utilised in medical and healthcare, food and agriculture, industry, water and environment, energy, and safety and security [14]. Mostly used nuclear technique such as mutation breeding to produce new varieties of plants and crops, used in nutritional studies. It plays an important role in cancer management such as diagnostic radiology, radiotherapy and nuclear medicine [15]. Radiochemical and radioactivity contamination analysis including for food and drinking water. It is also used in management of water, local natural resources and environment conservation and climate change studies, education and training. Climate change studies using light stable isotope and soil erosion and environmental studies using nuclear and radio isotopic techniques. It is used in industrial non-destructive testing techniques which help to optimise industrial productivity. The nuclear technology for peaceful uses transfer to developing countries through technical cooperation programme which enable sharing and building capacity in NST [16].

**Information and communications technologies (ICTs):** Online education especially after COVID-19 pandemic to student using internet and mobile application deliver awareness and knowledge more suitably through platform like Massive Open Online Courses (MOOCs). These new technologies enable the students who cannot attend classes receive more or less the same education opportunities which targets the SDG 4 of education to all. Use of mobile technologies also changes the healthcare service sector by providing information on diseases, medication and managing the services online. eGovernment systems like <https://aaplesarkar.mahonline.gov.in> open up the possibility to complete administrative processes from anyplace and anytime [17,18]. This is an enough motivation to investigate the relevance of SDGs to ICT so as to determine how these 17 SDGs have been addressed and what have not been well studied.

**Discussion:** The purpose behind the SDGs is to defend the Earth from further environmental degradation including climate change and manage natural resources for sustainable production in order to support the needs of present and future generation [19]. The targeted goals provides tremendous opportunity for research community in the field of science, technology and engineering. Artificial Intelligence (AI), Information and communications technologies (ICTs), Nuclear Science and Technology, Affordable and clean energy and Modern Biotechnology are the trends in which discussed above. These trends shows tremendous possibilities for achieving the target efficiently. In the 21st century, innovation and technological progress is critical in both national and global economic development. A nation's technological capabilities clearly support its development and possible growth. "Asian economies, such as South Korea, Taiwan and Singapore, have transformed their economies by improving the technological performance of their industries through purposeful science and technology policies. With their deepened technological capabilities, they are now able to compete consistently and successfully on a global scale in a growing number of industries (e.g. in electronics manufacturing)" [20].

## VI. Conclusion

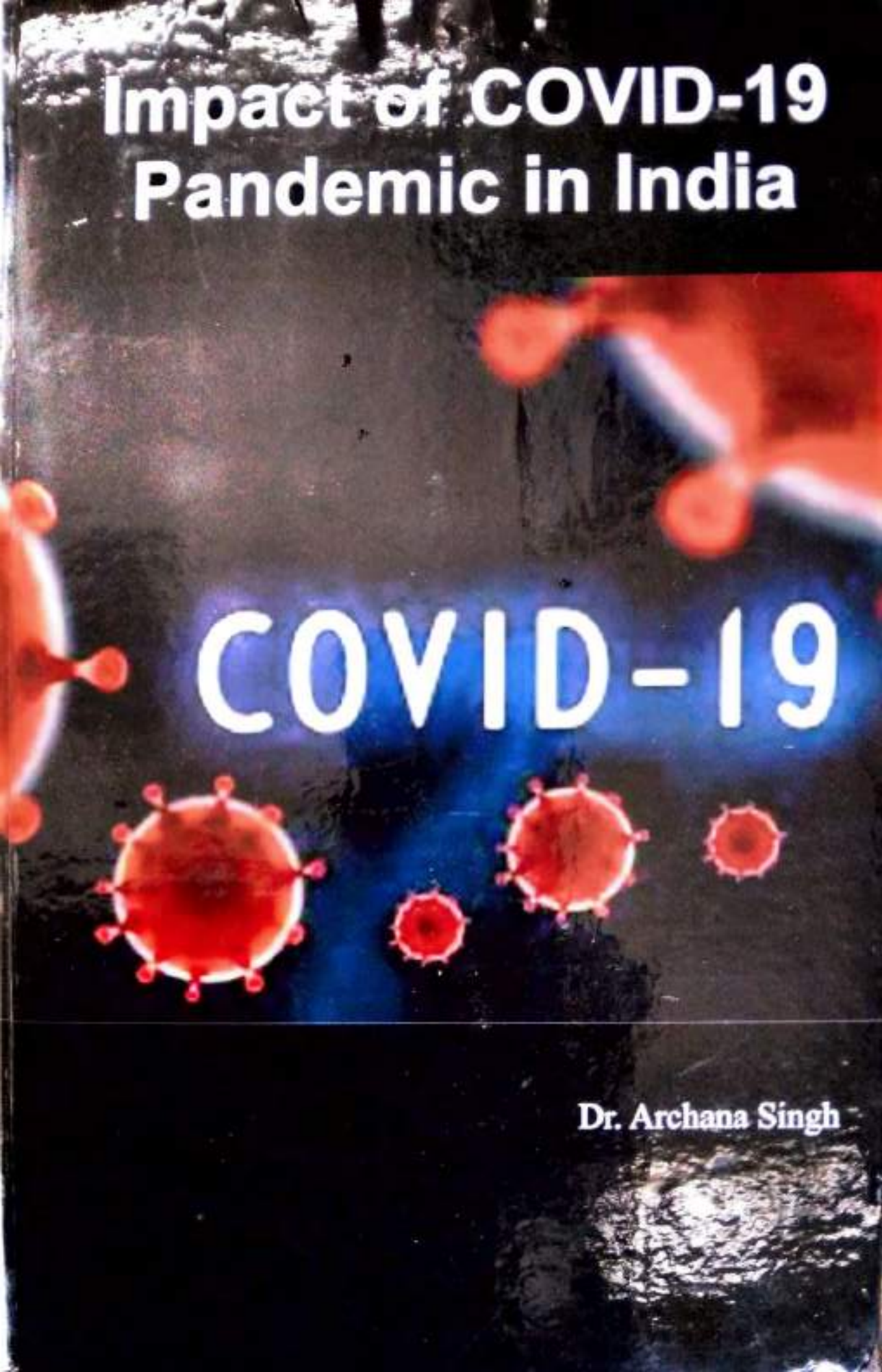
SDGs are robust directors toward the growth of global economy, societies, and environmental issues. Some trends from science and technology we discuss above have direct impact on these goals. It needs many more global scientific, technological, industrial, and governmental efforts to promote and support to reach these goals. They are strong targets for researchers and world governments to work on. These goals are highly dependent on science and innovation directly and indirectly, thus they are and can be a trend setter in the field of science and technology.

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# **Impact of COVID-19 Pandemic in India**

# **COVID-19**



**Dr. Archana Singh**

# **Impact of COVID-19 Pandemic in India**

Dr. Archana Singh

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## Impact of COVID-19 Pandemic on Education and Students in India

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### Abstract:

This study investigates the COVID-19 circumstances in India and confer the influence of it on education and students. Due to COVID-19, higher education institutions transitioned to online learning. This study discovered college student's observations of their implementation, use, and recognition of emergency online learning. The whole educational system from basic to tertiary level has been shrunk during the lockdown epoch of the novel coronavirus disease 2019 (COVID-19) not only in India but across the globe. The envisioned resolve of this manuscript pursues to report the mandatory essentialities of online teaching-learning in education amid the COVID-19 pandemic and how can existing possessions of educational institutions successfully transmute proper education into online education with the help of virtual classes and other vital online apparatuses in this frequently fluctuating educational background.

**Keywords:** COVID-19; students ; online learning; institutions .

## **1. Introduction**

The world is in front of a health calamity as COVID-19 has blow-out universally. The COVID-19 pandemic triggered an education emergency of unparalleled scale. Maximum administrations all over the place of the world have momentarily closed educational institutions in an effort to control the blow-out of the COVID-19 pandemic. This nationwide shutting has an impact on more than 91% of the world's student population. As an outcome of COVID-19, higher education has progressed to provide courses online. However, the queries about the readiness, scheming and usefulness of e-learning is still not undoubtedly agreed, mainly for a emerging nation like India, where the technical limitations like fittingness of devices and bandwidth accessibility pretences a serious contest. The existing technological developments agree to us to work several methods to enterprise the online content. It is very significant to think through the favourites and perception of students while planning the online courses to create the book learning operational and fruitful. The after- math of COVID-19 emergency, online education turn out to be a educational shift from traditional technique to the up-to-the-minute method of teaching-learning from classroom to Zoom, from personal to virtual and from seminars to webinars. The government of India in progress thinking gravely on this matter with accentuating on ICT and use of online education as the part of compulsory teaching-learning process at tertiary level.

## **2. Impact on students**

About 24.9% of students have experienced nervousness because of this COVID-19 eruption. Living in urban areas, living with parents, having a stable family income are protective factors for students against the anxiety experienced during the COVID-19 outbreak. Students accomplish online learning self-efficacy centred on earlier understandings with expertise and may necessitate teaching and help to custom learning tools and stages before the start of an online course. Using content analysis, we set up that students have a preference on recorded classes with quiz at the end of each class to progress the efficiency of learning.

### **3. Programmes and policy of the government of India on online teaching-learning in HEIs**

The government of India started thinking seriously on this problem with highlighting on ICT and use of online education as the part of necessary teaching-learning process at tertiary level. When the Government of India confirmed a nation-wide lockdown on 23rd March 2020 to contain the spread of COVID 19, instant act was taken to increase digital learning with even-handedness so that students across the country could continue their learning even during the lockdown. The Ministry has, over the last few years, developed a rich variety of online resources that are available on a variety of platforms. While students and teachers can access these through their laptops, desktops and mobile phones, these resources are being reached to learners in remote areas through Television and Radio. The following are some of the online resources developed by the Government as

- DIKSHA
- e-PATHSHALA
- NATIONAL REPOSITORY OF OPEN EDUCATIONAL RESOURCES (NROER)
- SWAYAM
- SWAYAM PRABHA
- NISHTHA—An integrated Teacher Training Portal and Mobile App
- NATIONAL DIGITAL LIBRARY

### **4. Discussion and Concluding remarks**

This study reconnoitred the awareness of college students about the use, adoption, and acceptance of emergency online learning during the stay-at-home orders due to COVID-19 in India. The online classes will prosper only if all the students have access to internet. Least technical necessities such as internet connectivity, devices and software supplies should be satisfied for optimum learning familiarity. The action

plan for effective online teaching should be as follows: “clear and proper planning of the sessions in consultation with the students, lesson preparation, regularity in the conduct of classes, doubt clearing sessions, and personalised responses to the queries of the students “.

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CURRENT  
**TRENDS**  
IN HIGHER EDUCATION



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## Role of Social Media In Higher Education

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### Abstract:

The universality of social media (e.g., Facebook, WhatsApp, Instagram, Telegram, YouTube, Wikipedia) is no more superficial than at the educational institute, colleges & university. Social media are progressively observable in higher education as teacher's aspect to technology to facilitate and improve their teaching as well as encourage active learning for students. Many academicians in all over the world claim for the determined incorporation of social media as an educational instrument. Social media have become an important tool for social communication and are extensively used in the teaching-learning process. Nonetheless of the use of social media by some academicians as an individual initiative, in India, social media's usage for the teaching-learning process has been neglected. The speedy implementation of social media technologies has given rise to in a vital modification that is in the way of communication and alliance between the humans. Distance Learning can take benefit of social media with virtual online learning via video conferencing and teleconferences. This chapter summarizes the different tools of social media and also highlights the advantages and disadvantages of Facebook, WhatsApp, Instagram, Telegram, YouTube, Wikipedia usage in teaching learning process ranging from educators' dominance to privacy concerns. As social media practice continues to cultivate in higher education, future experiential research is acceptable.

**Keyword:** Social media, Higher Education, Teaching learning process, Teacher, Technologies.

### 1.1 Introduction:

Social media technologies have changed the scenario of teaching learning in higher education. Social media platforms are an almost fundamental part of most

user's personal as well as educational lives via smartphones now-a-days. Social media takes the form of online platforms that empower connectivity, communication, and collaboration. Blogs, vlogs, instant messaging, virtual communities and social networking sites are diverse examples in which social media reveals the situation. Social networking sites are segmented into various types of market sectors and definite needs. Wikipedia and LinkedIn target formal business-related interactions whereas Facebook, WhatsApp, Instagram and Telegram target informal social communication, though the boundary between formal and informal use is getting indistinct.

Even as today's college student experiences a variety of virtual classroom forms like, google classroom, teachmint, google meet and zoom meet etc. Widely incorporated as a tool for personal or business purposes, the concept that social media could be an active medium for educational purposes that has acknowledged the recent consideration. At the same time, this emerging field is receiving an amplified educational research interest. The implicit part for social media as a facilitator and enhancer of literacy is worth probing. A broad understanding of scholarly comprehensions on the use of social media in education may also be a first step in understanding the relationship between the use of social media and important educational issues similar as assessment and pupil engagement.

Social media can be utilised to deliver tutorial material, educational information, updates and group communication and collaboration. Facebook's social communication aspects profit both preceptors and scholars by creating an online class group and adding relations between faculty-scholar and scholar-scholar and promoting cooperative literacy. A mindfulness of the

impact of social media on courses is important for preceptors. Since faculties and scholars establish the mainartist of the teaching learning process, their observations determine the difficulties and challenges of using social media in the learning process.

### **1.2 Definition of social media:**

The social media is the computer-based technology that simplifies the sharing of ideas, thoughts, knowledge and information through virtual systems and communities. Social media is internet and computational device-based gives users rapid electronic communication of content, such as personal information, educational documents, videos, photos and teaching learning materials. Users involve with social media through a computer, tablet, or smart phone using web-based software or applications. There are more than 5 billion social media users all over the world. The major social media networks comprise Facebook, Instagram, Twitter, YouTube, and Telegram.

### **2.1 Development of Social Media Tools:**

Present generation learners are growing up with digitalization of the teaching learning process. Educators are progressively understanding and familiarizing with the new methods of teaching laced with digitalization. YouTube, an important offshoot of digitalization, is leading the charge as the most multiuse medium for content transactions in the classroom and outside the classroom. It not only provides digital entertainment but also offers a great environment for learning.

WhatsApp can be used as a tool for academic guidance. WhatsApp it is much simpler and faster for the teacher to send voice messages and mark all aspects of the correction or even simply because it allows contact the student at any time and anywhere without having to delay for the next class. The educator can use WhatsApp groups as a means to assess student participation. WhatsApp is also an ideal tool to encourage and stimulate students. It is very important in the teaching-learning process to comprise the students so that they reach the objectives defined by the curriculum and their own aims.

Facebook is almost universally-used among higher education students. These scholars consider

Facebook as their core social media choice and thus spend a inordinate part of their time in its use in their normal day. Now-a-day in teaching learning process students can share their information and ideas by using Facebook. Apart from these teacher as well as students can use Facebook for sharing of educational work and learning material.

Telegram has become the greatest downloaded social media application and seen tremendous user growth, reaching 400 million monthly users. Telegram is free of charge, has unlimited space for cloud storage, supports media-sharing regardless of file size or type, and can be retrieved from several devices. Telegram also has distinct characteristics, such as high safety, video calls, chat groups, channels, polls. One of these advantages is Telegram's flawless network, which lets scholars pierce their accounts on any device, meaning they can start learning on their mobile phones and continue learning on their laptops, thus maintaining the information inflow from different coffers without stopping.

### **3.1 Importance of social media in teaching and learning in higher education :**

People of all ages are now heavily involved in social media. If you don't use social media, you're missing out on a lot of potential audience. Its implementation in higher educational institutions could be a highly beneficial option. The social networking sites and applications allows its users to make connections, to produce and enable collaboration and connectivity irrespective of geographical position. The fast rise of social media provides several possibilities for higher education institutions to implement it in teaching and learning process. Social media is widespread and highly accepted, making it suitable for administrators, managers, students and teachers of higher education institutions.

For education and learning, social media is employed in learning of languages, development of writing in students, discussion after class, simple and anytime anywhere communication, re- building community and curricular tool. Social media plays ansignificant role in every student's life. The usage of social media in higher education is altering the nature of student-teacher relationships. Students and teachers can

stay connected, students themselves, can communicate on social media in a unique way. Students find social media to be a straightforward and quick way to communicate, get information, and provide information. Teachers can host the live sessions on platform like Facebook, Twitter, YouTube etc. Instagram can be a good tool to provide flashcards of mathematical formulas and short notes.

Studies show that in recent years, educators have used social media to increase overtime and off campus support, lectures and hosting, dissemination of information, and student participation in discussions. The use of social media has also been shown to enhance teacher-student and student-student interactions. As a result of social media, students become proficient in using online technology in the context of education. They know exactly how to use both simple and complex services on various social media platforms. Studies have shown that the use of social media in higher education has improved learning, participation, participation and dissemination of content, education and information exchange. Teachers and students can take advantage of social media to improve and grow in their respective fields.

In addition to being used for teaching and learning, social media is also used for awareness, publicity, public relation, student enrolment management and alumni relations. Educational institutions can use social media to keep stakeholders up to date on new research programmes, policy changes, events, job openings, alumni interactions, and organisational news. Some universities and research institutes use social media to recruit students. To recruit more students, social media provides an ideal platform for highlighting new curriculum, research and educational staff, and campus facilities.

#### **4.1 Disadvantages of Social Media:**

There are some inherent restrictions on the use of social media in higher education. Its shortcomings include concerns about technology, privacy and online safety, passive student behaviour, decrease face to face communication, lack of expression of feelings, lack of use of academic language, unnecessary online distractions, increase laziness and chances of becoming or living a different personality than actual one. The

most important than all of the above disadvantages is the unawareness of the use of social media that is not securely.

Social media is also associated with the poor mental health and longer use of it may cause the same relationship problem with your friends, spouse and parents. Through the social media some malicious user target its user which may contain pornography, violent though provoking sites, engaging games and sites that can theft your money. Social media can also be used to abuse or bully others that lead recipient to psychological and stressed life. Thus, it is needed to learn or teach to manage the social media in healthier way.

Giving every teacher the flexibility to handle social media activities and maintaining equal regulation on published content is a major challenge that faces the higher education institutes. Educators must be mindful of the various ways individuals use social media when building social media integrations for learning and educational activities since people use social media in different ways. To avoid privacy concerns, it is suggested to create to encourage passive students and provide appropriate training to student, teachers and parents. This required to provide interesting and easily understandable content.

Social media presence is not merely a little chore that displays professionalism and actively engages a diverse audience. Higher education institutions, as well as their social media material and feeds, must be able to communicate more effectively with current students, parents, researchers, graduates, and colleagues. The social media can attract negative and offensive comments that can hurt particular gender, community or religion, which required proper management. Thus, it needs proper attention and timely engagement and for this purpose an additional set of social media managers and common social media policy is needed.

#### **5.1 Conclusion:**

Social media have revealed their dynamic role as platforms and tools for learning and permissible exchanging ideas and constant communications between scholar and faculties in higher education. Social media have been benefited for learning in the technologically advanced countries for a long time in

difference to the advanced countries in spite of their advantages to respond the disadvantages of outmoded education approaches including restriction on time, space, and facilities.

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## Chemistry And Biological Activities of Quercetin : A Bioactive Flavonoid

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### Abstract

Quercetin is a naturally occurring flavanol with diverse therapeutic properties. It is a plant pigment and a potent antioxidant flavonoid. Mostly reported in onions, grapes, berries, cherries, broccoli, and citrus fruits. Several review articles have documented various biochemical and pharmacological activities of quercetin. This review article focuses on the structure, chemistry, and biological activities of quercetin and also provides information available concerning isolation and purification methods of quercetin from various plant extracts.

**Keywords: Quercetin, isolation, purification, solvent extraction**

### 1. Introduction

Plants synthesize several organic compounds, most of which do not contribute directly to growth and development. These substances are referred to as secondary metabolites and often are differentially distributed among limited taxonomic groups within the plant kingdom (Goodman 2004). Plant secondary metabolites are classified as alkaloids, terpenes, flavonoids, coumarins, saponins, essential oils, tannins, and stilbenes. Flavonoids are an important class of secondary metabolites having a polyphenolic structure, widely found in fruits, vegetables, and certain beverages. Flavonoids include several subclasses viz., flavones, flavonols, flavanols, flavanones, isoflavones, proanthocyanidins, and anthocyanins (Mottaghipisheh and Iriti 2020). Quercetin (Qu) is a naturally occurring flavanol belonging to the class of flavonoids. Several studies have revealed that Quercetin has therapeutic properties for the prevention and treatment of several diseases viz., cancer, cardiovascular and neurodegenerative diseases (Babaei, Mirzababaei et al. 2018). Mechanistically quercetin exhibits anticancer (Rauf, Imran et al. 2018), antiviral (Derosa, Maffioli et al. 2021), antioxidant (Xu, Hu et al. 2019), antidiabetic (Bule, Abdurahman et al. 2019, Shi, Li et al. 2019) activities by modulating signaling pathways and gene expression in several *in-vitro*, *in-vivo* study models.

Quercetin is the most widely available dietary phytochemical in nature with varied beneficial and therapeutic effects on health. A large number of review articles and patents on the pharmacological and therapeutic activities of quercetin have been reported (Sharma, Kashyap et al. 2018). This review article focuses on chemistry, isolation methods of quercetin from various plants, and its therapeutic activities. This article is with special reference to the isolation methods of quercetin from plants. The most important articles published between 2010 to 2021 relating to the isolation of quercetin from plants have been selected from PubMed databases. The keywords used for the data retrieval were: 'quercetin' and 'quercetin and isolation methods'. This review comprises a brief note on chemistry, the structure of quercetin, details on isolation methods, and recent studies on the therapeutic activities of quercetin.

## 2. Chemistry of Quercetin

Quercetin is an important flavonol belonging to the flavonoid group of compounds. The term quercetin originates from *quercetum*, (i.e. oak) derived from *Quercus*, since 1857 (Fischer, Speth et al. 1997). Quercetin is one of the groups of over 4000 naturally existing plant phenolics whose isolation and biological identification were first described by Szent-Gyorgyi in 1936 (Harborne 2013). Quercetin is naturally found attached to sugars in various types of dietary sources. The quercetin content in different sources (mg/100gm) are Spinach 4.1, Pears 4.5, Romain lettuce 4.5, Red apples 4.7, Blueberries 5.1, Kale 7.7, Green hot peppers 15, Cranberries 15, White onions 21, Red onions 33 and Elderberries 42, Black tea 204.66 and in Green tea 255.55 (Patel, Mistry et al. 2018).

Quercetin (3,5,7,3',4'-Penta hydroxy flavone) (Figure 1), has a C<sub>6</sub>-C<sub>3</sub>-C<sub>6</sub> skeleton, two benzene rings (rings A and B) linked by a three-carbon chain that forms a closed pyran ring (C ring) which further combines with ring A. In addition, it contains 2, 3-double bonds and the five hydroxyl groups present at 3,5,7,3',4'-positions with the 4-oxo group. The presence of a phenolic hydroxyl group and double bonds bestows quercetin with strong antioxidant activity and determines its biological activity (Bentz 2017).

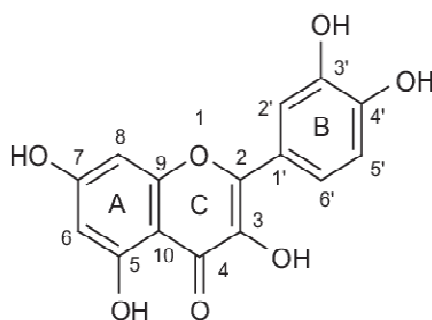
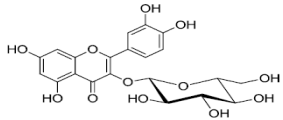
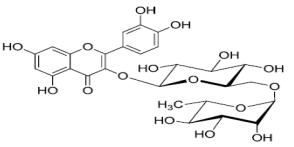
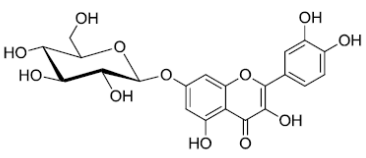
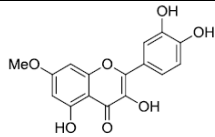
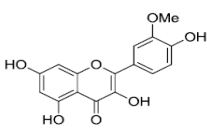
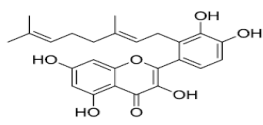
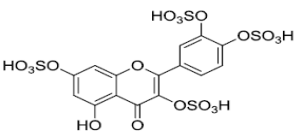


Fig 1. Quercetin

When Quercetin reacts with a free radical, it donates a proton and becomes a radical itself. The unpaired electron delocalized by resonance lowers the energy of quercetin radical to be reactive. The B ring o-dihydroxyl groups, the 4-oxo group in conjugation with the 2,3-alkene, and the 3- and 5-hydroxyl groups are the three structural groups that help quercetin to maintain its stability and function as an antioxidant against free radicals (Hollman and Katan 1997). The presence of five hydroxyl groups determines a possible number of derivatives. The main groups of quercetin derivatives are glycosides and ethers as well as the less frequently occurring sulfate

and prenyl substituents (Williams and Grayer 2004). The structures of quercetin derivatives, 1 to 7 along with their occurrence in nature have been shown in Table 1.

| Table 1 showing the structure of Quercetin derivatives |                                                                                     |                                    |                                    |
|--------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------|------------------------------------|
| S.No                                                   | Quercetin glycosides                                                                |                                    |                                    |
| 1                                                      |    | Quercetin -3-O- glucoside          | Sage, mango                        |
| 2                                                      |    | Quercetin -3-O- rhamnosylglucoside | Tea, spinach                       |
| 3                                                      |    | Quercetin -7-O-glucoside           | Beans, pepper tree                 |
| Quercetin methyl ethers                                |                                                                                     |                                    |                                    |
| 4                                                      |  | Rhamnetin                          | clove                              |
| 5                                                      |  | Isorhamnetin                       | Red onions                         |
| Prenylated and Sulphated Quercetin derivatives         |                                                                                     |                                    |                                    |
| 6                                                      |  | Solophenol D                       | Propolis                           |
| 7                                                      |  | Quercetin 3,3',4,7 tetrasulfate    | Leaves of <i>flaveria bidentis</i> |

## Biosynthesis

Quercetin is synthesized in plants through the phenylpropanoid pathway, phenylalanine the starting amino acid is converted to 4-coumaroyl-CoA through phenylalanine ammonia-lyase to cinnamate-4-hydroxylase (C4H) and 4-coumaroyl-CoA-ligase (4CL). A single molecule of 4-coumaroyl-CoA and the three molecules of malonyl-CoA construct tetrahydroxy chalcone in the presence of 7,20-dihydroxy and 4-methoxy isoflavanol synthase enzyme. Tetrahydroxy chalcone in the presence of flavonoid 3'-hydroxylase converts to naringenin and eriodictiol. Eriodictiol is

hydroxylated and converted to quercetin using flavanol synthase (Winkel-Shirley 2001). Chemically quercetin can be synthesized by two methods, viz., Kostanecki's synthesis and Robinson's synthesis (Sharma, Kashyap et al. 2018).

### 3. Isolation of Quercetin

Isolation of compounds from plants is performed by using the silica-gel chromatographic separation technique. The detection and separation of phenolic components from complex mixtures such as fruits and plant extracts have been performed using various techniques. Normal phase and reversed-phase C18 silica gel (SiO<sub>2</sub>) are used for isolation of various polarity flavonoids such as low polar flavonoids to moderate polar flavonoids and high polar flavonoids. The normal phase is generally best suited for isolation of low to the moderate polarity of flavonoids whereas reversed-phase C18 silica gel (SiO<sub>2</sub>) for high polar flavonoids. The advanced chromatographic techniques to isolate flavonoids are High-Performance Liquid Chromatography (HPLC) a popular and affordable technique, High-Speed Counter-Current Chromatography (HSCCC) a speedy technique, Molecular Imprinting Technology (MIT), Droplet Counter-Current Chromatography (DCCC) while the traditional techniques include Medium Pressure Liquid Chromatography (MPLC) a preparative column chromatography, Circular Liquid Chromatography (CLC) a type of chromatography, and Centrifugal Preparative Thin Layer Chromatography (CPTLC). Nuclear Magnetic Resonance (NMR) spectroscopy techniques, Mass Spectrometry (MS) is analytical techniques that work on the principle of Mass to Charge ratio of ions in samples, Spectrophotometric Ultra-violet (UV) a type of absorption spectroscopy techniques, and Infrared (IR) techniques which work in the infrared spectrum of the electromagnetic spectrum of light, give spectroscopic spectra of flavonoids and hence to elucidate the structure and purity of flavonoids these techniques have been used.(Chávez-González, Sepúlveda et al. 2020, Mottaghishah and Iriti 2020). This section details the isolation of flavanol "Quercetin" from various plant sources.

From the ethyl acetate (EtOAc) extract of aerial parts of *Halostachys caspica* C. A. Mey. (Chenopodiaceae) quercetin was isolated for the first time by physicochemical and spectrometric analysis. The EtOAc extract was passed through a silica gel (SiO<sub>2</sub>) chromatography along with concentration gradients of CHCl<sub>3</sub>-MeOH (from 1:0 to 1:1, v/v) as an eluent. From the six fractions (A to F) obtained fraction B was then passed through silica gel (SiO<sub>2</sub>) column chromatography with a concentration gradient of petroleum ether-acetone (from 1:0 to 0:1, v/v) as an eluent, and four sub-fractions were collected. Sub-fraction B-2 (0.10 g) obtained with the eluent petroleum ether-acetone (1:1, v/v) was further purified on Sephadex LH-20 and reverse phase chromatography (RP-18) to obtain *quercetin* (10 mg) (Liu, Mou et al. 2010). Quercetin was isolated from the ethyl acetate leaf extract of *Tibouchina semidecandra* L. (Melastomataceae). The EtOAc extract was subjected to column chromatography either on silica gel or Sephadex LH-20 on using petroleum ether/EtOAc (90:10, 85:15, 80:20, 75:25, and 70:30) and eluted with the gradient solvent system of CH<sub>2</sub>Cl<sub>2</sub>-MeOH (Sirat, Rezali et al. 2010). Chen, Lin et al. (2010) isolated and purified quercetin from the extract of *Lonicera japonica* (Caprifoliaceae).

The butanol extract of *P. longifolia* var. *pendula* (Annonaceae) were subjected to column chromatography over silica gel using a chloroform: methanol (10: 0 to 0: 10) gradient to obtain the number of fractions. Quercetin was purified by RP-18 column eluted with water: methanol (9: 1) solvent (Sashidhara, Singh et al. 2011). Gao, Yu et al. (2011) have been successfully

purified the crude extract of *Fructus caryophylli* (Myrtaceae), for the purification they used a non-conventional technique, a high-speed counter-current chromatography (HSCCC), separation was carried out with two separation solutions, one was chosen n-hexane-ethyl acetate-methanol-water with concentration ratio (5:8:6:13, v/v/v/v) and another separation solution was n-hexane:ethyl acetate:methanol:water with concentration ratio (5: 8: 9: 10, v/v/v/v) Quercetin was isolated and purified from fruits of *Lycium ruthenicum* Murr (Solanaceae) by using macroporous resin column, Sephadex LH-20 and by HPLC (Fa, Ji et al. 2012). Quercetin was isolated from methanol extract of guava leaves by column chromatography, eluted with MeOH-aqueous mixtures of different polarities (5 to 100% aqueous MeOH) (Nantitanon and Okonogi 2012). Quercetin was isolated from ethanol extract (95%) of the fruits from *Areca catechu* (Arecaceae) by silica gel, RP-18, and Sephadex LH-20 column chromatographies. Chemical and spectroscopic methods were used for structure characterization (Yang, Wang et al. 2012). Quercetin was isolated from ethyl acetate extract of *Polygonum perfoliatum* (Polygonaceae) by silica gel chromatography, Sephadex LH-20, and semi-preparative HPLC (Cheng, Liu et al. 2012). Cao and Li (2012) purified quercetin from the n-butanol extract of *Centipeda minima* (Asteraceae) by silica gel, reserved phase silica gel, and Sephadex LH-20 gel column chromatography. The ethyl acetate extract of *Psidium guajava* (Myrtaceae) was separated over a silica gel column eluted with CH<sub>2</sub>Cl<sub>2</sub>-MeOH (100:0-1:1 v/v) to yield four fractions A1-A4. Quercetin was obtained by eluting fraction A1 over a silica gel column with a solvent mixture of CH<sub>2</sub>Cl<sub>2</sub>-MeOH (50: 1 v/v) (Shu, Chou et al. 2012).

Hong and Chen (2013) revealed a novel method to selectively extract and determine quercetin from the extract of *Herba Lysimachiae* (Primulaceae). Their work used MIP (molecularly imprinted polymer) as selective MSPD (matrix solid-phase dispersion) sorbent, the ratio of MIP to sample was 1:1, the dispersion time was 10 min, washing solvent was 2% aqueous methanol, and elution solvent was acetic acid-methanol (2:98, v/v).

The EtOAc extract of *Loropetalum chinense* (Hamamelidaceae) (25 g) was subjected to CC (silica gel 200-300 mesh) with CHCl<sub>3</sub>/MeOH (100:2-8:2) solvent. Seven fractions were obtained by monitoring with TLC (F1-7). F5 (2.8 g) was repeatedly chromatographed over silica gel with CHCl<sub>3</sub>-MeOH from 95:5 to 90:10 and purified on Sephadex-LH-20, eluted with CHCl<sub>3</sub>-MeOH 1:1, and then on reverse phase chromatography (RP-18) eluted with CH<sub>3</sub>OH-H<sub>2</sub>O (from 4:6 to 8:2) to afford quercetin (Zhang, Fan et al. 2013).

The 70% EtOH extract of leaves of *A. pavonina* L (Fabaceae) was dissolved in water and then applied to the top of a polyamide 6S column chromatography eluted with MeOH-H<sub>2</sub>O mixture of decreasing polarities. Six main fractions (A -F) were obtained. The sixth fraction was subjected to Sephadex using MeOH-H<sub>2</sub>O (1:1) to yield quercetin (12 mg). Final purification was achieved by Sephadex LH20 column using MeOH as eluent (Mohammed, Abou Zeid et al. 2014). Water-soluble fraction of the methanolic extract of *Aconogonon molle* (D. Don) H. Hara (Polygonaceae) was subjected on MCI gel CHP20P CC and eluted successively with water, 40%, 60%, 80%, and 100% MeOH to give twenty fractions (1-20) based on their TLC patterns. Quercetin was isolated from fraction 16 (109 mg, 80% MeOH eluate) which was subjected to separation on Sephadex LH-20 CC (MeOH) (Joshi, Devkota et al. 2014).

Flavonol quercetin was isolated from ethyl acetate fraction of the methanol extract of flower petals of *Rhododendron arboreum* Smith (Ericaceae) by repeated Sephadex LH-20 column chromatography with **methanol**. **The sub-fractions were collected and monitored by**

TLC (Silica gel GF254) using a solvent system, butanol-acetic acid-water (4:1:5), ethyl acetate-methanol-water (100:15:10), chloroform-acetic acid-water (10:9:1), and toluene-ethyl acetate-formic acid (10:8:1). The quercetin was accumulated in fraction F-4 (2.5 g), which was further chromatographed on Sephadex LH-20 column eluted with 75% methanol (Bhandari and Rajbhandari 2014). The fresh whole plants of *Selaginella sinensis* (Selaginellaceae) were solvent-solvent partitioned and finally, EtOAc layer was chromatographed on silica gel, eluting with a gradient system of CHCl<sub>3</sub>-MeOH (70:1 - 5: 1) to afford fractions 1-4. Quercetin was obtained by column chromatography on silica gel (PE-EtOAc 5:1) from fraction 1 (Chen, Hao et al. 2014).

The ethyl acetate extract of *E. wallichii* (Euphorbiaceae) was subjected to silica gel liquid chromatography using stepwise gradient elution CHCl<sub>3</sub>/MeOH at 100:0, 200:1, 100:1, 50:1, 25:1, 10:1, 5:1, 2:1 and finally with MeOH to afford 17 pooled fractions A–Q according to TLC. Quercetin was obtained from Fraction M in CHCl<sub>3</sub>/Acetone (1:9) (Xu, Shen et al. 2015). Gouveia-Figueira and Castilho (2015) identified and characterized quercetin from 100% ethanol and aqueous extracts of the leaves, flowers, and fruits from *Rubus grandifolius* Lowe (Rosaceae) by HPLC–DAD–ESI/MSn method. Quercetin was isolated from the hydroalcoholic extract of leaves of *Euphorbia hirta* (Euphorbiaceae). Ethyl acetate soluble part of extract was eluted gradient using chloroform, chloroform: ethyl acetate (50:50), ethyl acetate, ethyl acetate: methanol (90:10) and methanol to give a compound which showed a single spot on the TLC plate developed in toluene: ethyl acetate: formic acid (6:2:0.8) and sprayed with aluminium chloride reagent. Quercetin was further confirmed by using UV and FTIR spectroscopy (Tiwari, Mishra et al. 2015).

Quercetin was isolated from ethanol leaf extract of *Trigonella foenum-graecum* (Leguminosae). The extract was chromatographed over silica gel column (100-200 mesh) using solvents of increasing polarity:100% hexane elution followed by chloroform, ethyl acetate and ethanol, and methanol in the ratio of 90:10, 80:20, 70:30, and 50:50 (Sambandam, Thiagarajan et al. 2016). Karaman Ersoy, Tütem et al. (2016) isolated quercetin from hydrolyzed nettle extract using molecularly imprinted polymer. Their studies revealed that molecularly imprinted solid-phase extraction (MISPE) procedures can be applied for selective pre-concentration and purification of quercetin from synthetic mixtures of phenolic compounds and nettle extract.

The methanolic extract of *Lagerstroemia speciosa* (Lythraceae) was subjected to an HPLC – DAD- MS system consisting of electrospray ionization. The mobile phase was composed of two solvents A and B, solvent A was water acidified with formic acid (pH = 3.0) and solvent B was methanol with 0.5 mL/min. flow rate and kept for 30 mins. Quercetin was characterized by Infrared Spectroscopy, NMR, and Mass (Saraswathi, Saravanan et al. 2017). Wang, Li et al. (2017) showed that deep eutectic solvents (DES) DESs-based monolithic cartridges can be used for simple and efficient extraction and as a pre-concentration technique for the purification of bioactive compounds. Quercetin was isolated by this method from *Ginkgo biloba* (Ginkgoaceae) extracts. Chromatography was performed on a C18 column at room temperature. The optimal mobile phase was methanol-water (6–4, v/v), and acetic acid 0.1% (v/v) added as a buffer.

Quercetin has been isolated from *Aesculus indica* fruit extracts (Sapindaceae). The ethyl acetate fraction of the fruit extract was subjected to column chromatography and eluted with ethyl acetate and n-hexane mixtures [1:4, 1:3, 3:7, 7:13, 2:3, 9:11 1:1]. Isolation and purity of

Quercetin were determined by HPLC and the structure of the compound was elucidated by FTIR and NMR studies (Zahoor, Shafiq et al. 2018). Quercetin was isolated from ethyl acetate leaf extract of *Azadirachta indica* (Meliaceae) by utilizing RP-HPLC method by semi-preparative column Intersil ODS-3 C-18 (5  $\mu$ m, 6 mm $\times$ 250 mm), using mobile phase composition of acetonitrile: methanol: aqueous solution of 0.2% formic acid in a ratio of 60:10:30 (Prakash, Mahapatra et al. 2018).

Pan and Lü (2019) revealed an efficient method for the preparative separation of quercetin and other compounds from *Gynostemma pentaphyllum* (Cucurbitaceae) by high-speed counter-current chromatography (HSCCC) for the first time. The n-hexane-ethyl acetate-methanol-water with a solvent concentration ratio (4:5:4:5, v/v) makes a two-phase solvent system that was used to purify quercetin by HSCCC technique. From their studies, it was revealed that from 164.7 mg of the crude extract, 90.5 mg quercetin at 99.23% purity was obtained. The structure was identified by Ultraviolet, Fourier transform infrared, ESI-MS (electrospray ionization mass spectrometry), <sup>1</sup>H nuclear magnetic resonance (NMR), and <sup>13</sup>C NMR spectra. Quercetin was isolated from ethyl acetate leaf extract of *Albizia lebbeck* L (Fabaceae). Preparative TLC on silica gel GF254 pre-coated plates was used to purify the ethyl acetate layer with a solvent system comprising ethyl acetate: methanol: water (15:1.25:1). The separated bands were visualized under UV light (254nm), bands at R<sub>f</sub>=0.5 were scraped off and eluted with acetone. The purified compound was analyzed by NMR (Jasiem, AL-Bazaz et al. 2019).

An efficient and green extraction method using natural deep eutectic solvents (NADESs) was developed for the extraction of quercetin from onion and broccoli by Dai and Row (2019). In this study, choline chloride and betaine-based natural deep eutectic solvents provided the highest extraction efficiency for the extraction of quercetin with ultrasonic-assisted solid-liquid method coupled with HPLC. Quercetin was isolated from the ethyl acetate extract of *Cyperus esculentus* rhizome (Cyperaceae). The extract was separated by repeatedly flash column chromatography on SiO<sub>2</sub> eluting with a mixture of ethyl acetate and cyclohexanes (from 1:9 to 8:2 vol ratio)(Vega-Morales, Mateos-Diaz et al. 2019).

Zahoor, Shah et al. (2020) devise a method for large-scale production of quercetin from *Rubus fruticosus* (Rosaceae) plant. The fruit ethyl acetate extract was loaded to 50 optimized silica gel columns. The column was eluted with an n-hexane/ethyl acetate solvent system. RO membrane was replaced by NF membrane through which 95% recovery was achieved. Ersoy, Tütem et al. (2020) isolated quercetin from red onion peels by quercetin-molecularly imprinted polymer (QC-MIP) in a molar ratio 1:4:20 of QC:4-vinyl pyridine: ethylene glycol di methacrylate by bulk polymerization. Molecularly imprinted solid-phase extraction (MISPE) procedures were applied for the selective pre-concentration and purification of quercetin from red onion peel methanolic extract with 58% recovery and from the extract hydrolyzate with 86% recovery. The results demonstrated that onion peel can easily and efficiently be converted to a valuable product quercetin, using QC-MIP as SPE (solid phase extraction) sorbent.

The ethanol extract of *Guiera senegalensis* (Combretaceae) was partitioned with n-hexane, chloroform, and n-butanol. Based on the bioactivity results, the n-butanol fraction was subjected to normal phase silica-gel (SiO<sub>2</sub>) column chromatography using chloroform: methanol elution with increasing polarity. Of the obtained eight fractions (BF1-BF8). Fraction BF2 was

subjected to column (Sephadex LH-20) elution with methanol: water (9:1 v/v), giving quercetin (Parvez, Al-Dosari et al. 2020). Pandiyan and Ilango (2020) reported on the identification, quantification, and isolation of quercetin in the leaves of *Huberantha senjiana* species smith (Annonaceae). HPLC-DAD-ESI (+) with mobile phases of methanol: water (0.1% formic acid) in the ratio of 55:45 was used at a flow rate of 0.5 ml/min revealed the presence of Quercetin, in the ethyl acetate extract of the leaves. An isocratic reversed-phase (RP)-HPLC method for the quantification of quercetin was developed with RP C18 column using mobile phase [(H<sub>2</sub>O (0.1% formic acid, A); (MeOH: ACN, (40:15v/v), B), 40:60 (v/v)].

Dried powdered aerial parts (1000 g) of *Hypericum afrum* Lam (Hypericaceae) were macerated at room temperature with EtOH–H<sub>2</sub>O (80:20, v/v) over 24 h, three times. The EtOAc fraction (7 g) was passed through on a silica gel (SiO<sub>2</sub>) column and a CH<sub>2</sub>Cl<sub>2</sub>–MeOH solvent system was used to elute with increasing polarity to yield 10 subfractions (E1–10) according to their TLC pattern. The subfraction E-3 (115mg) was further chromatographed on the column of a Sephadex LH-20 with CH<sub>2</sub>Cl<sub>2</sub>–MeOH (1:1) as the eluent yielding quercetin (Larit, Elokely et al. 2021).

#### 4. Biological activity

Quercetin (Qu) is a versatile flavanol with diverse properties and has been reported for several therapeutic activities by numerous researchers. Andres, Pevny et al. (2018) have detailed the safety aspects of the consumption of quercetin as a dietary supplement in humans. Several studies have documented the therapeutic activity of quercetin and its derivatives in cardiovascular diseases. Quercetin displays important heart-related benefits by reduction of adhesion molecules and other inflammatory markers, inhibiting LDL oxidation and endothelium-independent vasodilator effects. (Patel, Mistry et al. 2018). Qu serves as one of the vital phytochemicals capable of delivering anti-atherosclerotic effects in atherosclerotic cardiovascular disease. Inhibition of ROS (reactive oxygen species) by hindering NADPH (nicotinamide-adenine dinucleotide phosphate oxidase), stabilization of endothelial atherosclerotic plaque by downregulating matrix metalloproteinase-1 (MMP-1), preventing the formation of atherosclerotic plaques by upregulating nitric oxide synthetase and have been discovered as the biological targets of Qu (Deng, Li et al. 2020).

The anticancer potential of Quercetin (Qu) is documented in numerous *in-vivo* and *in-vitro* studies, involving several animal models and cell lines. The anticancer properties of Qu mainly occur through the modulation of phosphatidylinositol-3-kinase (P13K)/Akt (proteinase-kinase B)/mTOR (mammalian target of rapamycin), MAPK (mitogen-activated protein kinase)/ERK1/2 (extracellular signal-regulated kinase 1/2), Wnt/catenin signaling pathways, vascular endothelial growth factor (VEGF) and apoptosis (Almatroodi, Alsahli et al. 2021). Anti-cancer effects of quercetin in breast and prostate cancer have been validated through multiple *in vitro* studies and several *in vivo* studies. Recent studies have reported that Qu modulates several signal pathways to reduce the progression of breast cancer. Qu exerts its anticancer against breast cancer are via antioxidant activity, inhibition of proliferation, metastasis, angiogenesis, inflammation, and induction of apoptosis (Ezzati, Yousefi et al. 2020). Qu exerts its anticancer effect on prostate cancer cells by stimulation of caspase families, dissociation of Bax from Bcl-xL, and inhibition of angiogenesis. EGFR/PI3K/Akt/ERK1/2, NFκB, Wnt, and AKT/mTOR/P70S6K are among pathways that are influenced by Qu in the prostate cancer cells. The anti-angiogenic effects of Qu and its impact on cancer stem cells suggest its appropriateness for the prevention of tumor metastasis (Ghafouri-Fard, Shabestari et

al. 2021). Evidence from preclinical studies has shown that quercetin exhibits hepatoprotective activity against various drugs and toxic agents (Pingili, Challa et al. 2020). The bone protecting effects of Qu has been reported in several *in-vitro* and *in-vivo* studies by several investigators.

Qu was shown to inhibit receptor activator of nuclear factor-kappa B ligand-mediated osteoclastogenesis, osteoblast apoptosis, oxidative stress, and inflammatory response while promoting antioxidant expression, osteogenesis, angiogenesis, adipocyte, and osteoclast apoptosis. Regulation of Wnt, NF-kB, Nrf2, SMAD-dependent, intrinsic, and extrinsic apoptotic pathways could be the possible mechanism of action. Qu was shown to exert its actions on the MAPK signaling pathway to resulting in both stimulatory and inhibitory effects on bone metabolism (Wong, Chin et al. 2020). The pharmacological effects of Qu in hypertension and pregnancy-induced hypertension have been reported by several *in-vitro*, *in-vivo*, and by clinical studies (Ożarowski, Mikołajczak et al. 2018).

The role of quercetin as an antiviral agent against COVID-19 has been investigated recently. Results obtained from computational methods on molecular docking, it is expected that quercetin could affect SARS-CoV-2 by interacting with 3-chymotrypsin-like protease 3 (CLpro), papain-like protease (PLpro), and/or spike protein (S protein) (Derosa, Maffioli et al. 2021). To improve the oral bioavailability of quercetin, Quercetin Phytosome® is phosphatidylcholine bound to quercetin, as a delivery form was tested on humans. It showed an increased bioavailability rate by about twenty-fold for total quercetin. Quercetin Phytosome® must be considered a possible candidate to treat COVID-19 (Di Pierro, Khan et al. 2020). Quercetin may be a novel therapeutic agent for COVID-19-induced acute kidney injury (AKI). Gu, Zhang et al. (2021) used network pharmacology and molecular docking method to investigate the mechanisms between quercetin and SARS-CoV-2 targets proteins. The renal protective effects of quercetin on COVID-19-induced AKI may be associated with, inhibition of inflammatory response and cell apoptosis-related signaling pathways.

## 5. Conclusion :

Quercetin is one of the most prominent dietary phytochemicals with antioxidant properties present in fruits and vegetables. It also possesses proven health benefits and is now largely used as a nutritional supplement. This review summarizes valuable information about the isolation methods of quercetin from plant extracts belonging to various plant species and families, useful for researchers carrying out the phytochemical investigation.

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## Thermokinetic Studies of Cr(III), Mn(III) and Fe(III) Complexes Derived From Thiazole Schiff Base.

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### Abstract:

Thiazole Schiff base ligand was derived from the condensation of thiazole and 2-hydroxy-5-chloro-3-nitro acetophenone. The Schiff bases behaved as charge bidentate ligand. The ligand was characterized by elemental analysis and spectral methods. The coordinating ability of the ligand is investigated by preparing its metal complexes with Cr(III), Mn(III) and Fe(III), have been prepared and characterized by elemental analysis, conductance measurements, molecular weight determinations, spectral and thermal studies. The synthesized products are coloured solids, soluble in DMF, DMSO and THF.

**Keywords:** Schiff base, Magnetic susceptibility, Thermal

### Introduction :

Synthesis, characterization and antifungal activity of manganese (II) complex with Schiff Base derived from acetylacetone and leucine<sup>1</sup> synthesis, characterisation and various methods of Schiff base derived from sulphanilic acid and salicylaldehyde and Comparative study of Schiff base using various synthesis methods and their theoretical prediction of activities<sup>2</sup> The newly synthesized Schiff bases, 2-acetylthiophene thiosemicarbazone and thiophene-2-aldehyde thiosemicarbazone and their metal complexes with Co(II), Cu(II), Zn(II) and Ni(II) complexes and Their Schiff bases metal complexes were tested for antibacterial activity<sup>3</sup> There is the combination of the azo group, the imidazole unit and the Schiff base fragment to studies the synthesis, characterization, and optical properties of four different Schiff bases ligands. They are reported the possible use of such systems in biological applications for their antifungal properties and antioxidant activities<sup>4</sup>. Synthesis and structural diversity transition metal coordination complexes with diverse Schiff base ligands and macrocyclic systems<sup>5</sup> The aim of present investigation is to synthesize various transition metal complexes of Schiff base derived from 2-hydroxy-5-chloro-3-nitro acetophenone and 2-amino-4-phenylthiazole

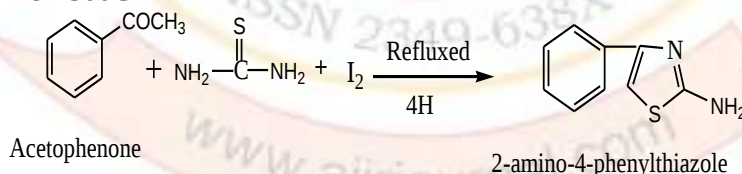
### Experimental :

All the chemicals were of A.R. grade and used as received. 2-hydroxy-5-chloro-3-nitro acetophenone (HCNA) and 2-amino-4-phenylthiazole was prepared by known methods<sup>6-9</sup>. The solvents were purified by standard methods<sup>10</sup>.

Synthesis of 2-amino-4-phenylthiazole;

The synthesis of 2-amino-4-phenylthiazole prepared by known method<sup>7-9</sup>. The product was filtered and crystallized from 70% ethanol, after several minutes the golden coloured product of 2-amino-4-phenylthiazole was separated out.

Yield: 9g (75%); m.p.: 148-150°C



Synthesis of 2-hydroxy-5-chloro-3-nitroacetophenone 4-phenyl-2 imino thiazole [HCNAT]: A solution of 4-phenyl-2 imino thiazole (0.02M) in 25ml of ethanol was added to an ethanolic solution (25ml) of 2-hydroxy-5-chloro-3-nitro acetophenone (0.02M) and the reaction mixture was refluxed on a water bath for 4h. After cooling a pale yellow coloured crystalline solid was separated out. It was filtered and washed with ethanol, crystallized from DMF and dried under reduced pressure at ambient temperature. The purity of ligand was checked by elemental analysis and m.p. It was also characterized by IR and <sup>1</sup>H NMR spectral studies. Yield: 75%; m.p. 305°C

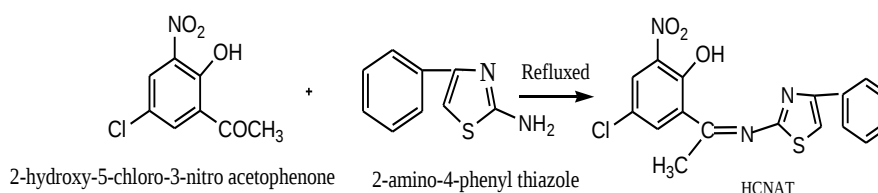


Table1. Analytical data of the Ligands.

| Ligand | Molecular Formula                                                 | Formula Weight | Color and nature   | Elemental Analysis |                 |                  |                 |
|--------|-------------------------------------------------------------------|----------------|--------------------|--------------------|-----------------|------------------|-----------------|
|        |                                                                   |                |                    | C% found (Cal.)    | H% Found (Cal.) | Cl% Found (Cal.) | S% Found (Cal.) |
| HCNAT  | C <sub>17</sub> H <sub>12</sub> N <sub>3</sub> O <sub>3</sub> SCl | 373.06         | Yellow Crystalline | 52.35 (52.20)      | 03.20 (03.34)   | 9.22 (9.38)      | 08.34 (08.46)   |

### Preparation of complexes:

All the metal complexes were prepared in a similar way by following method. To a hot solution of ligand HCNAT (0.02M) in 25ml of ethanol a suspension of respective metal salts was added drop wise with constant stirring. The reaction mixture was refluxed on a water bath for 3-5 h. The precipitated complexes were filtered, washed with ethanol followed by ether and dried over fused calcium chloride. Yield : 55-60%. The complexes are soluble in DMSO and DMF but insoluble in water and common organic solvents. The metal chloride content of complexes were analyzed by standard methods<sup>11,12</sup> The <sup>1</sup>H NMR spectra of ligand was recorded and obtained from RSIC Chandigarh. IR spectra of the compounds were recorded on Perkin Elmer 842 spectrophotometer in the region 400-4000cm<sup>-1</sup>, Carbon, Hydrogen and Nitrogen analysis were carried out at RSIC, Punjab University, Chandigarh. The molar conductance of the complexes at 10<sup>-3</sup> M dilution in DMF were determined using equiptronic digital conductivity meter EQ-660 with a cell constant 1.00 cm<sup>-1</sup> at room temperature. The magnetic moment measurement were made on a Gouy balance at room temperature using [HgCo(SCN)<sub>4</sub>] as the calibrant. The thermogravimetric analysis were performed on laboratory set up apparatus in air atmosphere at 100 C min<sup>-1</sup> heating rate. The molecular weights of the complexes were determined by Rast method.

Table 2. Analytical data and molar conductance of the compounds.

| Ligand                                                   | Formula weight g mole <sup>-1</sup> | Colour | Elemental Analysis Found (Calcd.) |               |             |               | $\mu_{\text{eff}}$ B. M | $\Lambda_M$ (Ω <sup>-1</sup> cm <sup>2</sup> mol <sup>-1</sup> ) |
|----------------------------------------------------------|-------------------------------------|--------|-----------------------------------|---------------|-------------|---------------|-------------------------|------------------------------------------------------------------|
|                                                          |                                     |        | M%                                | C%            | H%          | Cl%           |                         |                                                                  |
| [CrL <sub>2</sub> (H <sub>2</sub> O)Cl] H <sub>2</sub> O | 868.7                               | Green  | 5.42 (5.96)                       | 44.98 (45.29) | 2.56 (2.98) | 11.18 (11.19) | 3.6                     | 17.6                                                             |
| [MnL <sub>2</sub> (OAc)] H <sub>2</sub> O                | 895.1                               | Brown  | 5.46 (5.80)                       | 46.35 (46.59) | 3.23 (3.42) | 7.41 (7.53)   | 4.8                     | 17.4                                                             |
| [FeL <sub>2</sub> (H <sub>2</sub> O)Cl] H <sub>2</sub> O | 872.6                               | Black  | 6.12 (6.19)                       | 44.85 (45.10) | 3.22 (3.28) | 11.46 (11.72) | 5.4                     | 21.2                                                             |

### Result and Disscution:

The Schiff base HCNAT and its complexes have been characterized on the basis of <sup>1</sup>H NMR, IR spectral data, elemental analysis, molar conductance, magnetic succceptibility measurements and thermogravimetric analysis data .

All these values and analytical data is consistent with proposed molecular formula of ligand . All the compounds are coloured solid and stable in air. They are insoluble in water but soluble in coordinating solvents like DMF and DMSO. The molar conductance values in DMF(10<sup>-3</sup> M) solution at room temperature (Table2 ) shows all the complexes are non electrolytes.

The <sup>1</sup>H NMR spectra of ligand shows signals at δ 12.14,(1H, s phenolic OH), δ 7.56, 7.54, 7.53 and 7.52 (4H, m, phenyl) δ 6.81,6.80, and 6.78 (3H, s, Phenyl), 6.68 (1H,s, thiophene), and 2.56 (3H, s, methyl)

IR spectra of ligand and metal complexes shows  $\nu(\text{C}=\text{N})$  peaks at  $1622\text{ cm}^{-1}$  and absence of  $\text{C}=\text{O}$  peak at around  $1700 - 1750\text{ cm}^{-1}$  indicates the Schiff base formation<sup>16-19</sup>.

Table 3. IR spectra of ligand and metal complexes

| Compound                                                               | $\nu(\text{O}-\text{H})$ hydrogen bonded | $\nu(\text{C}=\text{N})$ imine | $\nu(\text{C}-\text{O})$ phenolic | $\nu(\text{M}-\text{O})$ | $\nu(\text{M}-\text{N})$ | $\nu(\text{C}-\text{S})$ |
|------------------------------------------------------------------------|------------------------------------------|--------------------------------|-----------------------------------|--------------------------|--------------------------|--------------------------|
| HCNAT (LH)                                                             | 3119                                     | 1622                           | 1514                              | --                       | --                       | 1126                     |
| $[\text{CrL}_2(\text{H}_2\text{O})\text{Cl}] \cdot \text{H}_2\text{O}$ | --                                       | 1595                           | 1500                              | 478                      | 406                      | 1118                     |
| $[\text{MnL}_2(\text{OAc})] \cdot 2\text{H}_2\text{O}$                 | --                                       | 1567                           | 1462                              | 498                      | 418                      | 1095                     |
| $[\text{FeL}_2(\text{H}_2\text{O})\text{Cl}] \cdot \text{H}_2\text{O}$ | --                                       | 1605                           | 1505                              | 513                      | 436                      | 1085                     |

Table 4. Thermal decomposition data of HCNAT and its complexes.

| Compounds                                                              | Half Decomposition Temperature (°C) | Activation Energy (kJ mole <sup>-1</sup> ) |       |        | Frequency Factor Z (sec <sup>-1</sup> ) | Entropy Change $-\Delta S$ (J mol <sup>-1</sup> K <sup>-1</sup> ) | Free Energy Change $\Delta F$ (kJ mol <sup>-1</sup> ) |
|------------------------------------------------------------------------|-------------------------------------|--------------------------------------------|-------|--------|-----------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------|
|                                                                        |                                     | B*                                         | H-M** | F-C*** |                                         |                                                                   |                                                       |
| HCNAT (LH)                                                             | 260.46                              | 3.22                                       | 5.47  | 4.31   | 87.28                                   | 211.42                                                            | 118.65                                                |
| $[\text{CrL}_2(\text{H}_2\text{O})\text{Cl}] \cdot \text{H}_2\text{O}$ | 550.32                              | 9.78                                       | 12.92 | 12.92  | 259.78                                  | 208.14                                                            | 183.62                                                |
| $[\text{MnL}_2(\text{OAc})] \cdot 2\text{H}_2\text{O}$                 | 710.34                              | 11.15                                      | 18.54 | 11.16  | 222.34                                  | 208.83                                                            | 217.88                                                |
| $[\text{FeL}_2(\text{H}_2\text{O})\text{Cl}] \cdot \text{H}_2\text{O}$ | 429.25                              | 3.78                                       | 9.48  | 8.40   | 169.78                                  | 208.34                                                            | 156.57                                                |

Thermogravimetric studies : Thermogravimetric study indicates all the complexes are stable up to 60-700°C. All the complexes shows half decomposition temperature (Table 4). The Thermal activation energy was calculated by Freeman-Carroll,<sup>20</sup> Horowitz-metzger<sup>21</sup> and Broido<sup>22</sup> method.

## Conclusions

In conclusion, we have synthesized new ligand 2-hydroxy-5-chloro-3-nitro acetophenone 4-phenyl-2-imino thiazole and their metal complexes. Ligand was found to bind the metal ion monobasic (ON) bidentate manner. Conclusion of thermal decomposition temperature and activation energy of synthesized Schiff base metal complexes

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## Biodiversity: Concept, Threat and Conservation

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### Abstract

In our biosphere enormous diversity (or heterogeneity) exists not only at the species level but at all levels of biological organisation ranging from macromolecules within cells to biomes. Biodiversity refers to the various life forms that exist on earth, including animals, plants, microorganisms, the genes they contain and the entire ecosystem they live in. It refers to genetic variation, species variation, ecosystem variation, within an area, biome or planet. Biodiversity is considered at three main levels including species diversity, genetic diversity and ecosystem diversity. Biodiversity plays a fundamental role in maintaining the aesthetic value of the environment, the integrity of the natural environment, and promotes the general well-being of all plant and animal life. Diversity of life ensures environmental resilience, provides humans with the life systems on which they rely and reinforce life on earth. In spite of the benefits from biodiversity, today's threats to species and ecosystems are the greatest recorded in recent history and virtually all of them are caused by human mismanagement of biological resources often stimulated by imprudent economic policies, pollution and faulty institutions in-addition to climate change. Activities such as habitat fragmentation, human disturbance, and habitat loss have to be effectively curtailed to enrich biodiversity conservation measures. Some of the existing measures of biodiversity conservation include; botanical gardens/arboretums, zoological gardens, biosphere reserves, germplasm banks and adoption of breeding techniques, tissue culture techniques, social forestry to minimize stress on the exploitation of forest resources. Hence, biodiversity conservation is all about protecting all organisms and species within their natural habitats with the aim of ensuring intragenerational and intergenerational equity. This study focuses on the importance of biodiversity conservation, threat to it, biodiversity status of India, various approaches for biodiversity conservation, action plan and current status.

**Keywords:** Biodiversity, Environment, Conservation, Aesthetic

## Introduction

Biodiversity is the enormous, dizzying variety of life that surrounds us, including all of the earth's plants, animals, their habitats, and the natural processes that they are a part of. It has become clear that biodiversity is the keystone of our existence on Earth. It is also important to conserve biodiversity for the sake of our own curiosity and aesthetic appreciation. But, with the increased dependency on agriculture and industrialization, the emphasis on biodiversity has decreased. Indeed, the biodiversity, in wild and domesticated forms, is the source for most of humanity, food, medicine, clothing and housing, much of the cultural diversity and most of the intellectual and spiritual inspiration. Further that, a quarter of the earth's total biological diversity amounting to 2.1 million species, which might be useful to mankind in one way or other, would be in serious risk of existence over the next decades. (Journal of Biodiversity, Bioprospecting and Development, 2021). Researchers believe that there are actually about 13 million species, though as per UNEP estimates there are 9.0 to 52 million species exist on earth (Mora, Camilo, *et al.*, 2011). Biodiversity also includes genetic variations within each species - for example, between varieties of crops and breeds of livestock. Chromosomes, genes, and DNA-the building blocks of life-determine the uniqueness of each individual and species. Yet another feature of biodiversity is the variety of ecosystems such as those that occur in deserts, forests, wetlands, mountains, lakes, rivers, and agricultural landscapes. In each ecosystem, living being including human form a community, interacting with one another and with the air, water, and soil around them. On realization that the erosion of biodiversity may threaten the very existence of life has awakened man to take steps to conserve it (Rawat and Agarwal, 2015).

## BIOLOGICAL BIODIVERSITY

Biological diversity is usually considered at three different levels - genetic diversity i.e. at genetic level, species diversity i.e. at the level of species, and ecosystem diversity i.e. at the level of ecosystem.

## Genetic diversity

Genetic diversity encompasses all the variety of different genetic information contained in animals, microorganisms and plants. A single species of organisms with diverse genetic diversity portray more adaptability and survival mechanism against adverse environmental conditions compared to organisms of a single species with the same genetic make-up (Conserve-energy-future.com 2021). Each species, from bacteria to higher plants and animals, stores an massive amount of genetic information. For example, the number of genes is about 4000 in bacteria (eg. *Escherichia coli*), 450-700 in mycoplasma, 32,000 - 50,000 in rice (*Oryza sativa*); and 35,000 to 45,000 in human beings (*Homo sapiens sapiens*). This variation of genes, not only of numbers but of structure also, is of great importance as it enables a population to adapt to its environment and to respond to the process of natural selection. If a species has more genetic variation, it can acclimate better to the changed environmental conditions. Lower diversity in a species leads to genetic uniformity of genetically like crop plants. This homogeneity is desirable in producing uniform quality of grain. But genetic uniformity restricts adaptability of a species to environmental stress as all the plants have same level of resistance (ceetindia.org 2021).

## Species diversity

Species diversity refers to the variety of organisms in the environment. Species diversity can be measured in terms of:

**Species richness:** It is the total number of species in a given region or locality. It is measured using the Menhink and Mangalet indices.

**Species abundance:** refers to the relative numbers among species. For example, the number of species of plants, animals and microorganisms may be more in an area than that recorded in another area.

**Taxonomic diversity (Phylogenetic):** Taxonomic diversity (TD) is the genetic relationship that exists between various groups of species. This kind of diversity is represented using a hierarchical

classification based on the phylogenetic evolution of different species of organisms.(safeworldhse.com 2020).

Estimates on the number of Earth's current species range from 10 million to 14 million (Miller and Spoolman, 2015), of which about 1.2 million have been documented and over 86 percent have not yet been described. (Mora, Camilo, *et al.*, 2011) Species diversity is not evenly distributed across the globe. The overall richness of species is concentrated in equatorial regions and tends to decrease as one moves from equatorial to polar regions. In addition, biodiversity in land ecosystems generally decreases with increasing altitude. In marine ecosystems, species richness tends to be much higher in continental shelves.

#### **Ecosystem diversity**

Ecosystem diversity refers to variability in habitats within a geographic area. Unlike genetic diversity and species diversity, ecosystem diversity considers both biological drivers and non-biological drivers of variability, like temperature and sunlight (Alsterberg, Christian, *et al.* 2017). From one region or country to another, there are different ecosystems or biomes. It refers to the presence of different types of ecosystems. For instance, the tropical south India with rich species diversity will have altogether different structure compared to the desert ecosystem which has far less number of plant and animal species. Likewise, the marine ecosystem although has many types of fishes, yet it differs from the freshwater ecosystem of rivers and lakes in terms of its characteristics. So such variations at ecosystem level are termed as ecosystem diversity. As stated above, ecosystem diversity encompasses the broad differences between ecosystem, and the diversity of the habitats and ecological processes occurring within each ecosystem type. Biodiversity is not distributed evenly on Earth. It is the richest in the tropics. Terrestrial biodiversity tends to be highest near the equator (Gaston, 2000), which seems to be the result of the warm climate and high primary productivity. Marine biodiversity tends to be highest along coasts in the Western Pacific, where sea surface temperature is highest and in the mid-latitudinal band in all oceans. There are latitudinal gradient in species

diversity (Tittensor *et al.*, 2010). Biodiversity generally tends to cluster in hotspots (Myers *et al.*, 2000), and has been increasing through time but will be likely to slow in the future. India has very diverse terrestrial and aquatic ecosystems ranging from ice-capped Himalayas to deserts, from arid scrub to grassland to wetlands and tropical rainforests, from coral reefs to the deep sea. Each of these comprises a great variety of habitats and interactions between and within biotic and abiotic components (ceetindia.org 2021). The most diversity-rich are western-ghats and the north-eastern region. A very large number of species found in these ecosystems are endemic. The endemics are concentrated mainly in north-east, western-ghats, north-west Himalaya, and Andaman and Nicobar Islands. About 33% of the flowering plants recorded in India are endemic to our country. Indian region is also notable for endemic fauna. For example, out of recorded vertebrates, 53% freshwater fish, 60% amphibians, 36% reptiles and 10% mammalian fauna are endemic (Singh and Chaturvedi 2017).

#### **NEED OF BIOLOGICAL DIVERSITY**

The human civilization depends directly or indirectly upon this biodiversity for their very basic needs of survival-food, fodder, fuel, fertilizer, timber, liquor, rubber, leather, medicines and several raw materials. This diversity's the condition for the long-term sustainability of the environment, continuity of life on earth and the maintenance of its integrity. Biodiversity also has vast social and cultural importance(Singh, Y. K.2006).The various benefits of biodiversity can be grouped under three categories: ecosystem services, biological resources, and social benefits.

##### **Ecosystem services**

Biodiversity provides many ecological services free of cost that are responsible for maintaining ecosystem health. Thus, biodiversity is essential for the maintenance and sustainable utilization of goods and services from ecological system as well as species (Daily (2003).

Protection of water resources: Natural flora cover helps in maintaining hydrological cycles, regulating and

stabilizing water run-off and acting as a defense against extreme events such as floods and droughts. Vegetation loss results in siltation of dams and waterways. Wetlands and forests act as water purifying systems, while mangroves trap silt thus reducing impacts on marine ecosystems.

- **Soil protection:** Biodiversity helps in the conservation of soil and retention of moisture and nutrients. Clearing large areas of vegetation cover has been often seen to accelerate soil erosion, decrease its productivity and often result in flash floods. Root systems permit penetration of water to the sub soil layer. Root system also carries mineral nutrients to the surface by nutrient uptake.
- **Nutrient storage and cycling:** Ecosystem performs the key function of recycling nutrients found in the atmosphere as well as in the soil. Plants take up nutrients, and these nutrients then can form the basis of food chains, to be used by a wide range of life forms. Nutrients in the soil, in turn, is replenished by dead or waste matter which is converted by micro-organisms; this may then feed others such as earthworms which also mix & aerate the soil and make nutrients more readily available.
- **Pollution reduction:** Ecosystems and ecological processes play an key role in maintenance of gaseous composition of the atmosphere, breakdown of wastes and exclusion of pollutants. Some of ecosystems, especially wetlands have the ability to breaking down and absorb pollutants. Natural and artificial wetlands are being used to filter effluents to remove nutrients, heavy metals, suspended solids; reduce the BOD (Biological Oxygen Demand) and eliminate harmful micro-organisms. Extreme quantities of pollutants, however, can be detrimental to the integrity of ecosystems and their biota.
- **Climate stability:** Vegetation has impact on climate at macro as well as micro levels. Evidence suggests that undisturbed forests help to maintain the rainfall rate in the vicinity by recycling water vapor at a steady rate back into the atmosphere. Vegetation also exerts moderating influence on micro-climate. Cooling effect of vegetation makes living comfortable. Some organisms are dependent on such microclimates for their existence.

- **Maintenance of ecological processes:** Different species of birds and predators assist to control insect pests, thus reduce the necessity and cost of artificial control measures. Birds and nectar-loving insects which roost and breed in natural habitats are significant pollinating agents of crop and wild plants. Some habitats protect vital life stages of wildlife populations such as spawning areas in mangroves and wetlands (Chandrakar 2012).

#### **Biological resources of economic importance**

- **Food, fibre, medicines, fuel wood and ornamental plants:** Thousands of plant species are known to have been used as food by humans. Currently about 20 species feed the majority of the world's population and just 3 or 4 are the major staple crops to majority of population in the world. A huge number of plants and animals materials are used for the treatment of various ailments. The usage of medicinal plants in India has an ancient history, dating back to the pre-vedic culture, at least 4000 years B. C. The therapeutic values of herbal medicines led to evolution of Ayurveda which means "science of life" and estimated that at least 70 % of the country's population rely on herbal medicines and over 7000 species of plants are used for medicinal purposes. Wood is a basic commodity used globally for making furniture and for building purposes. Fire wood is the primary source of fuel broadly used in third world countries. Wood and bamboo are used for making paper. Plants are the traditional source of fibre such as hemp, flax, cotton, jute etc.
- **Breeding material for crop improvement:** Wild relatives of cultivated crop plants contain valuable genes that are of vast genetic value in crop development programmes. Genetic material of wild crop plants are used to develop a new varieties of cultivated crop plants for restructuring of the existing ones for improving yield or resistance of crops plants. For example: rice grown in Asia is protected from main diseases by genes contributed by a single wild rice variety.
- **Future resources:** There is a clear relationship between the conservation of biological diversity and

the discovery of new biological resources. The relatively few developed plant species currently cultivated have had a vast research and selective breeding applied to them. Many presently under-utilised food crops have the potential to become key crops in the future. Knowledge of the uses of wild plants by the native people is often a source for ideas on developing new plant products.

#### **Social benefits:**

- **Recreation:** Forests, wildlife, national parks and sanctuaries, garden and aquaria have great entertainment and recreation value. Ecotourism, photography, painting, film making and literary activities are closely associated.
- **Cultural values:** Plants and animals are significant part of the cultural life of humans. Human cultures have co-evolved with their environment and biological diversity can impart a different cultural identity to different communities. The natural environment serves the aesthetic, spiritual, inspirational, and educational needs of the people, of all cultures. In a majority of Indian villages and towns, plants like Tulsi (*Ocimum sanctum*), Peepal (*Ficus religiosa*), Khejri (*Prosopis cineraria*) are planted and considered sacred and worshipped. Underlying cultural and religious beliefs in serpent deities has played a role in protecting iconic animals such as snakes and other species.

#### **CAUSES OF BIODIVERSITY DEPLETION**

Loss of species is a severe cause of concern for human survival. It has been observed that 79 species of mammals, 44 of birds, 15 of reptiles and 3 of amphibians are endangered. About 1500 species of plants are endangered in India. The threat to endurance or loss may be caused in the following three ways:

- **Direct ways:** Deforestation, commercial exploitation hunting, poaching.
- **Indirect ways:** Loss or modification of the natural habitats, pollution, introduction of exotic species etc.
- **Natural causes -** Climate change.

Among these causes, habitat destruction and over-exploitation are the main.

#### **Habitat destruction**

Habitat demolition may result from clearing and burning forests, draining and filling of wetlands, converting natural areas for agricultural or industrial uses, human settlements, mines, building of roads and other developmental projects. These change either kill or force out many species from the area causing problem in interactions among the species. Fragmentation of large forest tracts (eg. the corridors) affects the species inhabiting the deeper part of the forest and are first to disappear. Apart from the direct loss of species during the development activities, the new environment is unsuitable for the species to endure. Over exploitation diminishes the size of the population of a species and may push it towards extinction.

#### **Introduction of exotic species**

When a species land in new places, they breed extra fast due to absence of any enemy and often wipe out the native species already present there. Exotic species (new species entering geographical region) may wipe out the native ones. A few examples are-

- **Parthenium hysterophorus** (Congress grass- a tropical American weed) has invaded many of the vacant areas in cities, towns and villages in India leading to elimination of the local plants and the dependent animals.
- **Water hyacinth** clogs lakes and riversides and endangers the survival of many aquatic species. This is common in Indian plains.

#### **Pollution**

Air pollution, acid rain abolishes forests. Water pollution executes fishes and other aquatic plants and animals. Toxic and lethal substances drained into waterways kill aquatic life. Oil spills kill littoral birds, plants and other marine animals. Plastic trash entraps wildlife. It is easy to see how pollution is a big menace to biodiversity.

### Population growth and poverty

Over six billion people live on the earth. Each year, 90 million more people are added. People use natural resources for food, water, medicine, clothes, shelter and fuel. Need of the poor and often greed of the rich generate continuous pressure resulting in over-exploitation and forfeiture of biodiversity.

### BIODIVERSITY STATUS OF INDIA

India has marvelous biodiversity, genetic as well as of species and ecosystems. It contains over 7 per cent of the world's biodiversity on 2.4 per cent of the Earth's surface. This diversity can be attributed to the vast variety of landforms and climates resulting in habitats ranging from tropical to temperate, and from alpine to desert.

### Vegetative Diversity In India

There are 17 large nations in the world like Australia, Brazil, Congo, Colombia, China, Mexico, South Africa, Indonesia, Venezuela, Peru, Philippines, Malaysia, India and United States of America that have large biodiversity. India comprise only 2.4% of the total land area worldwide but having more than 7% of the total known animals and species of the world. India is ranked 10th in the world based on its botanical diversity, 11th based on limited regional variations and 6th based on crop production. India is a home to about 18,660 flower plants (angiosperm), 82 gymnosperm, 7411 algae, 15396 fungus, 1302 pteridophytes and 1223 viruses. Till now, one third of all known angiosperms are only found in India. The plant genetic diversity of India is also unique. About 50000 varieties of rice, 2200 varieties of mango, 500 varieties of oats and pepper each are found in India, in which 167 species of crops were first grown in India. Among them are rice, cane, banana, lime mustard, ginger, cardamom, turmeric, black pepper, etc. In India, if we talk about crops varieties, 51 different varieties of grain coarse cereals, 104 species of fruits, 55 species of vegetable and beans, 24 species of fibres containing cereals and of 24 species of oilseed grow in India. One hundred nine varieties of spices are used in the world; out of 75 species grow from India. Out of them, 27 species are widely cultivated in large scale. India is also a leading producer of turmeric, pepper and cardamom.

Biodiversity of India is very sensitive as world's 34 leading biodiversity sites are in India. It is believed that not only regional species are found there, but highly sensitive biodiversity areas of the world are also found in various regions of India such as the Himalayas, the Sundarbans the Western Ghats etc. World's most ancient native flowering plants are found in the north eastern region of India (Agnihotri, Dassani and Sharma, 2020).

### Animal Diversity in India

India is also the world's leading country in terms of diversity of fauna. So far, about 89317 types of animals are identified in India. They comprise of 390 types of mammals, 1225 types of birds, 456 types of snakes, 2546 fish, include 470 types of moulds, 2577 types of protozoa, 68389 types of insects and Arthropodes, and 8329 species of other animals. 2/3 of the world tigers, 60% of wild buffalos and one-horned rhinoceros are found in India only. Gir sanctuary in Gujarat is the only residential place of Asiatic lion. Thus, many species of birds are also found only in India (Agnihotri, Dassani and Sharma, 2020).

### India's Forests

Only about 21.67% of India's area is covered by forests today. India is geographically divided into 10 biogeographical regions and 26 biological territories and based on botanical diversity, there are 16 types of major forest and 226 types of regional forests in India. Among them, 37% are tropical deciduous and 3.9% are grasslands. About 30% forests include desert, evergreen forests, mountain forests, etc. The most human forms in the world are found in India (India State of Forest Report, 2019).

### The Utility of Biological Diversity

Vegetation has been the basic source of food since the beginning of life on earth. Since the beginning of the existence of human life; various uses of biodiversity have been made, either directly or indirectly. Vegetation has been used in Puja, recitation and religious rituals etc. Thus, use of 2,000 kinds of grains in the Yajurveda is known. There is a description of the medicinal utility of about 500 plants in the Vedas. According to the

Botanical Survey of India, more than 10,000 species of plants are used in India in various forms. Food supplements are obtained from 4000 types of plants, medicines are obtained from 8000 kinds of plants and fibers are also extracted from 6000 kinds of plants. Animal feed is obtained from 5000 types of plants; 325 species of plants are used for fishing, 100 plants are utilized for fragrance purpose, 75 plants are used as spices and about 750 plants are also utilized for various purposes. Presently, about 150 modern medicines have been obtained from trees and plants. 30 of these medicines have been discovered in India. Similarly, more than 70 medicinal trials have been made possible by traditional medicinal knowledge used by tribes of India. Recently collaboration with various government research organizations like National Botanical Research Institute, Central Medicinal and Aromatic Plant Institute an important and effective medicine for curing diabetes, rheumatism and skin diseases have been launched in the Indian market (Agnihotri, et al., 2020).

## STRATEGIES FOR ENVIRONMENT AND BIODIVERSITY CONSERVATION IN INDIA

Conservation efforts can be grouped into the following two categories: In-situ (on-site) & Ex-situ (off-site).

### In-situ methods

In-situ methods conservation includes the protection of plants and animals within their natural habitats or in protected areas. Protected areas are land or water dedicated to protect and maintain biodiversity.

### Protection of habitat

The main approach for conservation of species is the protection of habitats in representative ecosystems. Presently, India has ninety six National Parks, five hundred Wildlife Sanctuaries, thirteen Biosphere Reserves, twenty seven Tiger Reserves and eleven Elephant Reserves covering an area of 15.67 million hectares or 4.7 % of the geographical area of the country. Twenty one wetlands, thirty mangrove areas and four coral reef areas have been identified for rigorous conservation and management purposes by the Ministry of Environment and Forests, Govt. of India.

### National parks and sanctuaries

India is unique in the abundance and diversity of its vegetation and wildlife. India's national parks and wildlife sanctuaries (including bird sanctuaries) are located Ladakh in Himalayas to Southern tip of Tamil Nadu with its vast bio-diversity and heritage. Wildlife sanctuaries in India attract people from all over the world as the rarest of rare species are found here. Wildlife lovers eager to see magnificent Bird Sanctuary at Bharatpur, Rajasthan as it is the second habitat in the world that is visited by the Siberian Cranes in winter and it provides a vast breeding area for the native water birds, Great Indian bustard is found in the Indian deserts. In western Himalayas, birds like Himalayan monal pheasant, western tragopan koklass, white crested khalij pheasant, griffon vultures, lammergeiers, choughs, ravens are common. In the Andaman and Nicobar region, about 250 species and subspecies of birds are found, such as rare Narcondum horn bill, Nicobar pigeon and megapode. Some of national parks and sanctuaries are given below along with important species found there (Alok kumar *et al* 2016).

- Kaziranga sanctuary (Assam) - One-horned rhinoceros
- Manas sanctuary (Assam) - Wild buffaloes
- Bandipur sanctuary (Karnataka) - Indian bison, elephants, langurs
- Periyar sanctuary (Kerala) - Elephants, barking deer, sambhar
- Kanha National Park (Madhya Pradesh) - Tiger, leopards, wild dogs
- Simlipal National Park (Orissa) - Mangroves, marine turtles lay eggs
- Bharatpur bird sanctuary (Rajasthan) - Ducks, herons
- Corbett National Park (Uttaranchal) -Tigers, barking deer, sambar, wild bear, rhesus monkey.
- Jaladpara sanctuary (West Bengal) - Rhinoceros
- Gir forest (Gujarat) - Lions, chital, sambar, wild bears
- Kelameru bird sanctuary (Andhra Pradesh) - Pelicans and marine birds

- Dachigam sanctuary (Jammu and Kashmir) - Kashmir stags, Himalayan tahr, wild goats, sheep, antelopes.

Wildlife Conservation Society (WCS) India in association with other NGO partners and tribal people, is making every possible effort to develop new models of wildlife conservation to conserve India's most precious fauna and to protect the environment.

### Biosphere Reserves

These are representative parts of natural and cultural landscapes extending over large areas of terrestrial or coastal/marine ecosystems which are internationally recognized within UNESCO's Man and the Biosphere Programme. Thirteen biodiversity-rich representative ecosystems, mainly within the forest land (total area - 53,000 sq. km.), have been designated as Biosphere Reserves in India. The concept of Biosphere Reserves (BR) was launched in 1975 as a part of UNESCO's Man and Biosphere Programme, dealing with the protection of ecosystems and the genetic material they contain. A Biosphere Reserve consists of core, buffer and transition zones. (a) The core zone is entirely protected and natural area of the Biosphere Reserve least disturbed by human activities. It is legally protected ecosystem in which entry is not allowed except with permission for some special purpose. Destructive sampling for scientific investigations is prohibited. (b) The buffer zone surrounds the core zone and is managed to lodge a greater variety of resource use strategies, and research and educational activities. (c) the transition zone, the outermost part of the Biosphere Reserve, is an area of active collaboration between the reserve management and the local people, wherein activities like settlements, cropping, forestry, recreation and other economic that are in coordination with the conservation goals. Till date there were 553 biosphere reserves located in 107 countries.

The main functions of the biosphere reserves are:

- Conservation: Long term conservation of representatives, landscapes and different types of ecosystems, including their species and genetic resources.

- Development: Encourages traditional resource use and endorse economic development which is culturally, socially and ecologically sustainable.
- Scientific research, monitoring and education- Assist conservation research, monitoring, education and information exchange related to local, national and global environmental and conservation issues.

### Species-oriented projects

Certain species have been identified as needing a concerted and specifically directed protection effort. Project Tiger, Project Elephant and Project crocodile are examples of focuses on single species through conserving their habitats.

### Project Tiger - A success in species conservation

Tigers which were once copious in Indian forests have been hunted. As a result tiger population within the country declined drastically from estimate of 40,000 at the turn of century to 1200 by the 1970. This led to initiate the Project Tiger in 1973 with the objective of conserving and rescuing this species from extinction. In 2007, there were more than 40 Project Tiger wildlife reserves covering an area of 37,761 km<sup>2</sup>. Project Tiger assisted to increase the population of these tigers from 1,200 in the 1970s to 3,500 in 1990s. However, a 2008 census held by Government of India revealed that the tiger population had reduce to 1,411. A total ban has been forced on hunting of tigers and trading in tiger products at the national and international levels. Elaborate management plans are made for each of the tiger reserves for tiger habitat improvement and anti-poaching measures.

### Project Elephant

Project Elephant was launched in February, 1992 to support states having free ranging populations of wild elephants to ensure long-term survival of identified viable populations of elephants in their natural habitats. The project is being executed in twelve states viz. Andhra Pradesh, Arunachal Pradesh, Assam, Jharkhand, Karnataka, Kerala, Meghalaya, Nagaland, Orissa, Tamil Nadu Uttaranchal and West Bengal.

### **Sacred forests and sacred lakes**

A traditional approach for the protection of biodiversity has been in practice in India and some other Asian countries in the form of sacred forests. These are minor forest patches protected by tribal communities due to religious sanctity. Sacred forests are located in several parts of India i.e. Karnataka, Maharashtra, Kerala, Meghalaya, likewise, several water bodies for example, Khecheopalri lake in Sikkim, have been declared sacred by the people, leading to protection of aquatic flora and fauna.

### **Ex-situ Conservation**

Ex-situ Conservation is conservation of plants and animals outside their natural habitats. These include botanical gardens, zoo, gene banks, seed bank, tissue culture and cryopreservation.

### **Botanical gardens, zoos etc.**

To complement in-situ conservation efforts, ex-situ conservation is being undertaken through setting up botanical gardens, zoos, medicinal plant parks, etc by various agencies. The Indian Botanical Garden in Howrah (West Bengal) is about 200 years old. Other significant botanical gardens are in Ooty, Bangalore and Lucknow. The most recent one is The Botanical Garden of Indian Republic established at NOIDA, near Delhi in April, 2002. The main objectives of this garden are -

- ex-situ conservation and propagation of important endangered plant species,
- serve as a Centre of Excellence for conservation, research and training,
- build public awareness through education on plant diversity and need for conservation.

A number of zoos have been established in the country. These zoological parks have been looked upon fundamentally as centres of education about animal species and recreation. They have also played an important role in the conservation of threatened animal species such as the Manipur Thamin Deer (*Cervus eldi eldi*) and the White winged Wood Duck (*Cairina scutulata*). Notable successful examples of captive breeding are those of Gangetic gharial (*Gavialis gangeticus*), turtles and the white tiger.

### **Gene Banks**

Ex-situ collection and conservation of genetic resources is done through gene banks and seed banks. The National Bureau of Plant Genetic Resources (NBPGR), New Delhi preserves seeds of wild relatives of crop plants as well as cultivated varieties; the National Bureau of Animal Genetic Resources at Karnal, Haryana maintains the genetic material for domesticated animals, and the National Bureau of Fish Genetic Resources, Lucknow for fishes.

### **Cryopreservation**

Cryopreservation is particularly useful for conserving vegetative propagated crops. Cryopreservation is the storage of material at ultra low temperature of liquid nitrogen (-196°C) and essentially involves suspension of all metabolic processes and activities. Cryopreservation has been successfully applied to meristems, zygotic and somatic embryos, pollen, protoplasts cells and suspension cultures of a number of plant species.

### **Conservation at molecular level (DNA level)**

In addition to above, germplasm conservation at molecular level is now possible and attracting attention. Cloned DNA and material with DNA in its native state can all be used for genetic conservation. Furthermore, non-viable material representing valuable genotypes stored in gene banks can all be used as sources of DNA libraries from where a related gene or a combination of genes can be recovered.

### **LEGAL MEASURES**

There are numerous strategies which are adapted for conservation of natural resources, environment and biodiversity. Some of these are as follows. **LEGISLATION** Formal policies and programmes for conservation and sustainable utilization of biodiversity resources dates back to several decades. The concept of environmental protection is enshrined in the Indian constitution in articles 48a and 51a(g). For Biodiversity The Biological Diversity Act 2002 was born out of India's attempt to realize the objectives enshrined in the United Nations convention on biological diversity (CBD) 1992 which recognizes the sovereign rights of states to use their own biological Resources. The Act

aims at the conservation of biological resources and associated knowledge as well as facilitating access to them in a sustainable manner and through a just process for purposes of executing the objects of the Act it establishes the National Biodiversity Authority in Chennai. Important legislations and policies relevant to biodiversity conservation are as follows\_

#### Acts:

- Fisheries Act 1897.
- Indian Forests Act 1927.
- Mining and Mineral Development Regulation Act 1957.
- Prevention of cruelty to animals 1960.
- Wildlife protection act 1972.
- Water (prevention and control of pollution) act 1974.
- Forest Conservation Act 1980.
- Air (prevention and control of pollution) act 1981.
- Environment Protection Act 1986.
- Biological Diversity Act 2002.
- Scheduled Tribes and other traditional forest dwellers (recognition of rights) act 2006.

#### Policies

- National Forest Policy.
- National Conservation Strategy and Policy statement on Environment and Development.
- National Policy and macro-level action strategy on Biodiversity.
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- National Agriculture Policy.
- National Water Policy.
- National Environment Policy (2006).

Major central acts relevant to biodiversity conservation include:

- Indian Fisheries Act, 1897
- Indian Wildlife (Protection) Act 1972 and Wildlife (Protection) Amendment Act 1993 and 2002.
- The Environment Protection Act, 1986
- The Forest Conservation Act, 1980, Biological Diversity Act, 2002
- Biological Diversity Rules, 2004

## CONCLUSION

Conservation of biodiversity is of utmost importance for the sustainability of a healthier land by preserving and protecting species, ecosystems and natural resources. There are still several species that are not yet discovered, the several habitat and landscapes are still unexplored, and therefore their effect on others, the ecosystem and species is still unknown. Without the conservation of biodiversity, modern development is insignificant. Loss of biodiversity eventually threatens other species, as species disappear from an ecosystem other species are threatened by the changes in available resources. Biodiversity is important to the survival and welfare of human populations because it has impacts on our health and our ability to feed ourselves through agriculture and harvesting populations of wild animals. India and the whole world taken several measures for biodiversity conservation. The emphasis is on conserving the animals in their natural habitats and in National Parks of the protected area. Similarly, conservation in residential areas like the donation to zoo vegetation is also being encouraged, besides promoting the breeding of crocodiles, turtle etc. which are included in the qualification category. In addition, biodiversity conservation can also be done through seed bank, gene bank etc. Biodiversity conservation should be dealt with at scale of habitat or ecosystem rather than at species level with enforcement of strong law.

**Conflict of Interest:** The authors declare no conflict of interest

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## Research Article

# Maturity level among the inter college level high and low performing Kabaddi players

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### ABSTRACT

The purpose of the present study was to find out the maturity level among the inter college level high and low performing Kabaddi players. The researcher hypothesized that there may not be significant difference with regard to maturity level among the inter college level high and low performing Kabaddi Players. For this study Two Hundred ( $n = 200$ ) male inter college level Kabaddi players aged between 18 and 25 years were selected. Differences between the groups were assessed using the Student's *t*-test for dependent data. After data collection, the data were statistically analyzed. In order to test the hypothesis, the level of significance was set at 0.5 level of confidence which was considered adequate and reliable for the purpose of the study.

**Keywords:** Maturity level, High and low performing

## INTRODUCTION

Maturity is simply the process of children growing and obtaining adult stature. All humans experience maturation differently, but we notice the greatest change after puberty. Females tend to mature sooner than boys, but post-pubertal boys will experience greater increases in strength and power due to testosterone and other androgen hormones. An appropriate strength and conditioning programmer will increase the motor skills, coordination, strength, and power in children and adolescents. Adolescents may be prone to overuse injuries during periods of rapid growth in height and mass. Maturation should be measured in youth athletes to properly monitor their growth and well-being as athletes. Maturation is quite simply the process of becoming mature. To understand maturation properly, we must realize that each child differs at the timing and tempo of this process. Timing refers to when" maturation begins, while tempo refers to the "Rate" at which it progresses. We typically discuss maturation as the process from early childhood to adolescence and then to full adult stature. Childhood is generally regarded as the time until which one reaches adolescence. The start of adolescence begins with the onset of puberty where hormonal and physical changes begin

to occur. Initially, rapid changes begin to occur with increases in height, weight, stature, and the development of secondary sex characteristics. Up until puberty, there are few performance differences between genders. The adolescent stage usually begins sooner in girls (8–19 years) than in boys (10–22 years), but up until puberty, there are few performance differences between genders. However, significant changes begin to emerge between genders after puberty due to circulating androgens (testosterone). Testosterone causes boys to develop larger arm girth and larger shoulder breadth in comparison to girls, while increases in hip breadth are alike. Similarly, during this rapid growth spurt boys will have greater fat-free mass than girls and a smaller increase of body fat.

## MATURITY AFFECT PERFORMANCE

Maturation plays a significant role in motor skill development, strength, power, and even has implications on injury risk in young athletes. Understanding maturation and how it impacts youth performance is of great benefit to coaches and parents. Research indicates that childhood is an ideal and opportunistic time in which to maximize motor skill proficiency. This is due to the natural and accelerative rate at which the brain and

central nervous system mature in the child. Therefore, this vital time frame should be utilized by introducing children to a broad array of foundational movements, as well as exposing them to a variety of stimuli. If such foundational movements are developed before adolescence, it is believed that the athlete will be better- equipped when faced with more complex motor skills during a later developmental stage. As athletes reach adolescence and adulthood, they are less sensitive to developing new motor pathways, which therefore makes it more difficult to teach certain movement skills. As a result, youth athletic development programmers should be thoughtfully designed and carefully delivered in order to ensure the program has maximal effect. Moreover, young athletes should be exposed to range different stimuli; however, this must not be delivered in a random or poorly thought-out format. Instead, the goal and focus of training sessions should be to develop gross athletic motor skill competencies through a challenging and playful environment.

## STATEMENT OF THE PROBLEM

The purpose of the study was to compare Maturity level among the Inter College Level high and low performing Kabaddi players

## SELECTION OF SUBJECTS

Two hundred ( $n = 200$ ) male Inter College Level Kabaddi players aged between 18 and 25 years were selected for this study. The purposive sampling technique was used to attain the objectives of the study. All the subjects, after having been informed about the objective and protocol of the study, gave their consent and volunteered to participate in this study. They were further divided into two groups  $N = 200$  each (i.e.  $N_1 = 100$ ; High Performance and  $N_2 = 100$ ; Low Performance). A-High performance B-Low performance

## SELECTION OF VARIABLES

A feasibility analysis as to which of the variables could be taken up for the investigation, keeping in view the availability of tools, adequacy to the subjects, and the legitimate time that could be devoted for tests and to keep the entire study unitary and integrated was made in consultation with experts. With the above criteria's in mind, the psychological variable, namely, "Maturity level" was taken up for the present study: Semantic Differential Maturity Instrument (Carothers *et al.*, 2000): Semantic Differential Maturity level Instrument developed by (Carothers *et al.*, 2000) was used to assess the differences among Inter College Level high and low performing Kabaddi players. In total there are 34 items in semantic differential Maturity instrument. Before administering all the items were arranged in random order. It was rated on 7 point scale. The subject has to

place a tick mark in one of the seven alternatives to his best of honesty and sincerity. Eighteen out of thirty-four items which are marked must be reversed coded before analyzing the data. After administration, submission of scores was done for each of five dimensions of the instrument and also a single score of the overall instrument was calculated by summing each score indicating subject's maturity. The instrument identifies those individuals who were high on five non-cognitive traits of personality which indicates competence in personal and interpersonal skills.

## COLLECTION OF DATA

The survey method through the technique of questionnaire had been adopted to collect the relevant data for this study. A group of two hundred ( $n = 200$ ) male Inter College Level Kabaddi players aged 18–25 years, who participated in Kabaddi Inter College Level tournament for the session 2018–2019 volunteered to participate in this study. The purposive sampling technique was used to attain the objectives of the study

## ADMINISTRATION OF QUESTIONNAIRE

The questionnaire is an information form that attempts to elicit data from the selected respondents. The final draft of questionnaire was administered to all the respondents.

## STATISTICAL PROCEDURE USED

The between-group differences were assessed using the Student's *t*-test for dependent data. The level of significance was set at 0.05

## ANALYSIS OF DATA

The statistical analysis of the data was collected on two hundred subjects ( $n = 200$ ). The subjects were further divided into two groups  $n = 100$  each (i.e.  $N_1 = 100$ ; high performance and  $N_2 = 100$ ; low performance). To find out the between-group differences and the difference of Maturity Level between the Inter College level high and low performing Kabaddi players the following statistical techniques were employed. The level of  $P \leq 0.05$  was considered statistically significant. Student's *t*-test for independent data

## FINDINGS

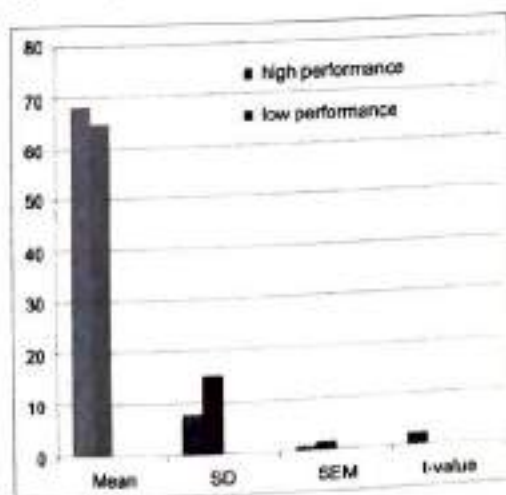
Findings of this study were made in sequence of all the variables namely Maturity. For each of the chosen variable, the results pertaining to significant difference, if any, between the Inter College Level high and low performing Kabaddi players are presented in following.

**Table 1: Mean values ( $\pm$ SD), standard error of the mean and test statistic of maturity in high-performance group ( $n=100$ ) and low-performance group ( $n=100$ )**

|                            | High performance   | Low performance  |
|----------------------------|--------------------|------------------|
| Sample size                | 100                | 100              |
| Arithmetic mean            | 68.200             | 64.7250          |
| 95% CI for the mean        | 66.8153 to 69.5847 | 62.0001-67.4499  |
| Variance                   | 58.6824            | 227.2599         |
| Standard deviation         | 7.6604             | 15.0751          |
| Standard error of the mean | 0.6993             | 1.3762           |
| Mean difference            |                    | 16.2754          |
| Standard deviation         |                    | 3.4750           |
| 95% CI                     |                    | 6.4169 to 0.5331 |
| Test statistic t           |                    | 2.339            |
| Degrees of Freedom (DF)    |                    | 119              |
| Two-tailed probability     |                    | P=0.210          |

Significant at 0.05 level of significance, Tab  $t(0.05)(119)=1.645$

Table 1 indicates that the mean of high performance and low performance group was 68.20 and 64.72, respectively, whereas the standard deviation (SD) of high performance and low-performance group was 7.66 and 15.07, respectively. The computed value of  $t(=2.339)$  between high performance and low performance group in maturity was greater than the tabulated  $t(0.05)(119)(=1.645)$ . Thus it may be concluded that the Maturity found to be statistically significant. As per the study the above remark can be given at 95% probability level. The graphical representation of responses has been exhibited in



## Hypotheses

It was hypothesized that there may not be significant difference with regard to Maturity Level among the Inter College level high and low performing Kabaddi. The subject has to place a tick mark in one of the seven alternatives to his best of honesty and sincerity. Eighteen out of thirty-four items that are marked must be reversed coded before analyzing the data. After administration, submission of scores were done for the instrument and also a single score of the overall instrument was calculated by Summing each score indicating subject's maturity level players.

## CONCLUSIONS

The mean of high performance and low-performance group was 68.20 and 64.72, respectively, whereas the standard deviation (SD) of high performance and low-performance group was 7.66 and 15.07, respectively. The computed value of  $t(=2.339)$  between high performance and low-performance group in maturity was greater than the tabulated  $t(0.05)(119)(=1.645)$ . This means that the null hypothesis is rejected. Thus, it may be concluded that the maturity found to be statistically significant. As per the study the above remark can be given at 95% probability level.

## RECOMMENDATIONS

In the light of the findings of the present study the following recommendations can be made for further studies:

1. Physical education teachers and coaches can use the result of this study as an aid in screening, identification, and selection of players in team games.
2. In the training program for individual and team games, emphasis must be laid on the improvement of those psychological dimensions, which have been found to be significantly related to performance.

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**Study of Water Quality Parameters of Pimpalkhuti Dam in TalukaRalegaon, District-Yavatmal****S. V. Jadhav<sup>1</sup> and P. R. Jagnit<sup>2</sup>**

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**Abstract:**

Water resources are essential and equally important for natural eco system and human development. All eco system on earth depends on the water. Fresh water is finite, critical, renewable, vulnerable the resource on the earth plays as important role in living environment without its life is impossible. The present study is focus on the determination of Physico- chemical parameter such as hardness, chlorides, alkalinity, DO, BOD, COD, temperature, pH, TDS, phosphate, and sulphate of water sample. Where analyzed for periods of twelve months from 1<sup>st</sup> February 2021 to 31<sup>st</sup> January 2022. All parameter were within the permissible limits. The result indicates that the corresponding dam is non-polluted and can be used for irrigation, fishculture, and domestic purpose.

**Keywords:** Physico- chemical parameters, permissible limits, living environment.

**Introduction:**

Water is most indispensable requirements for all living organism. Unsafe drinking water is one of the main concerns in developing countries. In order to deal with this problem, physico- chemical parameters were determined in order to identify the contamination problems and suggest appropriate solution. The good quality of water is essential for living organism. The quality of water can be assessed by studying its physical and chemical characteristic. Because of vast population[1] highly used fertilizers[2], pesticides, insecticides, and negligence of human being [3], the quality of water is being deteriorated day by day. Regarding the quality of drinking water, microbiological contamination is primary concern of developing countries[4]. In addition, inorganic contaminants[5], concerning both health and aesthetic aspect can be present in the water. Fluoride and arsenic are a great health problem worldwide [6,7]. The natural aquatic resources are causing heavy and varied pollution in aquatic environment leading to water quality and depletion of aquatic Biota. It is there for necessary that the quality of drinking water should be checked at regular time interval because due to use of contaminated drinking water. In present study includes the analysis of water quality in terms of physico- chemical parameters of Pimpalkhuti dam talukaralegaon district, Yavatmal (Maharashtra). The dam water is basically used for Domestic, Agriculture purpose, Fisheries activity and Various Animal water drinking purpose. In Yavatmal region still now several researchers have done study on physicochemical parameters of various water resources [8, 9, 10].

**Materials and Methods:**

Surface water sample were collected from Pimpalkhuti dam. Water sample from all site were collected in sterile glass bottles in the morning Hours between 9 to 11 am, regularly for every month, brought to the laboratory, processed within 1-3 hrs for the estimation of various physico- chemical parameters like water temperature, pH, and Total Dissolved Solids were recorded at the time of sample collection by using Thermometer, pocket Digital pH meter and pocket Digital TDS meter. Transparency was measured with the help of Secchi Disc. While other parameters such as DO, Free CO<sub>2</sub>, Hardness, Chlorides, Alkalinity, Phosphate and Nitrate were estimated in the laboratory.

**Result and Discussion:** The monthly variation in physico-chemical parameters are represented in following table

| Months   | Temperature °C | TDS | pH  | Turbidity NTU | Total Hardness mg/l |
|----------|----------------|-----|-----|---------------|---------------------|
| January  | 24             | 722 | 7.8 | 9.40          | 81.0                |
| February | 24.5           | 701 | 8.1 | 11.90         | 90.5                |
| March    | 27             | 648 | 8.3 | 11.93         | 160                 |
| April    | 27             | 645 | 8.3 | 11.92         | 160                 |
| May      | 27.5           | 652 | 8.4 | 11.02         | 157                 |
| June     | 25             | 958 | 8.0 | 10.5          | 150                 |
| July     | 25.5           | 965 | 7.3 | 1.35          | 73                  |

|           |      |     |     |      |     |
|-----------|------|-----|-----|------|-----|
| August    | 25   | 961 | 7.2 | 2.3  | 84  |
| September | 25.5 | 940 | 7.1 | 2.2  | 100 |
| October   | 24.5 | 810 | 7.2 | 0.5  | 67  |
| November  | 23.5 | 760 | 7.5 | 1.45 | 106 |
| December  | 23.5 | 743 | 7.6 | 1.90 | 83  |

Table No. 2

| Months    | DO    | Free CO <sub>2</sub><br>mg/l | Chloride | Alkalinity | Transparency<br>Cm |
|-----------|-------|------------------------------|----------|------------|--------------------|
| January   | 8.90  | 0.0                          | 42.32    | 118.25     | 14.3               |
| February  | 9.10  | 0.0                          | 33.08    | 122.50     | 6.9                |
| March     | 12.32 | 0.0                          | 42.06    | 182.50     | 6.8                |
| April     | 15.5  | 0.0                          | 55.08    | 160.25     | 6.6                |
| May       | 15.4  | 3.5                          | 55.59    | 205        | 6.7                |
| June      | 12.08 | 7.6                          | 41.18    | 169.0      | 9.4                |
| July      | 10.02 | 8.4                          | 43.32    | 153.25     | 60.1               |
| August    | 9.08  | 7.3                          | 48.59    | 191.0      | 61.4               |
| September | 9.15  | 21.0                         | 37.12    | 192.0      | 57.2               |
| October   | 7.96  | 15.7                         | 41.09    | 173.25     | 92.0               |
| November  | 6.55  | 25.3                         | 43.57    | 150.50     | 92.4               |
| December  | 6.40  | 25.3                         | 47.61    | 141.25     | 66.25              |

### Water Temperature:

Water temperature can exert great control over aquatic communities. Temperature of water may not be as important in pure water, but in polluted water, temperature can have profound effects on dissolved oxygen (DO) and biological oxygen demand (BOD). The fluctuation in dam water temperature usually depends on the season and sampling time. In this present study of the water temperature ranges from 23.5 °C to 27.5°C. The maximum (27.5 °C) temperature was recorded in the month of May (summer) and minimum (23.5 °C) in the month of December (winter). It shows that higher temperature in summer and relatively lowers in winter. Similar study has done at Kapileshwar Dam AshtiDist- Wardha [11], observed that water temperature was high during summer season due to low water level, and clear atmosphere.

**Total Dissolved Solid (TDS):** The TDS in water consist of inorganic salts of calcium, magnesium, sodium etc. Small amount of organic matter and dissolved material present in the water. In this study TDS fluctuate from 645 ppm to 965 ppm. The maximum value of TDS was found to be 965 ppm in the month of July. It is due to heavy rainfall in rainy season and the minimum value of TDS 645 ppm was recorded in the month of April. Similar result reported by Ioryueljah Silas et al [12]

**pH:** The pH is an indicator of the existence of biological life. The pH of dam water was found to alkaline character throughout the study period. Were most of the water samples collected in different months of the year, tested in the present study were found to be in permissible range of pH value recommended by several health and pollution control organization eg. WHO, (the permissible value of pH is 6.5 to 8.5). The maximum pH value (8.4) was recorded in the month of May (summer season) and minimum pH value (7.1) was recorded in the month of September. pH of water directly affect the biochemical and chemical reaction as well as pH of water is increased by reducing the percentage of CO<sub>2</sub> and biocarbonate which is happened due to photosynthetic activities. Apart from above some other factors such as air and temperature bring about changes the pH of water. K. Bheemappa et al [13] reported that the maximum value of pH was found in pre- monsoon season.

**Turbidity:** Turbidity may be due to the organic or inorganic constituents. The turbidity of water fluctuates from 0.5 NTU to 11.93 NTU during the year. The maximum values (11.93 NTU) was recorded in month of March

(summer) it is mainly due to the decrease in the water level and suspended particulate matter and minimum value of turbidity (0.5 NTU) was founded in the month of October.

**Total Hardness:** The amount of dissolved salts of calcium and magnesium in the water is generally known as hardness of water. Hardness of water is an important consideration to determining the suitability of water for industrial and domestic uses. The value of the hardness fluctuates from 67 mg/l to 160 mg/l. the maximum value (160 mg/l) was recorded in the month of March to April (summer) and minimum value (67 mg/l) in the month of October. Similar result were reported by H. V. Vyas and V. A. Sawant [14]

**Dissolve oxygen (DO):** The dissolved oxygen content is essential for aquatic life. Its deficiency directly affects the ecosystem of dam or river low dissolved oxygen (less than 2 mg/l) would indicate poor water quality. The value of DO is generally average from 6.40 mg/l to 15.5 mg/l.

The maximum values of DO (15.5 mg/l) was recorded in month of April (summer) and minimum values of DO (6.40 mg/l) was recorded in month of December (winter).

**Free CO<sub>2</sub>:** The value of free CO<sub>2</sub> ranges from 0.0 mg/l to 25.3 mg/l. The maximum value (25.3 mg/l) was found in the month of November to December (winter) and minimum value (0.0 mg/l) was found in the month of January to April.

**Chloride:** The value of chloride ranges from 33.08 mg/l to 55.59 mg/l. The maximum value (55.59 mg/l) was found to be in the month of May (summer) and the minimum value (33.08 mg/l) in the month of February.

**Alkalinity:** Due to increase in the percentage of bicarbonates in the month of March to May (summer) alkalinity was found to be maximum. Total alkalinity ranges from 118.25 mg/l to 205 mg/l. The highest value of alkalinity (205 mg/l) was recorded in the month of May (summer) and lowest value of alkalinity (118.25 mg/l) in the month of January (winter).

**Transparency:** Transparency of water fluctuates from 6.6 cm to 92.4 cm. The maximum water transparency 92.4 cm was recorded in the month of November (winter) and minimum 6.6 cm in the month of April (summer). Similar result were reported by Rachel M. Pilla et al [15]

## Conclusion:

The thermal decomposition of the complexes is not simple and involves different stage decomposition. It is assumed that dehydration of the complexes containing water occurs within an active reaction interface. The compensation effect of thermal decomposition of the complexes indicating the change of sample mass on the estimated values of activation energy. The structural changes of all complexes have marked effect on the sensitivity and sensitivity varies with organisms.

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# Using ICT in Teaching and Learning in New Ways

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**Abstract:** *The purpose of this paper is to discuss creative ways to include ICT into the teaching and learning process. ICT facilitates understanding of complex processes through simulations, which again contribute to a realistic learning environment. ICT may thus serve as a facilitator of higher order thinking and active learning. Information and communication technology integration may energise both educators and pupils. By offering curricular support in challenging topic areas, this can aid in improving and developing the quality of education. Students enjoy studying and the independent inquiry that provides innovative and proper usage of ICT helps them adopt ICT because teachers create engaging and meaningful learning experiences for their students. Through the efficient use of this technology in the classroom, students and teachers can practise various ICT skills and gain knowledge of its advantages. ICT can be used to enhance the learning and teaching process. This novel strategy may be adapted to meet the teaching requirements of the students in a classroom setting. It is a fact that the only option available to instructors is to use technology as an integrated tool in the classroom. As a result, a teacher might be referred to as a "Teaching Technician" as the pupils are not solely dependent on their teachers.*

**Keywords:** ICT, Teaching

## I. INTRODUCTION

Teaching and learning specific skills are included in education, as well as something less concrete but more profound: the transmission of information, sound judgement, and mature wisdom. The transmission of culture from generation to generation is one of education's core components. Education is the process of encouraging a person to realise their own potential and abilities. It is a pedagogical application, which is a collection of theoretical and practical study pertaining to teaching, learning, and the environment is deteriorating, the globe is becoming more interconnected, and technology is constantly changing how we interact with information. We must reconsider what we learn, but much more crucially, how and where we learn it in light of shifting global realities. For the twenty-first century, we require education.

### 1.1 Definition of ICT

Information and communication technology (ICT) refers to a category of technology used in the form of tools, equipment, and application support that aids in the accurate and efficient collection, storage, retrieval, use, transmission, manipulation, and dissemination of information for the purpose of enhancing user knowledge and improving communication, decision-making, and problem-solving skills.

### 1.2 Technology's Importance in the Teaching and Learning Process

By accommodating the various learning styles that students have, technology has made learning easier for them. Before the introduction of technology in the classroom, teachers had to spend numerous evenings planning lessons, practising their 3D-graphics skills on students, and then repeating the lesson's main ideas to the class. The teacher's use of technology in the classroom helps close the "generation gap" between him or her and the students by giving them the impression that they are keeping up with the times and that their teacher is adequately preparing them for 21st-century abilities.

**1.3 Dimensions of Technology-based Learning and Teaching Strategies**

Teachers now conduct their lessons in the classroom using technological media. Every teacher should use various forms of educational technology into their lesson plans.

- **Electronic learning:** The student and the learning process should be the main emphasis of electronic learning. E-learning entails more than just the presentation and delivery of the contents via the internet. It is also referred to as online education.
- **Ubiquities Learning:** This term refers to "learning everywhere." It delivers on the promise of "anytime, anywhere, and any context" made by e-learning.
- **Virtual learning:** All educational activities that take place in non-contiguous environments where students and teachers are segregated are referred to as virtual learning.

**1.4 ICT's advantage over conventional pedagogy**

- Teachers can give students the contextual signals they need to understand new topics by introducing pictures or videos into the session.
- The essential link or scaffold between common language and more challenging academic language can be provided by visual information.
- Electrically generated resources are superior to textbooks and other static sources of information because they may be enhanced by user feedback or by allowing users to directly alter them.
- Students can use technology to demonstrate what they have learned in various assessments of their development.

**1.5 ICT Benefits for Teaching and Learning**

The use of ICT in the teaching and learning process has a huge number of advantages, which are outlined in the following way

- Increases productivity in both teaching and learning.
- It improves motivation.
- Creates space for personality growth.
- Students' active involvement
- Self-directed education.
- Multisensory learning environment.
- A very adaptable and abundant informational medium for kids.

**Teachers have the following duties regarding the use of ICT in the teaching and learning process**

- To be aware of the internet resources that are accessible to facilitate teaching and learning.
- Develop exercises that are appropriate for each student group and choose resources based on their content to create possibilities for improving both language and digital abilities.
- It's important to keep track of the abilities needed to survive in the digital age, such as reading and writing digital text as well as conversing and publishing online.
- Digital literacy is implemented effortlessly and comprehensively.

**Effects of ICT use in the teaching and learning process**

Teachers may plan and prepare lessons more effectively and quickly when they use ICT effectively. Teachers develop their facilitation skills. It encourages an integrative approach. The teaching and learning industry becomes more focused on results. Assist the teachers in directing the needs and exploration of the students during the learning process.

**ICT use restrictions in the teaching and learning process**

The school does not have ICT facilities. Teachers, institution leaders, and other educational authorities exhibit a pervasive ignorance of the use, applications, and advantages. Teachers are afraid of losing control of the teaching and

learning processes, which causes them anxiety. Teachers do not wish to move to new methodologies or switch over to them. Many students oppose changing their position from the passive to the active independent research and knowledge discovery

## **II. CONCLUSION**

As a result, we may conclude that ICT use has enormous potential for training pupils to handle a variety of tasks and responsibilities. In the context of today's educational system, there is transition, transportation, and revolution. Therefore, teachers must understand that if they want their pupils to reach a high level of proficiency, they will have to accept technology as an integral tool in the classroom.

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Proceedings of the  
**International  
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**21<sup>st</sup> January, 2023**

**S.P.M. Science & Gilani Arts,  
Commerce College,  
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Dist. Yavatmal, Maharashtra,  
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**International Conference on Multidisciplinary Research & Studies 2023**  
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**Conference Proceedings**

**ICMRS23**



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- Guest of Honour:** **Hon. Shri. Amol Yedge**  
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- Keynote Speaker:** **Dr. Kinnarry V. Thakkar**  
(Professor, Department of Commerce, University of Mumbai)
- Topic:** **Initiating Research Footprint.**
- In presence of:** **Dr. M. A. Shahezad**  
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### Technical Session I (12-01pm)

- Chairperson:** **Dr. R. D. Sikchi**  
(Principal, Sitabal Arts, Commerce and Science College, Akola & Senate Member, S.G.B.A.U. Amravati)
- Resource Person:** **Dr. Deepak Waikar**  
(Founder & Managing Partner of Eduenergy, Singapore)
- Topic:** **Nurturing Resilient Researchers – Pro Mindset.**

### Technical Session II (01pm – 02pm)

- Chairperson:** **Dr. Nilesh N. Gawande**  
(Principal, Late B. S. Arts, Prof. N. G. Sci. & A.G. Comm. College, Sakharherda, Dist. Buldhana & Senate Member, S.G.B.A.U. Amravati)
- Resource Person:** **Dr. Ramchandra S. Tatwawadi,**  
(Principal, Jawaharlal Darda Institute of Engineering & Technology, Yavatmal)
- Topic:** **Transforming Perspectives towards Multi-Disciplinary Approach.**

### Valedictory Function (02.30 pm – 4.30 pm)

- Chairperson:** **Dr. Keshav Tupe**  
(Joint Director, Higher Education, Amravati)
- In presence of:** **Prof. Pradip Khedkar**  
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## National Education Policy 2020: Impact on the Library

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### Abstract

Education is an effective tool for social change. Education is an important tool for bringing about positive change in society. The skills possessed or acquired by man must be enhanced through education. For that purpose, a training program is designed to create professional skills based on the interests and needs of the people while deciding the policies during the educational planning. The cornerstone for enabling people to reach their full potential, creating a fair and just society, and advancing national development is education. In this background, the role of libraries in the formation of society becomes very important. A creative citizen can be educated if children develop interest in reading in their school years. For this it is necessary to establish a library in the society. Libraries should be developed in their entirety, not simply when they are first established. This dissertation examines the function of libraries and librarians in light of the new education strategy 2020.

**Keywords :** National Education Policy 2020, Higher Education Librarian, Library Higher Education Librarian, Library.

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### Introduction

The needs of society are changing with time. Similarly, the circles of science and technology are widening day by day; because of this reason it is necessary to add new aspects to the education system as well. For this reason, the policies of various committees and commissions have been included in the education stream so far.

Hence formal education is gaining momentum in an innovative and expected direction. These include Tarachand Committee 1948, Radhakrishnan Commission 1948, Mudaliar Commission 1952, Kothari Commission 1964-66, National Education Policy 1968, Prof. D.

P. Chattopadhyay Commission 1983 National Education Policy 1986 Acharya Ramamurthy Committee 1990, Janardhan Reddy Committee 1992, Yashpal Committee 1993.

Also includes Primary Education Curriculum- 2004 National Curriculum Plan- 2005 and National Education Policy 2020. Providing basic quality education to all is important for India's sustained progress and global leadership in the areas of economic development, social justice, equality, scientific progress, national integration and cultural preservation. Universal education of high quality is the best way forward to fully utilize the rich image and resources of our country for the benefit of the individual, society, country and the world. India will have the most young in the next ten years, and they will all be of high quality. The capacity of a nation to offer educational opportunities determines its future.

**National Education Policy 2020** As India emerges as a developed sovereign nation in our country after 34 years the education policy has been formulated. Earlier in the year 1968, the Indira Gandhi government introduced the first education policy which was based on the recommendations of the Kothari Commission of 1964. In which 10+2+3 educational system was adopted, with mother tongue as first language, national language as second language and English as third language as the third language. In 1986, the Rajiv Gandhi government introduced the second education policy. It laid special emphasis on equalizing education and eliminating inequality for the Indian women Scheduled Caste community. But the percentage of education in the country has increased but in terms of quality, the mark has stood.

The percentage of those who have higher education has not reached 50 percent. The National Education Policy 2020 was announced after accepting the report of the Kasturirangan Committee for the last five years regarding education in our country. The National Education Policy 2020 has considered pre-primary education, women's vocational education, disparity in education. The contours of education have changed. This policy will be applicable from Anganwadi to higher education. 10th and 12th board will lose importance by creating a new formula of education like 5+3+3+4.

### **National Education Policy 2020 Important Issues**

1. Making India a Global Knowledge Superpower - New National Education Policy 2020 is the ultimate goal.
2. Ministry of Human Resource Development was renamed as Ministry of Education.

3. This is the third major change in the education system in India after 1947. Earlier in 1968 and 1986, the geological system was improved.
4. Innovation by increasing investment in school education Implement basic literacy and technology acquisition for every student build capacity to.
5. School education Intellectual development based on 5+3+3+4 structure for and
6. A curriculum and pedagogy structure has been developed based on the principles of study. A National Research Foundation will be established for the rapid dissemination of innovative ideas across the country to preserve the preservation, growth and vitality of all Indian languages. A National Education Commission will be established under the chairmanship of the Prime Minister. This commission will be the custodian of educational vision in India,

## Higher Education :

A "Higher Education Commission of India" (HECI) will be constituted for all higher education except medical and legal education. It will have four separate departments as follows: will be

1. National Higher Education Regulatory Council (NHERC)
2. General Academic Council (GEC)
3. Higher Education Grants Council (HEGC)
4. National Accreditation Council (NAC)

There will be a four-year degree course for students who want to pursue higher education for research and a three-year degree course for students who want to get a job after graduation. That is, it will be a four-year degree with a degree plus a one-year Masters course for those doing research. After this they will be able to do Ph.D. There will be no need to do M. Phil.

The Union Ministry of Education has set a target of starting at least one multidisciplinary interdisciplinary college in every district by 2030. Until now, the degree was taken from a single subject. Now the degree is going to be completed by taking multidisciplinary subjects simultaneously. Not only universities but also colleges will have multi-disciplinary courses so the fees will be fixed accordingly. The same percentages are to be fixed for charging fees of government as well as private educational institutions. It is within this framework that the fee will be fixed and the maximum limit on the fee will also be

observed

As per the new education policy, the proportion of vocational education and higher education is targeted at 26.3 percent by 2035. For this, 3.5 crore new seats will be increased in higher education institutions.

### **National Education Policy 2020 from a librarian's point of view**

Being inclusive it must include all groups of people to avail library services and all strata of society including different tribes, rural socio-economically disadvantaged groups children with special needs and minorities. To support the fundamental principles of education and to provide best practices, the librarian emphasizes a charitable attitude in pursuing projects of curiosity and youth through cluster groups in collaboration with teachers who can promote the fundamental principles laid down in the National Education Policy. Librarians must always keep in mind that the library is an educational service centre that works to bring current non-library and digital resources to the reader with the help of a dedicated staff.

A college library is a safe, welcoming and intellectually stimulating place for students to learn. By shaping the personality and character of the students, the library works to develop various skills in them and make them civilized citizens in the society. Academic libraries are said to be the soul of colleges. In the 21st century, librarians need to develop a variety of curricula and skills to develop values in students. like

1. Cleanliness Respect, Courtesy Democratic spirit Sense of service, Responsibility Pluralism, Equality, Justice Sympathy and respect for others.
2. A sense of scientific nature and evidence-based thinking, creativity and innovation, beauty and art. Oral and written communication, cooperation, relational work, logical and logical
3. Problem solving, professional exposure and skills. Digital Literacy, Coding, and Computational Thinking. Knowledge and practice of human and constitutional values. gender sensitivity, ethics Promoting multilingualism and language strengths in teaching and learning through a collaborative professional development positive work, environment, and service environment for teachers and librarians is a continuous learning process.

**A librarian should have the following skills:**

- Scientific temperament and evidence-based thinking
- Creativity and innovation Problem solving and logical reasoning
- Aesthetic and artistic sensibility
- Torts and written disputes
- Collaboration and teamwork
- Digital Literacy and Information Literacy Ethical and Moral Reasoning
- According to the NEP, the newly included items are as follows: - Knowledge of India Ancient and Modern
- Environmental, including water and resource conservation and sanitation awareness, and located Understanding of critical issues.
- Tribal and indigenous knowledge All types of literature Indian and International - Multi-disciplinary approach to all subjects If working as a teacher while working as a librarian

NEP 2020 has suggested that at least 50 hours of teaching work per year should be done to develop and enhance one's professional skills. Through a stream of professional development opportunities for schools to implement the new practices introduced by NEP 2020 that will be provided to all faculty members. Librarians have the opportunity to learn with others in schools which transforms your role from a bookkeeper to a teacher librarian.

**National Education Policy 2020 and Libraries:** As per the recommendation in the New Education Policy 2020, the library has the following

- Emphasis should be placed on high-quality translation (with the help of technology as needed).
- Providing enjoyable and inspiring books for students of all levels
- To create a culture of reading across the country by establishing public and school libraries, digital libraries, book clubs will be created in public and school libraries to provide wide and easy reading to the readers during non-school hours and thereby serve the society.

- Geographical, language, level and through the National Book Promotion Policy
- Both public and school libraries will be greatly expanded to increase readership across the country. For this, public libraries will be strengthened and modernized.
- Adequate supply of books to meet the needs and interests of the society will be ensured. More children's libraries, mobile libraries and social across the country to support widespread reading and community development
- Establishing a book club. Academic libraries are the heart of the institution and further steps will be taken for digital library and online accessibility of library books by government procuring reading materials like books, journals and other learning and teaching materials on a large scale. E-content will also be provided in regional languages.

To meet the needs of all types of readers across the country. Establishment, development, and strengthening of existing libraries to achieve objectives, develop suitable career paths for library staff and ensure adequate staffing for proper functioning.

According to the National Education Policy 2020, the library should be integrated, enjoyable and engaging with learning materials relevant to school curriculum and pedagogy. Read in the library on recommendation. Books based on inquiry, critical thinking and problem solving. A bibliography that will encourage students to learn about world cultures and enrich their global knowledge in learning languages of higher quality in Indian languages and international languages. Folktales and stories from different states. Resources covering India's diverse, ancient and modern cultures, traditions and knowledge systems.

Resources to create global awareness, the government will focus on making books widely available in schools and public libraries. The Government should take steps to ensure accessibility and availability of books to all, including persons with disabilities and persons with disabilities using modern ICT technology across the country. The main focus will be on socio-economically deprived areas and rural, remote areas.

## Conclusion:

Education is the most important tool for nation building. A man's life is worthless without education. According to the NEP 2020 strategy, education is fundamental to develop a fair and just society to achieve full human potential and to promote national development. India's sustained presence on the world stage in terms of economic and social justice and equality, scientific advancement, national cohesion, and cultural preservation depends on ensuring that everyone has access to high-quality education. Helping Governments strive to provide high quality educational opportunities for themselves and society.

As reflected in the scheme, it ensures that education is inclusive and equitable. Against this backdrop, ICT equipped schools, public libraries will be set up to serve the community and students especially in villages during non-school hours, book club facilities will be developed to encourage wider reading. For this, public and academic libraries and their library staff will play an important role.

In every age of mankind, all that has been created by all the previous generations of man, has been set forth in knowledge. The new generation adds its own contribution. Creating, transferring, appropriating and disseminating knowledge through this continuous effort is an important responsibility of the library.

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# **INNOVATIVE SCIENTIFIC, BUSINESS AND SOCIAL PRACTICES FOR SUSTAINABLE DEVELOPMENT**

**Chief Editor:**

Dr. Naglaxmi N. Tirmanwar

Editor: Dr. C.R.Karar

Editor: Dr. N.S.Dharkar



# Innovative Scientific, Business and Social Practices for Sustainable Development

Chief Editor:  
Dr. Naglaxmi N. Tirmanwar

Editors:  
Dr. C. R. Kasar    Dr. N. S. Dharkar



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## ENVIRONMENT AND STRATEGIES FOR SUSTAINABLE DEVELOPMENT

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### Abstract

The long-term idea of sustainable development prioritises the growth of present and future generations equally. The economic development improves the quality of life of peoples. Rapid industrialization, urbanisation, and high rate of population growth in the last 50 years has led to large-scaled environmental degradation. As a result, natural resources are rapidly depleting and environmental pollution has become one of the most important challenges being faced by the world today. Thus, it is more important to balancing economic growth and environmental protection side by side. We focus on strategies for sustainable development which are necessary for survival of present as well as upcoming generation.

**Keywords:** Environment, development, economic, pollution, strategies

### 1. Introduction :

The environment consists all living or biotic factor and non-living or abiotic factor that influence to each other. Living things included plants, birds, animals, microbes etc. and non-living thing included soil, rocks, water, air, temperature, etc. The environment provides

various resources to humans, like renewable and non-renewable. Renewable resources are those resources which are replenished easily over time, and hence can be used without the possibility of the resource becoming depleted or exhausted. e.g. trees in the forests, water, fishes in the ocean, etc. Non-renewable resources are those resources which can get exhausted or depleted over the time as they are used up. e.g. fossil fuels, natural gas, coal, etc. Therefore, these resources must be utilised wisely while taking into account the needs of future generations.

Sustainable development is a most concern phenomena for every country including developing country like India. Most of the countries in the world realised that their future generation must suffer to lack resources which is most important to survive. The concept of sustainable development is not related only future generation but also with the current generation. The right to development refers to the ability to promote social, political, economic, and cultural circumstances that can raise overall standards of living.

## 2. Challenges for Sustainable development

### 2.1 Population:

The challenges for sustainable development are clearly visible. A significant obstacle to sustainable development is population growth. In the beginning of the 21<sup>st</sup> century the population of the earth reaches 6 billion (Gupta & Chaturvedi 2011). India is the second highest populated country of the world. About 16.87% population of the world lived in India. Due to the tremendous growth rate in population, increased the rate of demand of food, land, water, energy, etc. to full feel this increasing demand large scale of natural resources has been used.

#### CENSUS YEAR POPULATION CHANGE (%)

|      |                |      |
|------|----------------|------|
| 1951 | 36,10,88,000   | —    |
| 1961 | 43,92,35,000   | 21.6 |
| 1971 | 54,81,60,000   | 24.8 |
| 1981 | 68,33,29,000   | 24.7 |
| 1991 | 84,63,87,888   | 23.9 |
| 2001 | 1,02,87,37,436 | 21.5 |

|           |                |      |
|-----------|----------------|------|
| 2011      | 1,21,07,26,932 | 17.7 |
| 2022 Est. | 1,417,170,000  | 15.1 |

Fig: Population growth in India per decade

### 2.2 Water:

Water is a common factor in all sectors of development. Because water and development have a strong linkage. Monitoring the sustainability of water resources can effectively provide an indication of sustainable development in the region. Drinking water scarcity in many regions of India is a major obstacle to sustainable development. Drinking water increasingly fails to meet standards due to pollution, wastage of rain water, unused of waste water, poor condition of supply systems and sewerage systems. Apart from households, water being an essential input to agriculture, industry and commercial purposes like electricity generation, aesthetics and recreation etc.

### 2.3 Energy

Consumption of energy is a major challenge for sustainable development. Energy is crucial to social and economic well-being and is required for the advancement of humanity (Jyoti, 2016). Large population has large demand of energy, to satisfy the daily need used more amount of coal, nuclear energy that pollute the environment. Therefore, it's crucial to utilise energy wisely and use the right fuel to prevent future crises. This may be achieved by using renewable energy in lieu of non-renewable resources and efficient technology in place of inefficient ones.

### 2.4 Land

Land use is mainly to satisfy commercial, residential and industrial requirements and also to improve public facilities, which in turn enhance quality of life. The land usage pattern changes due to the interaction of demographic, political, economic, societal, environmental, and cultural reasons. However, this leads to change a direct and serious impact to the natural environment. Since land is a limited resource, it needs to be used in a sustainable manner. Strategies for maximising economic growth,

advancing social welfare, and reducing the negative effects of human activities on the environment are necessary for sustainable land use.

### 2.5 Insecticide & Pesticides

In the developing countries, the uses of insecticide and pesticide has increased to control the insects and pests in agriculture field on large scale. It impacts adversely on environment as well as human health directly or indirectly.

### 2.6 Plastic

Plastic is one of the new major challenges for sustainable developments well as developing countries. Globally use of plastics increases tremendously day by day for daily needs. It is used to making polybags, making furniture, cups, kabot, bottals, decorative material, etc. after used of all this thing it converts in to waste material which is hazardous to living health.

## 3. Strategies for Sustainable development

The goal of sustainable development is not to obstruct the process of progress, but rather to use resources in a way that establishes relationships between the current and the future generation. To prevent future scarcity, long-term usage of natural resources must be sustainable. New efficient technologies can be reducing the exploitation of resources. So, this technology may good for sustainable development using eco-friendly fuel like LPG, CNG and solar energy can reduce the greenhouse gases production on the earth. Many countries as well as in many Indian metro cities bus corporation has been moved on CNG and electric buses for transportation. It is one of the best efforts to reduce the CO<sub>2</sub> and other harmful gases. Also, government of India focus on renewable sources of energy like solar, wind and water for energy need. Government of India has formed new policies, developed new schemes for increase of renewable energy used by peoples. Government provided solar pump, solar rooftop, LPG gases to peoples on government subsidy. Water is in great scare in many parts of our country. People do not have enough clear

and safe water to drink. Conserving water is crucial if we want to protect it from pollution and waste. Water can be conserved by harvest rain-water; check overflow of roof-top tanks, recycled used water. Plastic use is a major issue for environment, social health and sustainable development. Recently Indian government banned single use of plastic. It is a first step toward the decrease use of plastics. Scientist continuously search for new optional material, which replace the plastic.

### Conclusion :

The sustainable development is a vision and way of thinking and acting on it. So that we can secure the natural resources and surrounding environment for our future generation. It is not possible to creating policies only by government it must be taken up by society at large scale. People should implement it in their daily life and spread awareness among societies. Sustainable development not an issue of single country, all countries should share common interest and responsibility in addressing the challenges of environment and sustainable development. India continuous moving toward a sustainable development in agriculture, check on population, environment, water, forests, energy, etc. Also developed many policies, acts, programmes for sustainable development & implement it on ground level.

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# *Seventy-Five Years of Indian Library Profession*

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Dr. Sanjay H. Bhoge  
Mr. Nagsen D. Bansod  
Mr. Bhushan N. Dayawate



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## **EDITORIAL**

India has completed 75 years as an independent country in the year 2022. During this period we have taken a huge leap in development in almost all fields. The government has developed the education system in India to a great extent by accepting and considering the various recommendations of the constituted commissions and committees. These commissions forced the government to give special attention to libraries by giving positive recommendations regarding libraries. However, it is equally true that this has only been possible due to the continuous pursuit of various LIS organizations. At the time of independence, many universities started undergraduate and postgraduate courses in library science. After the rise of computers and the Internet, traditional libraries were replaced by computerized libraries. The rapid growth of ICT further transformed these libraries into digital libraries, paperless libraries and virtual libraries.

In the 21st century, the nature of libraries has changed according to the changing demands of their users. The changing nature of reading material also played a major role in this change. A study on the development of library, LIS education and LIS association in these 75 years after the status of independent India should be discussed and the future roadmap of these matters should also be placed before the youth working in the profession. Keeping this in mind, Maharashtra University and College Librarians Association(MUCLA) has decided to organize this conference in collaboration with Indian Library Association (ILA).

**- Editors**

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# Future of Academic Libraries and Library Profession

**Dr. Virendrakumar L. Barde**

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## **Abstract**

*The paper discusses the impact of information technology on academic libraries in India, also highlights on new developments in academic libraries with a focus on the role of UGC and other networks. It describes about the indicative role of the emerging trends in information services that the librarians play in the academic libraries. The study also addresses the function of academic libraries in the Indian educational system. To improve resources for academic libraries, the necessity of resource sharing through consortia is stressed. Finally, it discusses presents the goal of the new generation; the challenges facing implementation of the digital libraries and to review the problems faced by the library professionals in the academic libraries in new digital era.*

**Key words :** Academic Libraries, Digital technology, Digital Era, Library professional, Libraries and information centers

## **Introduction**

The education system of India has a large higher education system. Before independence the growth rate of educational institutions was very slow in India. Today there are 1072 numbers of Universities in the country, in which 460 are State Universities, 128 are Deemed to be Universities, 54 are Central Universities and 430 are Private Universities. The development of higher education in India has evolved rapidly with globalization. Academic libraries are an important part of the national education system as long as they function as information centers that meet the basic needs of library users. Digital evolution has brought many changes to society. These days, excellent learning experiences with innovations are in high demand for establishing educational institutions rather than merely learning.

In the development of higher educational institutions as University, colleges Library and Information centre(LICs) plays a vital role. Library networks and consortia play a vital role in reducing the financial problems of libraries and information centre. The pride of libraries like in service extended to knowledge seekers. LICs, therefore, are major academic entities in the architecture of an institution of learning. The dissemination of knowledge has always been one of the main goals of academic libraries when they functioned as institutions of learning, cultural repositories, and research centers, but in this digital age of knowledge, these roles have expanded and Instead, academic libraries improve their service by storing resources in a variety of formats and making them easily accessible online for the academic community, should provide quality education.

## **Libraries and LIS Profession in the Present Scenario**

The evolution of libraries and various studies conducted to understand the future of libraries due to various factors such as information explosion, globalization and adoption of emerging technology have greatly influenced the future of academic libraries and LIS profession everywhere in the world. Ordinary people are satisfied with the information they find on the internet. However, scholars and researchers seeking quality and scientific information from online resources are frustrated by the large amount of information available on the Internet. They are the ones feeling the effects of information overload affecting the LIS fraternity and user community.

The dissemination of knowledge has always been one of the main goals of academic libraries when they functioned as institutions of learning, cultural repositories, and research centers, but in this digital age of knowledge, these roles have expanded and instead, academic libraries improve their service by storing resources in a variety of format and making them easily accessible online for the academic community, should provide quality education. Academic librarians must possess a range of technical skills to provide a range of library services to students. The LIS professionals also meet their information needs in a way that attracts users who have never been to a library and allows them to recognize the relevance of LIS expertise in selecting quality content. Many Indian libraries cannot afford to purchase or license all the documents their users need. Sharing of resources through library networks at national and international levels therefore becomes essential for libraries. This allows you to manage access to information resources that users do not have access to. Thus, resource sharing adopted by various libraries helps in reducing information overload in most economical way. Librarians are currently relevant because they can provide information for users and assist in the knowledge creation process.

The ability to find, evaluate, use and produce information using digital technology, communication tools or networks is the meaning of information literacy in the digital environment. Today's academic libraries offer the possibility of accessing electronic resources anytime, anywhere. This encourages users to go to the library alone from home. Students today use the Internet extensively to find the information they need. The Internet provides the most up-to-date digital materials to use.

Librarians with appropriate knowledge and technical skills in digital resources can guide the users for proper use of information. A librarian can guide a user through her OPAC catalog of the library, use of e-journals, e-books, and use of digital materials in general. Additionally, librarians can be taught to recognize if the information they are looking for is right for them and to show them how to make the right decisions about it. Education wants to impart knowledge and make good citizens. Libraries are repositories of knowledge and an integral part of education. Libraries have a long history, starting with the chained, closed libraries of the past to today's hybrid, digital, and virtual libraries that use the latest technology to deliver information to a wide variety of services. Similarly, librarians have changed from shopkeepers concerned with protecting books from theft, mutilation, and theft to information officers, navigators, and librarians, finding themselves in vast seas of books and finding information anywhere, anytime.

### **University Grants Commission (UGC)**

In 1947 Sargeant Commission was given the responsibility of dealing with all the universities then in existence. UGC was established by an Act of Parliament in 1956, UGC coordinates and over sees the Indian higher education system and provides scholarships to universities. The Educational System of India has a large higher education system. Today 1072 nos. of Universities in the Country, in which 460 are State Universities 128 are Deemed to be Universities, 54 are Central Universities and 430 are Private Universities. However, UGC was not formally established

as a statutory body of the Government of India in November 1956 by the Act of Parliament to Adjust, Set and Maintain Standards of University Education in India. To ensure effective regional coverage across the country, UGC decentralized its activities by establishing six regional hubs. UGC Headquarters is in New Delhi. It also advises the union and state governments on measures to university education. It frames rules and regulations for overall teaching and research at higher education. As a result, it also looks after the academic libraries, i.e., sets various standards for library education, library staff, library services, etc. UGC had set up various committees for support of higher education in general and the library services in academic library particular.

### **Technologies used in Academic Libraries**

**Information Library Network (INFLIBNET) :** The UGC has set up an autonomous inter university center in 1991 called INFLIBNET. Participated in the modernization of India's university libraries and connected by a nation wide high-speed data network. It facilitates library automation, develops standards, and produces a unified catalog of journals, theses, books, monographs, and non-book materials and also provide access to bibliographic sources. Create a data base of projects, institutions and experts and also provide training to the LIS professionals. Almost all academic libraries, especially university libraries, are members of INFLIBNET, it also developed a library automation software called SOUL (Software for University Libraries) and distribute it free of charge to our member libraries.

**Other Networks :** NICNET (National Informatics Center Network), INDONET, ERNET (Education and Research Network), CALIBNET (Calcutta Library Network), DELNET (Developing Library ADINET to INFLIBNET, DELNET to NIC, MALIBNET is connected to CFTRI. Many educational institutions are members of such networks. These networks in particular DELNET are engaged in compilation of union catalogs, various It is engaged in creating a data base of relevant experts, providing training for library staff, ILL, online facilities, reference materials services, and subsequent conversion supports.

**Library Consortium :** Due to the financial crisis and rising journal prices, many Indian academic libraries are unable to subscribe to all the journals and databases they need. Libraries are forming a consortium to solve this problem. Indian Institute of Astrophysics (IIA) Library, Raman Research Institute (RRI) Library, National Radio Astrophysics Center (NCRA) Library Interuniversity Center for Astronomy and Astrophysics (IUCAA) Library, the Council of Scientific and Industrial Research, the Department of Atomic Energy, Physical Research Institute (PRL), the Tata Institute of Fundamental Research (TIFR) Library and others are forming a consortium to share electronic access to journal literature.

NISCAIR is developing a consortium for CSIR research institutes to access electronic journals. Indian consortium is still a new concept and needs proper policies and methods. Due to insufficient resources available in many academic libraries UGC launched a major initiative called UGC-INFONET. It provides high-speed internet connectivity that enables electronic access to professional literature such as research journals, abstracts, review publications and databases in all areas of science and technology, social sciences and humanities. All universities now have access to a large number of professional journals via UGC-INFONET. UGC-Infonet's e-subscription initiative is an important portal for the exchange of print and electronic resources among academic libraries.

**INDEST Consortium** is another one which was established by the Ministry of Human Resources Development (MHRD) the 'Indian National Science and Technology Digital Library (INDEST) Consortium'. The INDEST consortium is the most ambitious initiative to date in engineering and technology. The primary purpose of libraries is to organize and make information

accessible, and although the forms and methods have changed significantly, they have remained the same. The current scenario of reduced budgets and higher journal subscription fees in India makes it very difficult to meet the demand of library/information users. The only solution to this problem is to pool and share both print and electronic resources through consortia. New technologies have created great opportunities to serve with in consortiums. More and more libraries need to merge, which ofcourse requires changes in attitudes, practices, and policies for maximum benefit.

### **Challenges for the Academic Libraries in Future**

Many libraries fall short of their goals due to staff shortages and lack of technical competencies. Building exclusive digital collections and providing relevant search capabilities to access the miskey. Butl imited funds are adampner. LIS professionals must address increasingly sophisticated users and their search capabilities through customized information literacy programs. Keeping research data management tools upto date is a requirement that all libraries must meet in order to maintain their position within the institution. This is another challenge that helps keep the library relevant. LIS professional smust be actively involved in scholarly communication by developing the necessary skills and competencies. Otherwise, the situation in libraries to use rcommunities, especially academic libraries, becomes a challenge. LIS professionals develop expertise on the issues of the irparent organization's user community. This is aprerequisite for helping libraries trans form especially in the Indian context. LIS professionals should able to provide service more attractive to researchers and students. Internet doesn'tsolve everything as a result, librarianscan fully assimilate the needs and desires of students and researchers, making an important and compelling difference in their futurework. Libraries should be places on campus for data maintenance and research management. Librarians need the support of faculty and administrators to accomplish this, but they also need to be familiar with advances in data management to keep research from becoming obsolete. The 20th century saw a massive shift in technological innovation affecting people of all ages. Open accessrequires librarians to acquire knowledge on an increasing number of subjects at an alarmingrate.No agency processes information at the speed of a computer, but some times it feel slikeit. Adding budgeting and resource constraints can also contribute to this problem. Librarian should be familiarizewith diverse digital content. In academic libraries, challenges in role development, digital licensing, and research tools are shaping the way librarians deliver quality content to students and researchers.

### **Conclusion :**

Academic libraries are being modernized through the use of digital technology. Librarians teach library users how to use digital materials correctly. This study seeks to explore the benefits of these new digital technologies in academic libraries and what challenges librarians and library users had to face. Today,theamount of digital information isincreasing as several departmentsproduce digital materials. As the internet becomes a part of our lives, people arenavigating online sources tofind information. New ICT technologies have also changed the librarylandscape and userattitudes.Usershavenewerrequirementsandhigherexpectationsas the information they need is available on the Internet. Academic librarians needto adapt to new technologies and develop their technical skills to best serve theirusers. Providing librarianswith adequate trainingon new technologies is a very good solution forsucccessfullydeveloping their skills and reducingthe stress that new technologies canbringon them. However, librarians often face challenges and weaknesses inusingtechnologyandarchivingduetosevere economic problems. This means that academic libraries do not have sufficient budgets to hire new staff, purchase new equipment, subscribe toelectronicresources,orhaveanuglyimpactonthe quality of servicesprovided.

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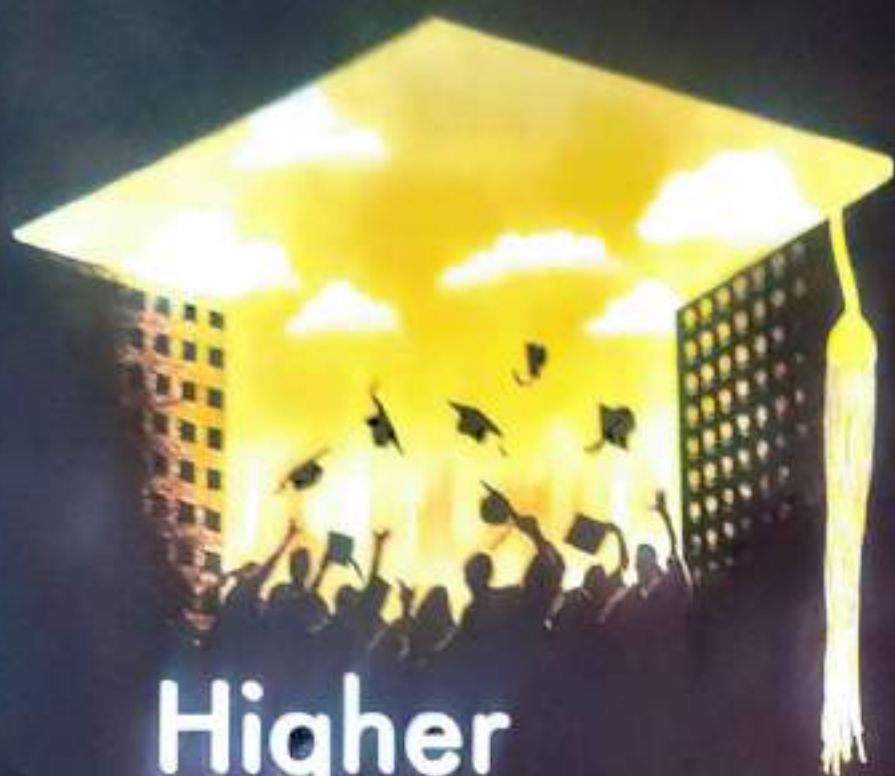
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# Higher

Education :

# Issue

# Challenges

and

# Opportunities

*Edited By : Dr. Sagar P. Narkhede*

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# Higher Education : Issue Challenges and Opportunities

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## **Understanding the new dimensions of Higher Education**

**Mr. Himanshu Arvind More**

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**Ms. Pauline Samson**

Researcher

### **Introduction:**

Higher education plays a significant role in the speedily changing world. The concept of higher education has changed drastically. It is not limited to the conventional way of learning. Today it is important to acquire the special skills which should be acquired by students in order to hold expertise in their field. Innovative and creative thinking is the need of an hour. Considering today's competitive world it is must that a student should adopt and mould himself or herself as per the changing time and adopt the attitude of learning. Whatever happens in the society has a direct connection with our life hence the student should be up to date with current affairs happening in the society. This habit will help the student to adopt creative thinking; will encourage them in productive decision making.

### **1) Need to adopt the new ways of learning in Higher Education:**

No doubt there are many lacunas when it comes to higher education as per changing times. It is utmost important to raise the quality of education. By implementing new ways of teaching such as group study, presentations, case studies which can be more of learners learning model. By this, students get the chance to shape their personalities. Use of new technological aids such audio-visual learning can make teaching and learning more interesting and ignite creativity. The opportunity of learning in the best way possible should be available to every child irrespective of socio-economic background as this will define the growth of nation.

### **2) Issues in relation to Higher Education:**

Indian society is diverse in nature. People of different culture, religion and languages form the nation as a country. Subjects taught sometimes draws different perception amongst its citizens. Following are some real problems in relation to higher education.

#### **a) Financial Differences:**

With the emergence of privatization, private players have entered into the market. Today education stands as the commodity than sacred duty. One needs to spend a hefty amount to get enrolled in a better education institute especially for higher education. Which brings a sense of competition amongst the group of classes, to choose the best institution, whereas the curriculum and the content to be learnt is the same.

#### **b) Geographical Hurdles :**

Geography can stand as a huge obstacle. It makes lot of difference when it comes to accessing the education. A child from a small town has to pour extra efforts in order to educate himself/ herself to acquire education and to compete with a child who resides in a city. Lack of educational institutes, teachers, study-materials makes the life of students difficult.

#### **c) Discrimination:**

Discrimination is still deeply rooted in India. Sadly, it ran through religion, hence we still witness discrimination in various forms. This is mainly because they are fastened to the old belief system. The

system of education is affected because of this belief system. Subjecting and denying education to the people who are socially and economical backwards can create a dramatic gap in the higher education.

**d) Language and Cultural Barrier:**

This is another type of diversity where students have to hustle to cope up with the language and cultural barrier. Though English plays a vital role to eradicate the gap but the problems raises about proficiency of English language considering teachers and students too.

**e) Ineffectiveness of Laws and Governmental Policies:**

Lack of effectiveness of law machineries and poor implementation of governmental policies leads to the foundation weak bridge of developmental process in the society. This deficiency directly impacts the child's future to grow in a developed nation.

**f) Gender Inequality:**

Article 14 was drafted in 1949 in the Indian Constitution which talks about Equality, woefully after the completion of 75 years of Indian Constitution, we still face gender inequality in the society. There are many women especially in rural area cannot dream to educate themselves. Evil religious practices, poor mindset dilute the society with their influence and thought process.

**3) Opportunities through the Emergence of Technological Era:**

Introduction of technology in the field of education has been a revolution. It changed the ways of learning and teaching. It became easier and hustle free. Following are some merits to be considered in relation to technological era.

**a) Availability of Information:**

Information is just one click away from us. It is easily available on the internet and

on many websites. This has reduced the burden of maintaining the record and reduction in wastage of time.

**b) E-Learning:**

Today because of e-learning any one can learn from anywhere and at any time. A learner does not have to be present physically in order to learn. It also saves money and time, as students do not have to commute from one place to another. Students can watch the recorded videos as many times they wish and take a benefit of study material uploaded on the website.

**c) Learning Platform:**

While students are learning on the online platform they also learn to use many tools such as email and use of various applications which are popularly used for online learning and meeting such as Google meet, Zoom etc. Power point presentation helps to enhance their presentation skills and ability to represent them.

**d) Easy Assessment:**

With the help of tools like Google form we can easily conduct the assessment and receive the responses. It has variety of options in which manner the assessment has to be done it can be in a quiz form or in brief. If it is viva or face to face interaction that can be done by using tools like go to meeting, skype, etc.

**e) Research:**

Today with the advancement of technology we have reached to such a mile stone that the best researches are available online on platform like Shodhganga and shodhsindhu. With the help of these platforms a researcher can get many dimensions and it will help students to get something innovative in the research.

**f) Efficient Functioning:**

There is a drastic change in the effective functioning of higher education. Systems

are doing majority of work with efficiency. Less number of people can get the majority of work with the help of technology. Works like book keeping, keeping the records of huge number of students, students registration simply can be done by the computer.

**g) World Wide and Global Participation:**

Today with the help of internet we can connect with anyone and anywhere. The programs like student exchange and faculty exchange can help each other to grow together by exchanging the expertise and knowledge. The best learning can be expected from with the help of global participation.

**4) Skill Gap and Employability:**

Considering today, we have huge gap when it comes to employability and acquiring skills, but they are utmost important. There is continuous evolution in the job market. The changing economy, changing market and its demand hence, up-gradation is must. The emergence of new technologies and digitalization has change the way job market works. Now, computer efficiency has become mandatory. It is important for a student of a higher education to upgrade their skills while they are perusing their academics especially with the introduction of artificial intelligence. This has easily substituted the traditional jobs. With the virtual world today, jobs can be done being anywhere, however, this too requires skills to handle computer and systems effectively and efficiently.

Another most important aspect is, a student's need is the soft skills such as communication, leadership critical thinking, problem solving, team work and leadership should be inculcated in the students foundation years of education. These can be adopted by reading life changing books and watching personality development videos that motivate and stir the

thinking reasonableness in them. Jobs in the markets has changed, there is increasing need of social media manager, content creator, SEO specialists and digital marketer. These demands are however not been supported by our traditional education system. Its the students who have to sharpen their skills. There is need of more of skill based learning to make the youth of our nation employable.

**5) Changes in the Pattern of Learning:**

The time has come that every education institute which deals with higher education should adopt the new ways of learning. For many years we have followed the conventional ways of learning. In which students were only passive learners but now it will not serve the purpose considering the need of the hour, they should be active learners.

Today, the time has come to embrace the way of learning where students get the chance to participate maximum, by doing this they will craft their skills and be ready for the competitive future. They can be encouraged to participate in group discussions where they can share their ideas, with the help of this they will get motivaon for creative thinking and enhance their problem solving abilities. Activities like brain storming should be conducted regularly, so they can develop the habit of productive thinking and increases their curiosity. By assigning the group activities, team work and social interactions can be developed. The role of teacher has been shifted to be a facilitator and a guide to help and assist student where they need assistance. Student-centric method has become the equilibrium from teacher-centric method where the students are the centre of attraction of education and not the teacher alone.

**6) Conclusion:**

To conclude this chapter, the higher education should be accessible to everyone which technology makes possible.

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Sustainable Goals 2030, the third goal is quality education. Every child is an asset for the nation and he or she should get fair chance and equal opportunity to craft his/her life. Right to education runs from Article 21 of the Indian Constitution that is right to life and personal liberty. In order to live a dignified life education is mandatory.

Students as well as teachers should be well versed with the new technologies and creative ways of learning. The major focus should be on student's development than completion of syllabus.

Teaching in higher education should be so intruding that the student should develop their interest in learning new things and wish to conduct research by self motivation.

Things are changing at a rapid pace, so is the education process. It is important for students

to keep on learning and updating themselves and make themselves familiar with new technologies and new learning tools. Hence, the higher education should be skill based in order to become a developed nation altogether.

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## EFFECT OF GLYPHOSATE BASED HERBICIDE ON DEVELOPEMENT OF EARTHWORM (EISENIAFOETIDA)

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### ABSTRACT

Glyphosate is an active substance that is broadly used in pesticides. Glyphosate based herbicides (i.e. formulations containing glyphosate and other chemicals) are applied in agriculture and horticulture primarily to combat weeds that compete with cultivated crops. They are applied before crops are sown and as a pre-harvest desiccating treatment, accelerating and evening the ripening process. ("European Food Safety Authority, 2016). Surprisingly, despite the enormous use of glyphosate-based herbicides around the world and the active research around glyphosate products, little is known of their potential effects on non-target soil organisms. The efficacy of glyphosate is based on the inhibition of 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) in the shikimate acid pathway, which in turn interferes with the production of aromatic amino acids and secondary compounds required in the defense functions of plants and many microbe. The present study investigated the effect of herbicides on development of *E. fetida* for 60 days. Different doses of glyphosate based herbicides were used.

**Keywords:** Glyphosate, Herbicides, Agriculture, Earthworm

### Introduction

The earthworms are long, thread-like, elongated, cylindrical, soft bodied, segmented animal commonly found in living in soil, feeding on wide variety of live and dead organic matter. An earthworm is a terrestrial invertebrate, common name for the largest number of Oligochaeta that belongs to the phylum Annelida. They are classified into three types, on the basis of their ecological environments: epigeic, endogeic, and anecic. Epigeic species lives above mineral soil layers near the soil surface. Endogeic species inhabit deeper layers (up to 0–20 cm) of soil profile, while anecic species (vertical burrowers) can open deep vertical galleries that may reach up to 1 m depth along the soil profile. Epigeic species function in the mineralization of plant surface residues as anecic species transport the decomposition products of this process to lower soil layers and also increase water infiltration and aeration (Edwards and Bohlen, 1996; Karaca, et al. 2010a). In many soils, earthworms play a major role in the conversion of large pieces of organic matter into rich humus, thus improving soil fertility. In addition to dead organic matter, the earthworm also ingests any other soil particles. When the worm excretes this in the form of casts, deposited on surface or deeper in the

soil. Earthworms accelerate nutrient cycling in the soil-plant system through fragmentation and mixing of plant debris – physical grinding and chemical digestion. Earthworm show many sensitive reactions towards environmental influences and they also act as decomposers, due to this they generally used as test organisms. Earthworms are ecologically very important as many substances are responsible for the risk of secondary poisoning through feeding on worms. It can be possible that worms themselves suffered from much adverse effect. The use of herbicides to control weeds has been recognized as a part of agricultural practices throughout the world. The herbicides, used to fight against the weeds in the agriculture are very toxic to soil biota (Kumar and Kumawat, 2018). Unfortunately, the indiscriminate use of these herbicides to improve agricultural production and yield but may have impacts on non-target organisms, especially earthworms and they are being killed as non-targeted organisms and aquatic life forms and their environment. The excessive use of herbicides is responsible for the debasement of agro ecosystem sustainability. Weeds and pests are responsible for degradation in agricultural crops. Although, earthworm species vary in their tolerance, reports have shown a decline in earthworm populations in response to large amounts of

organic chemical deposition (Yasmin and D'Souza, 2010). To minimize weeds problems in crop production, the herbicides application should be on a regular practice. Various studies have showed that the qualitative and quantitative change in enzyme activity occurs due to the use of herbicides. Insecticides are the largest subsegment of agrochemicals with 60% market share, whereas herbicides with 16% market share are the fastest growing segment in India (FICCI Report, 2016). The interactions between the herbicides and soil biota have practical significance by the reason of possible inhibition in microbial action increasing to soil fertility. Glyphosate (N-(phosphonomethyl) glycine) is a broad-spectrum, nonselective systemic herbicide and crop desiccant. It is an organophosphorus compound, specifically a phosphonate, which acts by inhibiting the plant enzyme 5-enolpyruvylshikimate-3-phosphate synthase. It is used to kill weeds, especially annual broad leaf weeds and grasses that compete with crops. Glyphosate is the most commonly used herbicide and was considered to be non-toxic. But its use in excess in agricultural lands has polluted soils and waters. Nowadays, glyphosate residues are found in soil, water and food. As a result glyphosate causes severe acute and chronic toxicological effects (Gill, Jatinder Pal Kaur, et al., 2018).

### Materials and Methods

*Earthworm, Eiseniafoetida* (Savigny, 1826) is recommended earthworm test species by Organization for Economic Co-operation and development (OECD, 1984a) and European Economic Community (EEC, 1985). *Eiseniafoetida* is collected from a commercial supplier and acclimatized and cultured in laboratory according to International Standard organization (ISO, 1993). The culture of earthworm species *E. fetida* was perpetuated to use the third generation of earthworms to avoid the pre-exposure or residual effects of agrochemicals at vermicomposting unit of Department of Zoology, Indira Gandhi Kala Mahavidyalaya, Ralegaon and animals were bred in Vermicomposting pit at temperature 15-30 °C. For the tests, only adult worms with clitellum with a fresh weight between 250 to

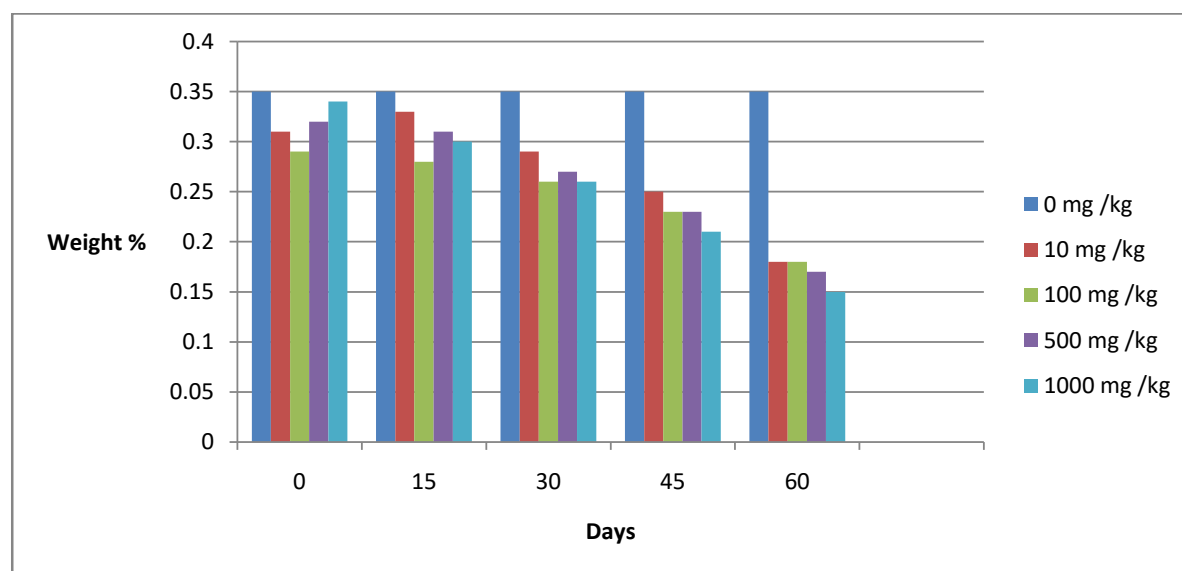
350mg were used. All earthworms were fed according to demand, usually once a week. The natural soil samples were collected from an abandoned area where no agricultural activity has done and which was an area with no known history of pesticides use. The physico-chemical characterization of soil was provided by department of chemistry Indira Gandhi Kala Mahavidyalaya Ralegaon. Glyphosate based herbicides with purity 71.% was used. All tests were performed using adult earthworms (age less than 2 months and clitella well developed) and with individual weight (ISO 11268-1 1993). For the experiments, 10 earthworms were transferred to each container with 400 g of soil prepared by adding different concentrations of glyphosate (dry weight basis). Four replicates were analyzed for each concentration and 4 control containers, prepared under identical conditions without the addition of the target pesticides. The concentrations used were 10; 100; 500; 1,000 mg/kg. The containers were covered with paper filter with holes to maintain aeration conditions during the 60 days of the test. Soil moisture was standardized at 60% of maximum water-holding capacity, and the samples were maintained at room temperature ( $27 \pm 2^\circ\text{C}$ ) in the presence of light. After 15, 30, 45, and 60 days of incubation, the containers were opened, surviving and dead earthworms were counted, and the survivors' average weight was verified. Earthworms were classified as dead when they did not respond to a gentle mechanical stimulus and morphological abnormalities were recorded.

### Results and Discussion

The glyphosate showed different effects on the earthworms. In the growth test, earthworms from the soil treated with glyphosate showed a gradual reduction in mean weight during the experiment. The percentage of weight loss at the end of the experiment was approximately 50% of baseline weight. All earthworms were classified as alive at all moments of sampling. Although glyphosate did not kill the test organisms in the range of test concentrations, the decrease in mean weight may indicate a severe effect of this herbicide. Morphological abnormalities like coiling, and curling were

observed in all specimens exposed to the highest concentrations of glyphosate after 30 days of exposure. Similar abnormalities were also observed in the organisms exposed for 55 days at lower concentrations. Excessive mucous secretion was observed in all exposed worms. For glyphosate, reproduction was always lower than 20% when compared to the control, so that glyphosate can be classified as toxic. Additional studies are required to fully understand this effect. In addition, reduction in weight was observed in the earthworms at the end of the experiment as compared to the

controls, suggesting a significant chronic effect. Soil ingestion and dermal absorption are the most important intake routes of soil pollutants by earthworms. Glyphosate demonstrated severe effects on the development of *Eiseniafoetida* in laboratory tests. Meanwhile, long-term exposure (60 days) to soil contaminated with glyphosate demonstrated a toxic effect on normal development of *Eiseniafoetida*, indicating that this substance may have significant toxic effects on soil biota.



**Fig.1 Effect of Glyphosate soil concentration and exposure time on *Eiseniafoetida* biomass**

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# Physical Education and Sports: Issue, Challenges and Opportunities

Volume II

Edited By : Dr. Sagar P. Narkhede

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Volume II



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## Impact of advanced training using technology after Pandemic

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### Abstract:

The paper deals with the study of the technological impact during the COVID-19 pandemic and elucidates technology usage to technology enhanced learning which assisted in obtaining the behavioral intention to use technologies among the sports students. Recently, higher education institutions suffered from the impact of using emerging technologies with electronic learning during the COVID-19 pandemic for improving student academic performance in sports. The main purpose of this study is to determine the impact of technology enhanced learning that allows the students to use emerging technologies and software to develop their skills and improve their academic performance.

### Introduction:

Physical education is the planned, progressive literacy that takes place in academy class timetable time and which is delivered to all pupils. This involves both 'literacy to move' (i.e. getting more physically competent) and 'moving to learn' (e.g. learning through movement, a range of chops and understandings beyond physical exertion, similar ask operating with others). The environment for the literacy is physical exertion, with children passing a broad range of conditioning, including sport and co-education.

Sports in academy and brain development and boost pupils' cognitive capacities. Active participation in sports may help scholars decompress from their everyday pattern of studying and lessen test stress. To keep the body and spirit in harmony, one must strike a balance between work and recreation. Sports are an extension of the classroom for trainers. Sports may educate a person how to be physically and mentally strong. Sports are a big part of numerous athletes' lives. To be successful, athletes have to train hard for hours every day. Training is important because it helps

athletes get stronger and busky. It also teaches athletes how to work more with their teammates on the field or court. Training is an integral part of athletes' lives. It's what allows them to be their stylish and contend with all that they love. Training can help with abstinence, skill development, weight loss, pretensions, injury forestallment, and much further; thus, athletes should no way neglect their training. Without training, it would be veritably delicate for athletes to contend duly. Training takes a lot of time and trouble, but it's worth every benefits for athletes. For illustration, baseball players will profit from training because they can work on enhancing the exit taste of the baseball, ameliorate their for speed, and work on their dexterity. This way, they will be more confident when it comes to joining events.

### The significance of Training for Athletes

Training is extremely important and should form an integral part of all elite athlete's diurnal routines. Training allows the body to gradually make up strength and abstinence, ameliorate skill situations and make provocation, ambition and confidence. Training also allows athletes to gain further knowledge of their sport as well as enabling them to learn about the significance of having a healthy mind and body. In terms of physical goods of training, regular exercise increases muscle tone, facilitates good rotation, improves strength, dexterity and inflexibility and improves the rate of waste product disposal. Regular training also speeds up recovery time following physical exercise; this enables the body to manage with the demands of training more effectively and makes it more resistant to injury and illness. Training also has benefits for internal health as it improves attention and increases long-regard. Training can be veritably demanding for athletes because training pushes athletes to give their stylish all the time. Athletes might not want to do the training

because it can be verifiably tiring or exhausting, but athletes need to understand that without proper training, they will no way reach their full potential as athletes. The use of sports specific training allows you to effectively and efficiently reach your pretensions in sport. It can affect in better performance, lower injury threat and increase competitive life. To exceed in your chosen sport, it's important for training to be varied and acclimatized to specific individual or platoon requirements. Sport specific training stimulates a movement or exercise in the sport perfecting performance benefits on the field, track, round or pitch etc. It provides athletes with real benefits, and it's included in numerous sports programs for several different reasons.

#### Training helps athletes make abidance

Abidance is important for athletes because it helps them contend in longer events. However, they won't be suitable to last throughout any game or match, if athletes don't train. This is especially important for athletes playing high-intensity sports like basketball and football which can wear out athletes fluently if they didn't have enough abidance training previous to a game or match. Without abidance, athletes might not be suitable to perform as well or might indeed get injured, thus, athletes need to train so that they can enhance their abidance effectively. Abidance training describes any type of athletic training that increases your body's cardiovascular or muscular abidance. Abidance training helps develop the body's respiratory capabilities and muscular strength to sustain physical exertion with lower injury pitfalls for extended ages. Cardiovascular abidance training focuses on aerobic exercise, which includes conditioning that ameliorate the way your body uses its oxygen force to give you energy for athletic performance. Muscular abidance training trains your muscles to handle decreasingly emphatic use for longer ages.

#### Training increases athletes' capability to recover from fatigue

The further training athletes do, the lower chance they've of getting tired during a game. This is because athletes are erecting up their position of abidance which allows them to repel long stretches without tiring out supply. As a result, athletes are suitable to perform better because they've further energy for their games. Athletes who get tired fluently are less likely to win their games because they won't be suitable to perform as well.

#### Sports that bear abidance

There are some athletic conditioning that can help increase your cardiovascular and muscular abidance.

1. Cycling or biking is a typical abidance exercise that builds cardiovascular abidance and speed. It's a great low-impact abidance exercise because it proves lower threat of injury to the joints than running.

2. Abidance sports: Playing tennis, basketball or soccer is a great way to make abidance because these sports bear sustained cardio and muscular trouble over a many hours, generally longer than your typical single drill.

3. **Running:** Cross-country handing, jogging, and walking are common cardiovascular abidance exercises. Perform these exercises on the pavement, trails, tracks, or routine. Distance runners will frequently concentrate on conditioning that help ameliorate their VO2 maximum, or the body's maximum oxygen input and aerobic capacity. This training also develops a person's slow-twitch muscle filaments, aiding muscles to use oxygen more efficiently.

4. **Stair climbing:** Climbing stairs is a great drill for lower body muscles like the pms and gluts. Using a stair-stepper machine also helps you make cardiovascular abidance if you perform the exercise for longer ages.

5. **Swimming:** This low-impact cardio abidance training exercise doubles as a full-body drill. Learn introductory swimming strokes.

#### Types of Abidance Training

There are numerous types of abidance exercises that athletes of different situations can perform. When trying to ameliorate your abidance, aim to sustain the exertion for as long as possible. Always consult with a particular coach or croaker to determine what exercise program is right for your fitness pretensions. Then are five types of abidance training exercises.

1. **Distance training:** Distance training is the most common type of training that athletes use to develop overall abidance. It requires an athlete to achieve a specific distance thing, similar as running five long hauls or swimming one afar. Runners may choose to do this on pavement or trails, and cyclists may use roles or exercise bikes.
2. **Tempo training:** Tempo training requires

performing an exertion at a specific pace or tempo for a certain period or distance. The thing of tempo training is to find a pace that you can sustain for long distances and times without getting fatigued. Exercise machines like rotes can be salutary for long- distance runners to tempo train.

3. **Interval training :** Interval training, also known as high- intensity interval training( HIIT), involves short bursts of high- intensity exercise followed by short ages of moderate- intensity exertion or rest. Interval training improves an athlete's VO<sub>2</sub> maximum or maximum oxygen input and heart rate threshold.
  4. **Circuit training:** This drill involves performing a series of successional exercises with no rest in between. Circuit training can alternate between cardio exercises and resistance or strength exercises, and your muscles will tire out snappily. Circuit training gives you a full- body drill routine in a fairly short time.
  5. **Strength training:** Strength training and resistance training involve lifting weights or performing bodyweight exercises to ameliorate the performance of specific muscle groups. Abidance athletes use weight lifting to target the upper or lower body to enhance their overall physical fitness and capability. Strength training might include performing presses, dumbbell lifts, or kettle bell swings with heavy weights or light weights. Resistance training might involve drive- ups, pull- ups, sit- ups, or exercises with resistance bands. Training helps athletes mentally prepare for their games still, they may also struggle with internal medication. If athletes don't prepare themselves physically before games. Training is an important part of staying mentally set for a game or match. Athletes may not suppose they're ready to play if they've not trained duly, especially if their tone- regard is low because they don't feel fit enough to contend with other athletes in the same sport. As a result, athletes who don't train might suffer from anxiety or fear when they play, which can lead to poor performance. Focus is important. Without it, it'll be grueling to flash back what you 've rehearsed during physical exercises. Learning to manage stress duly and indeed controlling excitement can help ameliorate your internal game when it's time to contend.
- Be your stylish with these 6 tips for getting in the

zone before a competition

1. **Focus On fashion still,** you will get detracted from the conduct you need to perform physically, if you come consumed allowing about winning or losing. It's important to learn to ignore the factors that you don't have control over, similar as rainfall or terrain. Focus on the details you need to execute during competition rather of imaging the outgrowth, identify the individual way you need to take to get there.
2. **Understand How Stress Can profit you :** Heading into competition, you may feel stressed- out. Fete stress as commodity that can work for you or against you. A small quantum of stress can help profit your performance by aping you and giving you a rush of adrenaline. What's important isn't letting stress consume you, or turn into anxiety. Learn to accept the presence of stress and use it to your advantage.
3. **Fantasize Your performance :** numerous talented athletes practice visualization before a competition. They fantasize implicit scripts that they could potentially encounter and determine how they will respond. This helps athletes reply snappily when presented with the same script on the spot.
4. **Pick the Right Pre-Event terrain :** Some people like to get pumped up by harkening to loud, fast- paced music. Others feed off of stimulant from their suckers. Some choose to find a quiet space and hear to calming music, or meditate. Find out which system works best for you and make sure to produce replicate that terrain for yourself previous to the competition.
5. **Exercise Positive tone Talk :** The narrative in your head before competition should be aware and purposeful. Set yourself up for success by talking through the event in a positive, uplifting way, as a trainer would motivate their platoon.
6. **Tone mindfulness :** It's good to be in touch with yourself. Understand how you generally respond to certain stress triggers and produce a plan for dealing with them. However, you may want to keep a journal with you to log your studies, if it helps. You'll also be suitable to review the study processes you've written down and learn from them. In conclusion, it's about putting in the training ahead of time, both physically and

mentally. Preparation can make all the difference when it comes time to contend. Also, protect our full collection of running gear for fresh provocation to keep you running you're stylish, for men and women!

### **The thing of Mental Preparation**

Your mind plays a huge part in your success as an athlete. And so you want to be sure it's being used in your favor rather than holding you back. When you aren't in the right mindset to contend, it's easier for you to lose focus, deal with anxiety, and perform with fear. None of which leads to peak situations of performance.

The thing of internal medication is to get you into the stylish mindset to contend. That way, you can feel confident your internal game is elevating your play. To get more specific about why you want to be sure you're mentally preparing to perform, let's examine the main benefits of good internal medication in sports. "The thing of internal medication is to get you into the stylish mindset to contend. That way, you can feel confident your internal game is elevating your play."

### **Benefits of Mental Preparation for Athletes**

When you turn your attention onto breeding the right mindset going into each game, there are numerous benefits you'll witness. These include increased Confidence the more mentally set you are, the more confident you'll feel going into a game. Advanced Focus using sport psychology ways, your mind will be centered as you start a game. Making it easier for you to control your focus as the performance goes on. Reduced Fear & Anxiety with specific tools, you can increase positive internal chops and get yourself into a good mindset. That will reduce the passions of fear and anxiety you have ahead and during competition. Increased thickness all athletes want to be harmonious. But it's delicate to be harmonious when you can't force the outgrowth. But what you can be sure of is you approach each game with a harmonious mindset. Improved Performance looking at the benefits listed over, you can begin to see how internal medication increases performance. The better your mindset, the more likely you're to succeed.

### **6 ways for Pregame Mental Preparation**

Transition from life to sports and enter the part of the athlete. Focus only on the part of athlete and situate

any worries from life reject outgrowth prospects or strict demands. Let go of the prospects you feel to be perfect or win. Be visionary with confidence previous to competition. Take full control of your confidence position before the launch. Focus on prosecution of the process and not results. Stay into the moment and don't suppose too far ahead. Rehearse your performance and game plan. Fantasize how you want to perform and execute you game or race plan. Prepare your mind and body to trust in your chops. Get ready to come a pantomime and stop rehearsing so you can get into the zone.

### **Training improves strength**

Strength training is also known as weight training, resistance training, and muscular training. The general description of strength training is any physical movement in which you use your body weight or outfit (e.g., dumbbells and resistance bands) to make muscle mass, strength, and abundance. Muscular hypertrophy also known as muscle structure, this type of strength training uses moderate- to-heavy weights to stimulate muscle growth. Muscular abundance This refers to your muscles' capability to sustain exercise for a period of time. Training to increase muscular abundance generally involves high reps using light weights or body weight. During this form of full- body exertion, you cycle through colorful exercises with little to no rest between them. This type of exercise involves low reps (generally 2 – 6) and heavy weights to ameliorate your overall strength. It's stylish reserved for educated tramp limits who have learned their form. This training combines power and speed to ameliorate your power affair. It's generally employed among trained athletes to ameliorate their capability to perform explosive movements in their sport utmost people concentrate on muscular abundance, circuit training, and muscular hypertrophy as part of their strength- training routine, while strength and power training are generally reserved for educated athletes. Depending on the type of strength training you choose to reach your pretensions, you can use colorful outfit (or none at each), similar as body weight using your own body weight and the force of graveness to perform colorful movements (e.g., pushups, syllables, planks, pull-ups, and lunges). Free weights outfit not bound to the bottom or a machine, similar as dumbbells, barbells, kettle bells, drug balls, or objects around the house. Strength training is an

important part of training for athletes. Athletes need to be strong to contend at their stylish. Thus, athletes should engage in strength training exercises regularly. Strength training not only helps athletes make muscle but also increases collaboration and dexterity as well as helping athletes recover from injuries or lapses more snappily than if they hadn't trained; thus, training can help athletes retain their strength and attention for all the games or matches they're anticipated to play.

#### **Stylish Fitness Apps:**

A wide range of fitness apps make it simple to work up a sweat, make strength and stay motivated in any place at any time. Still, putatively endless options can make your hunt delicate. So, we did the heavy lifting to constrict the list to the 10 stylish fitness apps worth the download. To choose the stylish fitness apps of 2023, the Forbes Health editorial platoon reviewed over 40 fitness apps across the iOS and Android app stores. Star conditions associated with each recommendation were determined solely by the editorial platoon and grounded on factors including price and the vacuity of several features.

#### **Obé Fitness:**

This app brings the sense of a exchange group fitness class to your living room with further than 20 types of classes, including HIIT, dance cardio, carve, and more. The app offers live classes every day of the week — mugged in a fun neon plant — in addition to its expansive on- demand library of further than, 000classes. Workouts range from 10 twinkles to 1 hour. The top- notch preceptors bring the energy and will indeed give cry- outs during the live classes. It's also a five of Health line nutrition and fitness editor Kelli McCrae, MS, RD, who appreciates that the large selection of 20- nanosecond classes makes it easy (and fun) to squeeze a sweat session into her day.

#### **Peloton**

Peloton is best known for its cycling classes, but with the Peloton digital app, you can also pierce other types of exercises. You'll find everything from strength training and HIIT to out-of-door handling and yoga. You can work out in real time with expert preceptors and other members from around the world or take a prerecorded class. Peloton classes feature curated music playlists, and each educator brings their unique style to

their classes. Just keep in mind that although the preceptors give variations, true newcomers may find utmost of these exercises too grueling. Several Health line editors have reflected that the Peloton app is the key to their at- home fitness success. Health line elderly SEO associate Sydney Hanna started using the Peloton app during the COVID- 19 epidemic and continues to use it to condense her in- person spa and exercise classes. She appreciates its wide range of classes and the inflexibility it offers. Health line elderly dupe editor Anne Anton firstly paired the Peloton app with an Echelon Smart Connect bike to get in on the spin classes she was missing during the epidemic. As she began testing some of the app's other classes, she realized how important she enjoyed the range of class types and lengths available. This app was also featured as one of Health line's picks for the stylish fitness gifts.

#### **Fit Body:**

A community created for women by women, Fit Body features 12 programs led by four expert coaches to help you reach your fitness pretensions. The classes are designed to be 30 twinkles or shorter, but if you have redundant time, we recommend taking advantage of the stretching and froth rolling vids as well. What's more, the app offers 72 weeks of mess plans with custom portion recommendations according to your diurnal calorie requirements, plus access to further than 300 fashions to produce your own mess plan. There's also a community function within the app, allowing you to connect with others on your heartiness trip.

#### **Daily Workouts Fitness Trainer:**

Whether you're just getting into a diurnal drill routine or are a seasoned fitness sucker, Daily Workouts Fitness Trainer is a solid fitness app choice for those on a budget. It was developed by a pukka particular coach who guides you through randomized exercises drafted from further than 100 of the stylish drill moves. It offers drill sessions from five to 30 twinkles long, all of which can be performed anywhere. Pundits love that the exercises strike a balance between being easy enough to keep up with and hard enough to feel the burn, and that each session has easy- to- follow videotape instructions.

#### **Zones for Training app:**

This app helps you stay in the zone the heart rate zone, that is when you're working out by integrating

with Apple Watch to keep an eye on your palpitation. Zones for Training precisely monitors your resting and active heart rate and also provides parameters to determine when you're burning fat and when you've reached your peak exertion position. It's a perfect companion for the Apple Watch, which has an exemplary heart rate examiner erected into it. This app is stylish for someone who's educated with working out and wants more detailed data to help them reach their pretensions, or for someone who wants perk heart-monitoring features and flawless integration with their Apple Watch.

### 7. Nanosecond Drill:

The 7- nanosecond Drill is the perfect app for people with busy schedules that don't allow for spa time, frequent trippers, or for those who are just getting started with fitness and want to set lower pretensions. The app has a simple interface that offers three seven-minute drill vids on the home screen a introductory full-body drill, a session concentrated on abs, or a high-intensity sweat session. Fans of the app love the help fulera-workout demonstrations, the manageable time length of the exercises, and the low sticker price.

Numerous of us believe that there's no cover for a coach guiding to gain muscle or exfoliate off those redundant kilos or to make your dream body. But the arrival of home drill operations erected with the power of artificial intelligence, machine literacy, and other technologies, has disbanded this misconception. Home drill apps offer a stoner the freedom to work out anywhere as per their convenience. This composition will cover up the eight crucial benefits of similar operations that you make you forget enrolling into decoration spa enrollments to stay fit and healthy. Have a look individualized fitness programs We all have different body types and fitness pretensions, and the "

one plan fits for all " cannot be applied in this case. utmost of the home drill operations are erected with the power of artificial intelligence, machine literacy, and other top technologies that help in furnishing exclusive drill plans for every stoner. All you have to do is to enter the needed details, similar as body measures, your current fitness position, unborn fitness pretensions, and more, and it'll produce a unique exercise program for you. You can follow the exercises given in the plan to meet your fitness pretensions. Those who are formerly-fit and want to maintain this fitness position can choose from hundreds of drill plans formerly given in the fitness apps. The popular fitness apps also have colorful drill vids that druggies can follow to exercise.

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Volume II

Dr. Alfred Y. Shaikh, I Dr. Vinay M. Raut

An Introduction to  
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In mathematics graph theory is the study of graphs, which are mathematical structures used to model pairwise relation between objects. A graph in this context is made up of vertices (also called nodes or points) which are connected by edges (also called links or lines) A distinction is made between undirected graphs, where edges link two vertices symmetrically, and directed graphs,, where edges link two vertices asymmetrically; see Graph (discrete mathematics ) for more detailed definitions and for other variations in the types of graph that are commonly considered. Graphs are one of the prime objects of study in discrete mathematics.

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# THERMAL STUDIES OF Co(II), Ni(II) and Cu(II) COMPLEXES DERIVED FROM THIAZOLE SCHIFF BASE WITH MICROWAVE IRRADIATION METHOD

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## ABSTRACT

The new thiazole Schiff base have been synthesized by microwave irradiation method 2-hydroxy-5-chloro acetophenone and 4-(p-hydroxyphenyl)-2-aminothiazole. The metal complexes were obtained as a result of interaction of Schiff base ligand and metal ions Co(II), Ni(II) and Cu(II), The complexes have been characterized on the basis of elemental analysis, infrared, molar conductance, magnetic Susceptibilities, and thermogravimetric analysis. The kinetic analysis of the thermogravimetric data was performed by using Broido, Horowitz-Metzger and Freeman-Carroll method, which confirm first order kinetics and kinetic compensation effect.

**Keywords:** Thiazole Schiff Base, Molar conductance, Thermal.

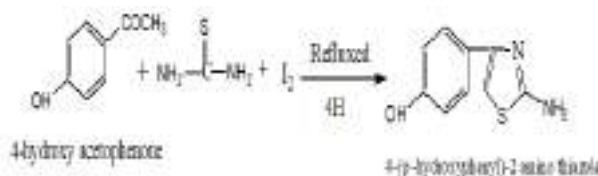
## 1. Introduction

Schiff bases are chemical compounds formed from the condensation reaction of aldehydes or ketones with amines. These compounds are majorly used in industries and also have significant biological activities, including antioxidant, antibacterial, antifungal, antiviral and antitumor. The majority of these compounds show excellent catalytic activities. Schiff bases are considered to be the most versatile ligands as they form complexes with the metal atoms. They are called privileged ligands because these compounds can be synthesized simply by condensation or microwaves. Performance of Schiff Bases Metal Complexes and their Ligand in Biological Activity<sup>1</sup> Antifungal Activity of Some Mixed Ligand Complexes Incorporating Schiff Bases<sup>2</sup> Spectral and thermal characterization of Mn(II), Ni(II) and Zn(II) complexes containing schiff Base ligands.<sup>3</sup> Compounds containing an azomethine group (CH=N), known as Schiff bases, were formed by the condensation of a primary amine with a carbonyl compound. Schiff bases of aliphatic aldehydes were relatively unstable and were readily polymerizable. Schiff bases and their complexes are shows good progress in thermal analysis<sup>4</sup>. The mathematical calculating thermogravimetric data, thermal decomposition activation parameters can be obtained<sup>5</sup> This paper discusses the kinetic of the thermal decomposition and the accompanying

compensation effect for Schiff base complexes of Co(II), Ni(II) and Cu(II)

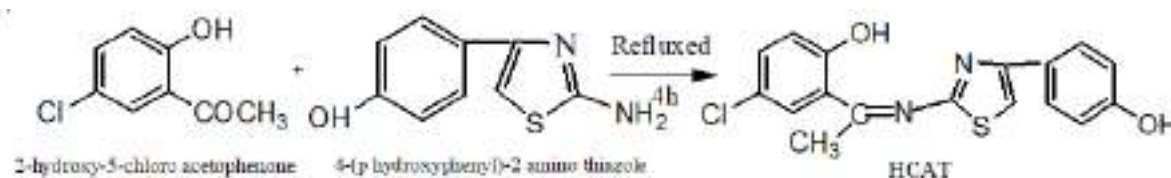
## 2. Experimental

All the chemicals were of A.R. grade and used as received. 2-hydroxy-5-chloro acetophenone (HCA) and 4-(p-hydroxyphenyl)-2 amino thiazole was prepared by known methods<sup>6-8</sup>. The solvents were purified by standard methods<sup>9</sup> Synthesis of 4-(p hydroxyphenyl)-2 amino thiazole;



Synthesis of 2-hydroxy-5-chloro acetophenone 4-(p-hydroxyphenyl)-2 imino thiazole [HCAT]:

A solution of 4-(p-hydroxyphenyl)-2 imino thiazole (0.02M) in 25ml of ethanol was added to an ethanolic solution(25ml) of 2-hydroxy-5-chloro acetophenone (0.02M) and the reaction mixture was heat in microwave oven for 4h<sup>10</sup>. After cooling a pale yellow coloured crystalline solid was separated out. It was filtered and washed with ethanol, crystallized from DMF and dried under reduced pressure at ambient temperature. The purity of ligand was checked by elemental analysis shown in Table 1. and m.p. It was also characterized by IR and <sup>1</sup>H NMR spectral studies. Yield:70%; m.p. 310°C

**Table1. Analytical data of the Ligands.**

| Ligand | Molecular Formula                                                 | Formula Weight | Color and nature   | Elemental Analysis |                 |                 |                  |                 |
|--------|-------------------------------------------------------------------|----------------|--------------------|--------------------|-----------------|-----------------|------------------|-----------------|
|        |                                                                   |                |                    | C% found (Cal.)    | H% Found (Cal.) | N% Found (Cal.) | Cl% Found (Cal.) | S% Found (Cal.) |
| HCAT   | C <sub>17</sub> H <sub>13</sub> N <sub>2</sub> O <sub>2</sub> SCl | 344.6          | Yellow Crystalline | 59.38 (59.19)      | 03.70 (03.77)   | 08.5 (08.12)    | 10.11 (10.30)    | 09.22 (09.31)   |

**Preparation of Complexes:**

All the metal complexes were prepared in a similar way by following method. To a hot solution of ligand HCAT (0.02M) in 25ml of ethanol a suspension of respective metal salts was added drop wise with constant stirring. The reaction mixture was in microwave oven for 4-6h. The precipitated complexes were filtered, washed with ethanol followed by ether

and dried over fused calcium chloride. Yield: 45-50%. The complexes are soluble in DMSO and DMF but insoluble in water and common organic solvents. The metal chloride content of complexes were analyzed by standard methods<sup>11</sup> The molecular weights of the complexes were determined by Rast method are shown in Table 2.

**Table 2. Analytical data and molar conductance of the compounds.**

| Compounds                                                               | Colour | Mol.wt. | Analysis % Found (calc.) |               |             |             |             | $\mu_{\text{eff}}$ B.M. | $\kappa M$ ( $\Omega^{-1} \text{cm}^2 \text{mol}^{-1}$ ) |
|-------------------------------------------------------------------------|--------|---------|--------------------------|---------------|-------------|-------------|-------------|-------------------------|----------------------------------------------------------|
|                                                                         |        |         | M                        | C             | H           | N           | Cl          |                         |                                                          |
| [CoL <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ]<br>H <sub>2</sub> O | Brown  | 800.1   | 7.25 (7.36)              | 50.86 (50.99) | 3.65 (3.74) | 6.86 (6.99) | 8.70 (8.87) | 4.48                    | 6.9                                                      |
| [NiL <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ]<br>H <sub>2</sub> O | Green  | 799.9   | 7.30 (7.33)              | 50.78 (51.00) | 3.68 (3.75) | 6.95 (7.00) | 8.72 (8.87) | 3.2                     | 7.9                                                      |
| [CuL <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ]<br>H <sub>2</sub> O | Brown  | 804.7   | 7.70 (7.89)              | 50.60 (50.70) | 3.65 (3.72) | 6.82 (6.95) | 8.72 (8.82) | 1.70                    | 8.3                                                      |

**3. Results and Discussion**

The Schiff base ligand HCAT and its complexes have been characterized on the basis of <sup>1</sup>H NMR, IR spectral data, elemental analysis, molar conductance, magnetic susceptibility measurements and thermogravimetric analysis data. All these values and analytical data is consistent with proposed molecular formula of ligand. All the compounds are coloured solid and stable in air. They are insoluble in water but soluble in coordinating solvents like DMF and DMSO. The molar conductance values in DMF (10<sup>-3</sup>M)

solution at room temperature (Table 2 ) shows all the complexes are non electrolytes<sup>11</sup>

The <sup>1</sup>H NMR spectra of ligand HCAT shows signals at  $\delta$  12.09, (1H, s phenolic OH ),  $\delta$  9.51 (1H, s, phenolic OH ),  $\delta$  7.55, 7.54, 7.53 and 7.52 (4H, m, phenyl)  $\delta$  6.81, 6.80, and 6.78(3H, s Phenyl), 6.68 (1H s thiophene), and 2.56(3H, s, methyl)<sup>12-15</sup> IR spectra of ligand and metal complexes shows  $\nu(\text{C}=\text{N})$  peaks at 1620cm<sup>-1</sup> and absence of C=O peak at around 1700–1750 cm<sup>-1</sup> indicates the Schiff base formation.<sup>16-19</sup> IR spectra of complexes are shown in Table 3.

**Table 3. IR spectra of ligand and metal complexes.**

| Compound                                                             | $\nu$ (O-H)<br>hydrogen<br>bonded | $\nu$ (C=N)<br>imine | $\nu$ (C-O)<br>phenolic | $\nu$ (M-O) | $\nu$ (M-N) | $\nu$ (C-S) |
|----------------------------------------------------------------------|-----------------------------------|----------------------|-------------------------|-------------|-------------|-------------|
| HCAT                                                                 | 3119                              | 1620                 | 1514                    | --          | --          | 1122        |
| [CoL <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] H <sub>2</sub> O | --                                | 1608                 | 1504                    | 470         | 430         | 1098        |
| [NiL <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] H <sub>2</sub> O | --                                | 1585                 | 1465                    | 468         | 422         | 1090        |
| [CuL <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] H <sub>2</sub> O | --                                | 1610                 | 1504                    | 509         | 410         | 1110        |

**Thermogravimetric studies:**

An analysis of TG curves of HCAT and its metal complexes show that the Co(II), Ni(II), and Cu(II), complexes decomposed in three stages, the ligand. The Co(II), Ni(II) and Cu(II), complexes are stable upto 70°C. Elimination of one water molecule from Co(II), Ni(II), Cu(II) complexes upto 130°C have been observed (%wt loss obs./calcd. Co(II) : 2.44/2.24; Ni(II) : 2.56/2.25; Cu(II) : 2.46/2.23; complexes. In the Co(II), Ni(II) and Cu(II) complexes there is further loss in weight upto 220°C indicating the presence of two

coordinated water molecule in each complex Co(II) : 4.57/4.49; Ni(II) : 4.59/4.50; Cu(II) : 4.58/4.47; <sup>20</sup> In the thermograms of ligand, Co(II), Ni(II) and Cu(II) complexes. The half decomposition temperature and the basic parameter calculated for the compounds are tabulated in Table 4. The relative thermal stability on the basis of half decomposition temperature is found to be Cu(II)>Co(II)>Ni(II)>HCAT

The Thermal activation energy (Table 4) was calculated by Freeman-Carroll,<sup>22</sup> Horowitz-metzger<sup>23</sup> and Broido<sup>24</sup> method

**Table 4: Thermal decomposition data of the complexes of HCAT**

| Compound                                                             | Half Decomposition Temperature (°C) | Activation Energy (kJ mole <sup>-1</sup> ) |       |        | Frequency Factor Z (sec <sup>-1</sup> ) | Entropy Change -ΔS (J mol <sup>-1</sup> K <sup>-1</sup> ) | Free Energy Change ΔF (kJ mol <sup>-1</sup> ) |
|----------------------------------------------------------------------|-------------------------------------|--------------------------------------------|-------|--------|-----------------------------------------|-----------------------------------------------------------|-----------------------------------------------|
|                                                                      |                                     | B*                                         | H-M** | F-C*** |                                         |                                                           |                                               |
| HCAT (LH)                                                            | 260.51                              | 3.27                                       | 5.45  | 4.36   | 87.25                                   | 212.55                                                    | 117.75                                        |
| [CoL <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] H <sub>2</sub> O | 433.50                              | 5.73                                       | 9.55  | 9.55   | 191.11                                  | 208.24                                                    | 156.67                                        |
| [NiL <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] H <sub>2</sub> O | 384.17                              | 4.13                                       | 8.26  | 3.30   | 66.03                                   | 216.60                                                    | 145.64                                        |
| [CuL <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] H <sub>2</sub> O | 494.86                              | 11.28                                      | 11.28 | 10.16  | 203.31                                  | 208.54                                                    | 170.28                                        |

\* Broido, \*\*Horowitz-Metzger and \*\*\*Freemenn-Carroll

**4. Conclusion**

The thermal decomposition in three stage decomposition. It is assumed that dehydration of the complexes containing water occurs

within an active reaction interface. The compensation effect of thermal decomposition of the complexes indicating the change of sample mass.

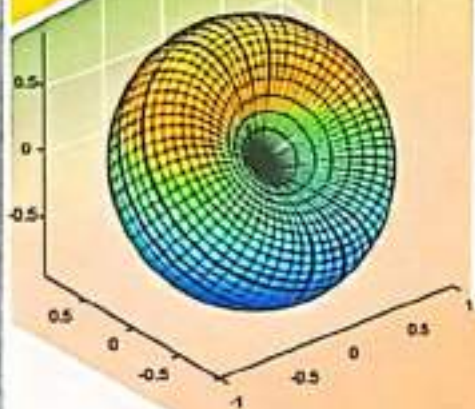
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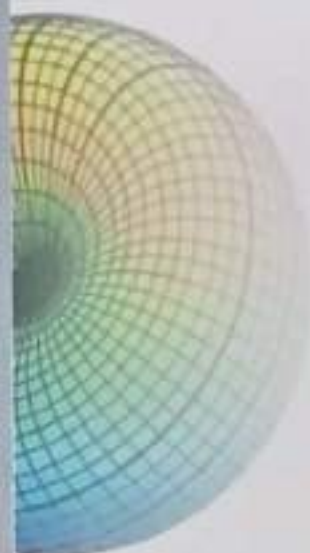
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# Ethnobotanical and Phytochemical Study of members of Cucurbitaceae from Ralegaon Region-A Review

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## Abstract:

The plant species belonging to Cucurbitaceae family have a worldwide distribution, but most species can be found in tropical and subtropical countries. A number of the plants belonging to this family have reported important and biological pharmacological activities. Cucurbitaceae member plants are also in use in the folk medicinal system of India. The members of the Cucurbitaceae are annual or perennial herbaceous plants having climbing habit with characteristic tendrils. Plants of this family have many medicinal and nutritional benefits. Therefore, it is important to find out the Ethnobotanical uses in rural region of Ralegaon area and containing active agents possessing pharmacological activity in plants. In this study, we have documented some of the important plants viz., *Citrullus lanatus*, *Lagenaria siceraria*, *Bryonia lacinosa*, *Cucumis sativa*, *Coccinia grandis*, *Cucurbita pepo*, *Momordica dioica*, *Momordica charantia*, *Cucumis callosus*, and *Luffa acutangula* located in Ralegaon region.

**Keywords:** Cucurbitaceae, Medicinal, Ralegaon region.

## Introduction

Ralegaon is tehsil place, town in Yavatmal District of Maharashtra. It includes 146 villages, covered 762 km<sup>2</sup> areas. Most of the area of ralegaon taluka is covered by forest. A number of villages are situated at edge of the forest. So, the population is mainly rural and agriculture and agricultural labor are the major occupations of the rural people. <sup>[2]</sup> They use folk medicinal practices for the treatment of many diseases and illness which is found around us. Plants were used as remedies to cure many diseases and infections during ancient time. Medicinal plants are easily available, cheap and affordable. The plants have medicinal importance due to the presence of certain chemical substances that produce specific physiological actions on the human body. The most essential of these bioactive constituents of plants are alkaloids, tannins, saponins, flavonoids and phenolic compounds. <sup>[1]</sup> The gourd family, Cucurbitaceae is one of the most important family, which includes approximately 125 genera and 960 species. <sup>[3]</sup> The family Cucurbitaceae includes a large group of cultivating crops like cucumbers, watermelon, luffa, etc. and medicinally important plants like bottle gourd (Lavki), bitter gourd (Karela) etc. which are medicinally important. The present study is to review the pharmacologically and biologically important plants and phytochemicals present in cucurbits and to understand their pharmacological activity

## Material & Method

A Systematic survey of the 10 species of family Cucurbitaceae growing throughout the Ralegaon region was carried out. To find out the traditional medicinal uses of this plants visited the tribals, rural population, and vaidus in the Ralegaon region. The information was collected from them about the plants of cucurbitaceae member used to treat diseases. Also phytochemical constituent's information was collected of those plants used for disease treatment. A literature review was conducted to study the phytochemistry & acknowledged.

## Result and Discussion

Ethnobotanical investigation and survey has led to the documentation of family cucurbitaceae plants used by tribals, rural people and vaidus for treatment of diseases like fever, infertility, heatstroke, worm infection etc. They gave information about their traditional medicinal applications in curing treatment of

various diseases. Out of 10 species, 10 were used medicinally, 9 were edible, for humans. The results of the present study are discussed below.

| Sr. No | Scientific Name of Plant                      | Common Name                                               | Phytochemicals                                                                                                                                                                                                       | Pharmaceutical and Biological activities                                                                                                                                                                                                               |
|--------|-----------------------------------------------|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | <i>Bryonia lacinosa</i> L.                    | Marble, Vine, Shivalingi, Shivaling                       | saponin molecules, flavonoids, phenolic acids, sugars, punicic acid, goniotalamin and glucomannan. The polysaccharides and fatty acids. <sup>[4]</sup>                                                               | Antimicrobial, antibacterial, analgesic, Anti-inflammatory, androgenic, antipyretic, antidiabetic, anti-asthmatic, anti-oxidant, anti-tumor <sup>[4]</sup>                                                                                             |
| 2      | <i>Citrullus lanatus</i> (Thunb.) Mat. & Nak. | Watermelon, Kharbuza, Tarabuuza, Tarabuuja.               | alkaloids, flavanoids, tannins, amino acids, carbohydrates, cardioglycosides, terpenoids, steroids, carotenoids, oils and fats, vitamins, Calcium, Iron, Magnesium, Phosphorus, Potassium, and Zinc. <sup>[10]</sup> | Antibacterial, antifungal, antimicrobial, antiulcer, antioxidant, anti-inflammatory, anti-hyperglycemic, anti-cancer, anti-diabetic, anti-hepatotoxic, anti-inflammatory, anti-helminthics, anti-virus, anti-bacterial, anti-microbial <sup>[10]</sup> |
| 3      | <i>Coccinia grandis</i> (L.) Voigt            | Ivy Gourd, Kundru, Tondli                                 | Steroid, carbohydrates, tannins, flavonoids, saponins, alkaloids b-amyryne, lupeol, cucubbitacin, cephalandrol, cephalandrine. <sup>[15]</sup>                                                                       | Antibacterial, Anthelmintic, Antioxidant, antiulcer, antimalarial, anti-inflammatory, antipyretic, analgesic, hypoglycaemic, antifungal, Anti-dyslipidemic, Antitussive, anticancer, antitussive, mutagenic activity. <sup>[14]</sup>                  |
| 4      | <i>Cucumis callosus</i> (Rottler) Cogn.       | Muskmelon, Sweetmelon                                     | alkaloids, carbohydrates, proteins/amino acids, glycosides, fixed oils & fats, phenolics, tannins, phytosterols, flavonoids, Saponins. <sup>[21]</sup>                                                               | antioxidant, anti-inflammatory, antidiabetic. <sup>[22]</sup>                                                                                                                                                                                          |
| 5      | <i>Cucumis sativus</i> L.                     | Cucumber, garden cucumber, apple cucumber, Khira, Kakadi, | Flavonoids, alkaloids, glycosides, saponins, tannins, terpenoids, carbohydrates, and sterols. <sup>[12]</sup>                                                                                                        | anti-bacterial activity, antifungal activity, cytotoxic activity, Antacid & Carminative activity, Activity against ulcerative colitis, Hepetoprotective activity, Hypoglycemic and. Hypolipidemic activity. <sup>[13]</sup>                            |
| 6      | <i>Cucurbita pepo</i> L.                      | Pumpkin, Field pumpkin, kaddu, Kohala, Bhopla             | Steroid, Protein, steroids, tannins, flavonoids, triterpenoids, phenols. <sup>[16]</sup>                                                                                                                             | Antitumor activities, Antimicrobial, Antioxidant, Hypoglycemic and hypolipidemic. <sup>[17]</sup>                                                                                                                                                      |
| 7      | <i>Lagenaria</i>                              | Bottle Gourd,                                             | Flavonoids, Protein,                                                                                                                                                                                                 | Analgesic and anti-inflammatory,                                                                                                                                                                                                                       |

|    |                                        |                                     |                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                      |
|----|----------------------------------------|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <i>siceraria</i> (Mol.) Standl.        | Bitter calabash gourd, Lauki, Dudhi | Triterpenes, Volatile essential oil, Carbohydrates. <sup>[11]</sup>                                                                                                      | Diuretic activity, Anthelmintic activity, Antihepatotoxic activity, Immunomodulatory activity, Antistress and adaptogenic property, Antimicrobia, Antioxidant. <sup>[11]</sup>                                                                                                                                                                                       |
| 8  | <i>Luffa acutangula</i> (L.) Roxb.     | Wild luffa, Ban turai, kadu-dodaki  | Proteins, Flavonoids, Anthraquinone, Fatty Acids, Saponin Triterpene. <sup>[20]</sup>                                                                                    | hepatoprotective, antidiabetic, antihyperlipidemic, antioxidant, anticancer, antibacterial, CNS depressant, immunomodulatory, and anti-ulcer activity. <sup>[20]</sup>                                                                                                                                                                                               |
| 9  | <i>Momordica charantia</i> L.          | Bitter Gourd, Karela, karali,       | Saponins, proteins, polypeptide, steroid, pyrimidine nucleoside. <sup>[19]</sup>                                                                                         | Anti-cancer, Antivirals, Analgesic Effects, Anti-inflammatory, Hypotensive action, Anti-fertility effects. <sup>[19]</sup>                                                                                                                                                                                                                                           |
| 10 | <i>Momordica dioica</i> Roxb. ex Willd | Ban Karela, Kartoli                 | Protein, lipid, fibre, carbohydrate, potassium, sodium, calcium, iron, zinc, fat, vitamins, alkaloids, steroids, triterpenoids, and saponins, flavonoids <sup>[18]</sup> | diuretic, laxative, hepatoprotective, antivenomous, anti-hypertensive, anti-inflammatory, anti-asthmatic, antipyretic, anti-leprosy, antidiabetic, and antidepressant properties but also its leaves have anti-helminthic, aphrodisiac, anti-hemorrhoidal, hepatoprotective, anti-bronchitic, antipyretic, anti-asthmatic, and analgesic properties. <sup>[18]</sup> |

### Conclusion

In the present study, we reviewed phytochemical constituents, pharmacological properties and medicinal uses of certain plant species of Cucurbitaceae in Ralegaon region. Different parts of the plants such as stem leaf, root, tuber, fruit and seed of the above members of this family have been studied extensively by many researchers. The ethnobotanical and phytochemical review undertaken in this plant family displayed multidisciplinary usage of these plants in curing of various types of diseases. Considering its huge phytochemical and variety of pharmacological activities, the Cucurbitaceae members could be proposed as good candidates for discovering new drugs as well as agriculture-based entrepreneurship.

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# A Multidisciplinary Approach to Higher Education

Volume - II

Edited By

Dr. Vikrant R. Wankhade

Dr. Khushal J. Alaspure

Dr. Akash V. More

Dr. Shrikant S. Mahulkar

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## Emerging interdisciplinary areas of physics in higher education and job opportunities

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### Abstract :

In the field of Physics job opportunity mostly associates with academic research and teaching roles. Also, it is considered as a pure science field and lack the skill-based job opportunities. This chapter highlights the wide range of industries and professions where physics graduates are in demand. The chapter illustrates the versatility and applicability of a physics degree with the emerging areas in the field of physics and its interdisciplinary nature. This chapter's purposes to inform and motivate students planning to do a career in physics. In recent years, the field of physics has expanded beyond traditional boundaries, leading to the emergence of several interdisciplinary areas. These areas combine principles of physics with other scientific disciplines, technology, and industry applications, creating exciting new opportunities for physicists. Below, we explore some of these emerging interdisciplinary fields along with potential career paths and typical employers for each.

**Keywords :** Interdisciplinary, Biophysics, Composite Multifunctional Materials, Emergent Materials, Medical Physics, Quantum Computing.

### Introduction :

Physics is a fundamental science which studies the behaviour of matter and energy in the universe. It has been a foundation of scientific discovery for centuries and has contributed to our understanding of the natural world. The rapid development of technology and the increasing complexity of contemporary challenges have expanded the horizons of traditional physics. This expansion has created new interdisciplinary fields.

Physics is the field that is primarily focused on academic research and teaching. However, this perception is far from the truth. Physics graduates possess a diverse set of skills and knowledge that make them highly desirable in a wide range of industries and professions. Graduate students who study the fundamental concepts of physics are in demand and needed in many fields including aerospace, agriculture, healthcare, transportation and many more.

Interdisciplinary areas of physics are fields that integrate knowledge and techniques from multiple branches of physics and other disciplines. These emerging areas have opened up exciting opportunities for physicists to apply their skills and knowledge in a varied field, including engineering, biology, chemistry, medicine, and even social sciences.

A Physics degree demands proficiency in mathematics and critical thinking, also have curiosity to learn unknown. But first one must grasp the fundamentals of physics professions as well as the necessary educations. In India, Students aspiring for careers in science and technology typically pursue 12th-grade science with physics as a compulsory subject, followed by Bachelor of Science, M.Sc. in physics, and potentially Ph.D. studies, with interdisciplinary options also available.

The interdisciplinary areas include nanoscience and nanotechnology, biophysics, Astrophysics, quantum information science, environmental physics, nuclear physics, renewable energy technology, and many more. In this chapter we are concentrating on the emergent interdisciplinary field which includes Biophysics, Electronic and Magnetic Composite Multifunctional Materials, Emergent Materials, Medical Physics, Quantum Computing Artificial Intelligence and Physics.

1. **Biophysics :** Biophysicists apply principles of physics, chemistry, and biology to study complex biological systems at the molecular and cellular levels. They use tools and techniques such as microscopes, spectroscopy, and computer modelling to understand the physical and chemical properties of biological systems. A Ph.D. in physics, biophysics, or a related field is typically required for research positions, while a bachelor's or master's degree is sufficient for some applied research roles. This interdisciplinary field explores phenomena such as protein folding, molecular dynamics, and biomechanics, with applications in areas like drug discovery, medical diagnostics, and biotechnology.

- **Study Path :** Graduates typically pursue advanced degrees (Masters or PhD) in biophysics, biochemistry, or related fields.

- **Typical Employers :** Pharmaceutical companies, biotechnology firms, research institutions, and academic universities. Organizations such as Abbott Laboratories, Johnson & Johnson, Merck, Reliance life sciences, Dr. Reddy's labs, Cipla, Jubilant life sciences, Wockhardt, Torrent pharma, Cadila healthcare and Ranbaxy and Pfizer etc. hire such postgraduates.
2. **Electronic and Magnetic Composite Multifunctional Materials :** Electronic and magnetic composite materials are a class of multifunctional materials that combine the properties of both electronic and magnetic materials. Electronic materials conduct electricity, while magnetic materials possess the ability to generate a magnetic field. By combining these two properties, electronic and magnetic composite materials offer unique and desirable functionalities such as tunable electrical conductivity and magnetic response, which can be controlled by external stimuli such as temperature, light, or magnetic field. These are meant for performing a variety of functions apart from the primary structural function which provides structural functions such as strength, stiffness, stability while non-structural functions provide energy harvesting, self-healing capability, sensing and actuation and sometimes acts as a protective layer. Researchers in this field explore applications in electronics, spintronics, data storage, and renewable energy technologies.
    - **Study Path :** Graduates may pursue advanced degrees in materials science, condensed matter physics, or electrical engineering.
    - **Typical Employers :** Semiconductor companies, electronics manufacturers, research laboratories, and academic institutions. Organizations such as Micron Technologies, AMD, NXP, Samsung, MosChip, Applied Materials, Broadcom, etc.
  3. **Emergent Materials :** Emergent materials refer to substances that exhibit extraordinary properties that cannot be explained by the individual behavior of their constituent elements, but rather arise from the collective behavior of these elements. This interdisciplinary field explores phenomena such as superconductivity, topological insulators, and quantum materials, with applications in quantum computing, energy storage, and advanced electronics.
    - **Study Path:** Graduates often pursue advanced degrees in materials science, condensed matter physics, or quantum physics.
    - **Typical Employers :** Research institutions, technology companies, government laboratories, and academic universities.
  4. **Medical Physics :** Medical physics applies principles of physics to healthcare, with a focus on diagnostic imaging, radiation therapy, and medical instrumentation. This interdisciplinary field plays a vital role in cancer treatment, medical imaging technology, and radiation safety in healthcare. It involves the use of physics to develop and improve diagnostic and therapeutic techniques in medicine. The field encompasses a wide range of applications, including diagnostic imaging, radiation therapy, and medical instrumentation.
    - **Study Path :** Graduates may pursue advanced degrees in medical physics, biomedical engineering, or radiation oncology. Certificate course after graduation and postgraduation in physics.
    - **Typical Employers :** Hospitals, cancer treatment centers, medical device companies, and academic medical centers like AIIMS, Fortis, etc.
  5. **Quantum Computing :** Quantum information science is an emerging interdisciplinary field that combines quantum physics, computer science, and mathematics to process and store information. It explores the potential of quantum mechanics to revolutionize computing, cryptography, and communication. Quantum computers, based on the principles of quantum mechanics, offers to solve complex problems that are beyond the capabilities of classical computers.
    - **Study Path :** Graduates often pursue advanced degrees in quantum physics, computer science, or electrical engineering with a focus on quantum computing.
    - **Typical Employers :** Research laboratories, government agencies, and academic institutions and private companies, such as tech giants like Google and IBM. They can also work as consultants, data analysts, and software developers in various industries, such as finance, healthcare, and cybersecurity.
  6. **Artificial Intelligence and Physics :** In terms of applying and creating AI technology, physicists are at the forefront. Physicists have been using AI techniques for data analysis and pattern recognition for decades. However, recent advancements in AI technology, such as machine learning and deep learning, have opened up new possibilities for solving complex problems in physics. By combining the power of artificial intelligence, big data and powerful computing capabilities with the laws of physics, researchers can develop new models, algorithms, and technologies that can have a significant impact on various fields such as astrophysics, particle physics, and materials science.

- **Study Path :** Graduates may pursue advanced degrees or certificate course in Artificial intelligence and machine learning
- **Typical Employers :** Research laboratories, government agencies, and academic institutions and work as a data scientist in private companies

#### Conclusion :

In conclusion, the field of physics offers a wide range of opportunities beyond academic research and teaching roles. As demonstrated by the job roles examined in this chapter, physics expertise is in demand in various industries and professions. From nuclear physics to medical science, physics plays a crucial role in solving complex problems and advancing technology. As such, a degree in physics can lead to a diverse and fulfilling career path. Whether pursuing a bachelor's, master's, or Ph.D., individuals with a passion for physics have the potential to excel in a variety of fields and make a significant impact on the world. As these fields continue to grow and evolve, it is essential for physicists to keep an open mind and adapt to the changing landscape of the field.

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# Holographic Dark Energy Model by Sharma and Mittal with Bouncing Scenario

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## Abstract :

In a flat FRW universe, the bouncing model is studied in the presence of Sharma-Mittal Holographic Dark energy. The equation of state (EoS) parameter for the SMHDE model describes the ironic behavior of the universe. The kinematic and physical characteristics of the models are analyzed in detail.

## Keywords :

FRW metric, SMHDE, Bouncing scenario.

## Introduction :

A persistent physical enigma is the character of the expanding universe linked to a strange energy source known as dark energy (DE). Large-scale structure, cosmic microwave background anisotropies, and observations of type-Ia supernovae provide evidence for this expansion. Quintessence, K-essence, tachyon, phantom, ghost condensate, quintom, Chaplygin gas models, and agegraphic DE models are a few contenders that fit the DE criteria [1-15]. The HDE has been thoroughly examined in the literature and is a good candidate for DE. Its foundation is the holographic principle, which claims that a system's number of degrees of freedom scales with area rather than volume. According to research by Cohen et al., the DE must adhere to the holographic principle and be limited by the infrared (IR) cut-off. Li has looked at the Hubble horizon, the future event horizon, and the particle horizon as potential candidates for the IR cutoff. She has also demonstrated that only the future event horizon can give the cosmos the necessary acceleration. Sheykhi [16] created the Hubble horizon HDE model and contended that, with the aid of DE and cold dark matter (CDM) interaction, this model could account for the current condition of the universe. In order to identify the evolution of the universe under the assumption that it is occupied by both cold dark matter and interrelating dark energy, new holographic dark energy models, THDE, RHDE, and SMHDE, have recently been established using an inventive formulation for entropy combined with the holographic principle (see Ref. [17]).

In this study, we looked into the General Theory of Relativity in relation to the bouncing model. The main goal of this paper is to study the bouncing conducts at an early era and the cosmic speed singularity in late time. In the framework of a flat FRW world, the bouncing model is examined in the presence of Sharma-Mittal Holographic Dark Energy (SMHDE).

## Metric and Field Equations :

A flat FRW metric is given by

$$ds^2 = dt^2 - a^2(t)(dx^2 + dy^2 + dz^2), \quad \dots(1)$$

where  $a(t)$  is the scale factor and is a function of  $t$ . The Einstein field equations in General Relativity are written as follows:

$$R_{ij} - \frac{1}{2}g_{ij}R = -(T_{ij} + \bar{T}_{ij}), \quad \dots(2)$$

The energy momentum tensor for matter and DE is defined as  $T_{ij} = \rho_m u_i u_j$ ;  $\bar{T}_{ij} = (\rho_{de} + p_{de})u_i u_j - g_{ij}p_{de}$ , where  $\rho_m$  and  $\rho_{de}$  are the energy density of matter and DE density, respectively, and  $p_{de}$  is the pressure of the DE, while the equation of state (EoS) is defined as

$$\omega_{de} = \frac{p_{de}}{\rho_{de}}. \text{ The field equations for the metric (1) are}$$

obtained as:

$$3H^2 = \rho_m + \rho_{de}, \quad \dots(3)$$

$$2H + 3H^2 = -p_{de}. \quad \dots(4)$$

## Bouncing Cosmology :

Imagine a symmetric bounce across the scale factor  $a = e^{\gamma t}$ , in which  $\gamma$  a positive constant parameter governs the cosmic expansion. The Hubble parameter is computed as  $H = \frac{\dot{a}}{a} = 2\gamma t$ . The scale factor behaves symmetrically at the bouncing point. There is a

chance that there will be a null Hubble parameter value at the bouncing epoch because the scale factor value does not disappear at the bouncing point. In the bouncing model, there is a bounce that moves the Hubble parameter linearly from the contracting universe to the expanding universe. This formula can be used to determine the deceleration parameter:

$$q = -1 - \frac{\ddot{H}}{H^2} = -1 - \frac{1}{2\gamma t^2}. \quad \dots(5)$$

It is important to note that the deceleration parameter tends to a constant value of  $-1$  after a finite length of time and has a negative value for both contracting and expanding worlds. The deceleration parameter goes to large negative values close to the bouncing point even after leaving the negative time zone (contracting universe). In the expanding universe, the deceleration parameter tends to at late times in the positive frame of cosmic time.

#### Sharma-Mittal Holographic Dark Energy (SMHDE):

In [18-20], the authors defined as they provided a two-parametric entropy

$$S_{\text{Sharma-Mittal}} = \frac{\left( \delta \frac{A}{4} + 1 \right)^{\frac{R}{\delta}} - 1}{R}. \quad \dots(6)$$

Here  $A = 4\pi L^2$ ,  $R$  is free parameter and  $L$  is the IR cutoff. The Sharma-Mittal entropy becomes Renyi entropy in the limit  $R \rightarrow 0$ . Similarly, in the limit  $R \rightarrow 1 \rightarrow \delta$ , the Sharma-Mittal entropy becomes Tsallis entropy. Cohen et. al. [21] recommended the energy

density  $\rho_{\text{sh}} \propto \frac{S_{\text{Sharma-Mittal}}}{L^4} \Rightarrow \rho_{\text{sh}} = \frac{3C^2 S_{\text{Sharma-Mittal}}}{8\pi L^4}$ . By considering the Hubble horizon to be the system's infrared cutoff, i.e.,  $L = H^{-1}$ , the Sharma-Mittal HDE density is

$$\rho_{\text{sh}} = \frac{3C^2 H^4}{8\pi R} \left[ \left( 1 + \frac{\pi\delta}{H^2} \right)^{\frac{R}{\delta}} - 1 \right] \text{ implies}$$

$$\rho_{\text{sh}} = \frac{6C^2 \gamma^4 t^4}{\pi R} \left[ \left( 1 + \frac{\pi\delta}{4\gamma^2 t^2} \right)^{\frac{R}{\delta}} - 1 \right].$$

The energy density of matter is

$$\rho_m = 12\gamma^2 t^2 - \frac{6C^2 \gamma^4 t^4}{\pi R} \left[ \left( 1 + \frac{\pi R}{4\gamma^2 t^2} \right)^{\frac{R}{\delta}} - 1 \right]. \quad \dots(7)$$

The EoS parameter of SMHDE is

$$\omega_{\text{sh}} = \frac{-(4\gamma + 12\gamma^2 t^2)}{6C^2 \gamma^4 t^4 \left[ \left( 1 + \frac{\pi R}{4\gamma^2 t^2} \right)^{\frac{R}{\delta}} - 1 \right]}. \quad \dots(8)$$

In both contracting and expanding universes with regard to cosmic time, the SMHDE energy density stays positive throughout the cosmic evolution. Near the bounce, the energy density exhibits a symmetric behaviour for all selected values of  $\beta$  and  $\delta$ . Next to the bouncing point, the EoS parameter progresses to exhibit symmetric behaviour. Generally speaking, the EoS parameter jumps from the phantom region  $\omega < -1$ , traverses the vacuum DE (CDM) model  $\omega = -1$ , and matter dominated period, and then overlaps with a quintessence zone  $\omega > -1$  in both wings of the bouncing epoch. In terms of movement away from the bouncing point, the EoS parameter is seen to advance in the phantom region.

#### Jerk parameter :

The Jerk parameter is defined as the third derivative of the scale factor with respect to cosmic time.

$j(t) = \frac{1}{H^2} \frac{\ddot{a}}{a} = q + 2q^2 - \frac{\dot{q}}{H}$ . The jerk parameter for the  $\Lambda$ CDM model has the value  $j = 1$ .

$$\text{The jerk parameter is } j(t) = 1 + \frac{3}{2\gamma t^2}. \quad \dots(9)$$

The parameter's value  $\gamma$  determines the jerk parameter. The jerk parameter has a solitary value because of the Hubble rate's disappearing nature at the bouncing point. The jerk parameter decreases to negligible levels near one when the bounce is indefinitely far away.

#### Discussion and Concluding remarks :

The flat FLRW model with an accurate form of the Hubble parameter, a function of cosmic time  $t$  was examined in this work. From a contracting to an expanding cosmos, the Hubble parameter increases linearly through at bounce. The deceleration parameter increases from small negative values close to the bounce to big negative values in the negative domain. It shifts from extremely negative values to late times in the positive domain. Bouncing cosmology offers a method to explain the singularity problem that appears in the standard astrophysical model, which is its main advantage.

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# Accelerating Magnetized Strange Quark Cosmological model for Bianchi type I (Kasner metric) in modified gravity

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## ABSTRACT :

In this paper, we have explored magnetized strange quark matter (MSQM) solutions for the Bianchi-I Kasner metric in  $f(R, T)$  gravity. The Bianchi-I Kasner type metric with magnetized strange quark matter (MSQM) distribution in  $f(R, T)$  gravity is considered, where  $R$  is the Ricci scalar and  $T$  the trace of matter source. For examination, the function  $f(R, T) = f_1(R) + f_2(T)$  with the cosmological constant  $\Lambda$  is selected. We discovered that the strings are there in the early phases of the universe's evolution and vanish with the passage of time. The action of the string may be the cause of the fluctuation in the equation of state (EoS) parameter  $p = -\rho$ . We discover that the string tension is constant throughout the evolution of cosmos. Magnetic field is not observed in our solutions.

## Keywords :

Kasner metric, magnetized strange quark matter, modified theories of gravitation.

## 1. Introduction :

One of the most significant mysteries of cosmology is the discovery of cosmic fast expansion, which has been verified over the past 20 years by a variety of observations. Dark energy (DE), a negative-pressure energy, is thought to be the source of cosmic acceleration. Rather of relying on the mysterious concept of DE, changed theories of gravity, which are only extensions of general relativity can be used to reproduce the dynamics that characterise the expanding cosmos. As a reasonable explanation for dark energy and the universe's expansion, these hypotheses are attracting the attention of an increasing number of individuals. A number of ideas, each with an unique importance, including  $f(R)$  theory [1], Brans-Dicke cosmology [2],  $f(T)$   $f(T)$  gravity [3], and others. A fascinating extension of GR which has received a lot of

interest recently is the  $f(R, T)$  theory of gravity, one of the various modified theories of gravitation put forward by Harko et al. [4]. The gravity theory, represented by  $f(R, T)$ , may give an explanation for the universe's late-time cosmic acceleration. Assuming an auxiliary scalar field along with two known forms of scale factor, Houndjo et al. were able to demonstrate a transition from the matter-dominated era to an accelerated era by re-establishing  $f(R, T) = f(R) + f(T)$  [5]. In  $f(R, T)$  gravity theory, Sharif and Zubair have studied the law of thermodynamics [6]. Recent findings show that magnetic fields exist in galaxy clusters, pulsars, and neutron stars [7]. Even if the majority of their genesis is still unknown, magnetic fields were crucial to the creation of structures in the early cosmos. In this study, we employ  $f(R, T)$  for the Kasner metric to relate magnetic fields to strange quark matter in gravitational models.

Large-scale observations reveal the cosmos to be homogenous and isotropic. The isotropy of a pre-recombination epoch is not supported by any observed evidence. The observed local anisotropies in galaxies, clusters, and superclusters prompted the investigation of anisotropic models [8]. The Kasner metric is invariant under an abelian translation group in three dimensions. The Kasner solution, which Taub developed, depicts an idealised universe expanding in a more anisotropic way. The Kasner solution is essential to the study of temperature isotropy, primordial nucleosynthesis, magnetic field evolution, big particle survivability, inflation and anisotropy in the creation of quantum particles, and statics of the microwave background, as stated by Palathansis et al. [9]. Clifton studies the existence of solutions in higher order theories [10]. The Kasner solution in  $f(T)$  cosmology has been examined by Skugoreva and Toporensky [11]. Furthermore, in order to get precise cosmological solutions in the fourth order gravity theory, Clifton and Barrow have examined the initial singularity using the Kasner metric [12]. Gao and Shen found a new method for solving static and solutions with spherical symmetry for  $f(R)$  theory of gravity [13]. The Killing tensors were used by Paliathansis to develop new integrable  $f(R)$

models [14]. Camanho et al. [15] have explored pure Lovelock equations for the Kasner measures.

Alternative theories and solutions for quark along with strange quark matter (SQM) in GR theory are included in various studies in the literature and several modified theories have been examined by Yilmaz et al. [16–19]. Gholizade et al.'s investigation on the geometry and thermodynamics of SQM is available [20]. Several researchers have investigated SQM for different cosmological models [21–26]. Based on observations of type Ia Supernovae, the behaviour of SQM combined with magnetic epoch suggests a faster expansion of the cosmos [27]. Aktas and Aygun used reconstructed  $f(R, T)$  gravity to study the development of the MSQM distribution in the FRW universe [28]. The MIT bag model is considered to be most effective qualitative models for quark confinement [34].

In this paper, the Bianchi-I Kasner type metric with magnetized strange quark matter (MSQM) dissemination in  $f(R, T)$  gravity with cosmological constant  $\Lambda$  is considered. This is how the paper is organised. Section 2 includes gravitational field equations of  $f(R, T)$  gravity. The Space-time Metric of the Kasner type and Solution to the Field equations are covered in section 3. At last, section 4 includes the discussion and conclusions.

## 2. Gravitational field equations of $f(R, T)$ gravity :

In  $f(R, T)$  gravity, the action is given by

$$s = \int \left( \frac{1}{16\pi} f(R, T) + L_m \right) \sqrt{-g} d^4x \quad \dots(1)$$

$L_m$  is matter Lagrangian,  $g$  is the determinant of  $g_{ij}$ . The function  $f(R, T)$  is determined by the Ricci scalar  $R$  and the trace  $T$  of the matter source's energy-momentum tensor  $T_{ij}$  and  $T_{ij}$  is defined as

$$T_{ij} = \frac{2}{\sqrt{-g}} \frac{\partial (-g L_m)}{\partial g^{ij}} \quad \dots(2)$$

The Lagrangian  $L_m$  is only depends upon  $g_{ij}$  and independent on its derivatives and hence reduces to

$$T_{ij} = g_{ij} L_m \quad \dots(3)$$

The gravity field equations for  $f(R, T)$  can be determined by varying the action (1) in accordance with the metric tensor components  $g_{ij}$ .

$$f_{,R}(R, T) R_{ij} - \frac{1}{2} f(R, T) g_{ij} + (g_{ij} \nabla^k \nabla_k - \nabla_i \nabla_j) f_{,T}(R, T)$$

$$f_{,R}(R, T) = 8\pi T_{ij} - f_{,T}(R, T) T_{ij} - f_{,T}(R, T) \Xi_{ij} + \Lambda g_{ij} \quad \dots(4)$$

where, the covariant derivative is

$$\nabla_i f_{,R}(R, T) = \frac{\partial f_{,R}(R, T)}{\partial R}, \quad f_{,T}(R, T) = \frac{\partial f(R, T)}{\partial T}$$

$$\text{and } \Xi_{ij} = -2T_{ij} + g_{ij} L_m - 2g^{kl} \frac{\partial^2 L_m}{\partial g^{ij} \partial g^{kl}}.$$

The Bianchi type-I Kasner space-time is

$$ds^2 = dt^2 - t^{2p_1} dx^2 - t^{2p_2} dy^2 - t^{2p_3} dz^2 \quad \dots(5)$$

Where,  $p_1, p_2, p_3$  are parameters satisfying condition

$p_1 + p_2 + p_3 = s$  and  $p_1^2 + p_2^2 + p_3^2 = \theta$ . It is necessary that the parameters  $p_1, p_2, p_3$  be constants and the space is anisotropic if two out of the three are different.

We consider We take MSQM as the gravitational source. We consider the energy momentum tensor as taken in [28,29] which can be expressed as

$$T_{ij} = (p + \rho + h^2) u_i u_j + \left( \frac{h^2}{2} - p \right) g_{ij} - \square_i \square_j \quad \dots(6)$$

where  $p$  is the pressure,  $\rho$  is the energy density,  $h^2$  is magnetic flux and  $u_i$  is the four velocities. We consider magnetic flux in the x-axis direction of that satisfies  $u_i u^i = 0$  [7,28].

Therefore, under this theory, we may derive many theoretical models for each option of  $f(R, T)$ , based on the type of the matter source. According to Harko et al. [4], there are three distinct forms of  $f(R, T)$ .

$$f(R, T) = \begin{cases} R + 2f(T) \\ f_1(R) + f_2(T) \\ f_1(R) + f_2(T)f_3(R) \end{cases} \quad \dots(7)$$

The model  $f(R, T) = f_1(R) + f_2(T)$  for MSQM with a Bianchi type-I Kasner space-time and a cosmological constant  $\Lambda$  is examined in this study.

## 3. Field equations for $f(R, T) = f_1(R) + f_2(T)$ model with $\Lambda$

We consider the model  $f(R, T) = f_1(R) + f_2(T)$  in Eq. (4),  $f(R, T)$  theory's modified field equations with a cosmological constant  $\Lambda$ , we obtain

$$f'_{,1}(R) R_{ij} f_{,1}(R) g_{ij} + (g_{ij} \nabla^k \nabla_k - \nabla_i \nabla_j) f_{,1}(R) R_{ij} \\ = 8\pi T_{ij} - f'_{,2}(T) T_{ij} + \left( f'_{,2}(T) + \frac{1}{2} f_{,2}(T) \right) g_{ij} + \Lambda g_{ij} \quad \dots(8)$$

We choose the arbitrary function  $f'_{,1}(R) = \mu R$  and  $f_{,2}(T) = \mu T$ , here  $\mu$  is constant.

Using above condition in Eq. (8), we get

$$R_0 - \frac{1}{2} R g_{\nu\nu} = \left( \frac{8\pi + \mu}{\mu} \right) T_{\nu\nu} + \left( \frac{\rho}{2} - \frac{p}{2} + \Lambda \right) g_{\nu\nu} \quad \dots(9)$$

Using co-moving coordinates, field equations of  $f(R, T)$  gravity for the given metric (5) are obtained as

$$t^{-2} [p_1(s-1) - l_0] = - \left( \frac{8\pi + \mu}{2\mu} \right) h^2 - \left( \frac{16\pi + 3\mu}{2\mu} \right) \rho + \frac{\rho}{2} + \Lambda \quad \dots(10)$$

$$t^{-2} [p_2(s-1) - l_0] = - \left( \frac{8\pi + \mu}{2\mu} \right) h^2 - \left( \frac{16\pi + 3\mu}{2\mu} \right) \rho + \frac{\rho}{2} + \Lambda \quad \dots(11)$$

$$t^{-2} [p_3(s-1) - l_0] = - \left( \frac{8\pi + \mu}{2\mu} \right) h^2 - \left( \frac{16\pi + 3\mu}{2\mu} \right) \rho + \frac{\rho}{2} + \Lambda \quad \dots(12)$$

$$t^{-2} \left[ \frac{1}{2} (\theta - s^2) \right] = 3 \left( \frac{8\pi + \mu}{2\mu} \right) h^2 - \frac{\rho}{2} \left( \frac{16\pi + 3\mu}{2\mu} \right) \rho + \Lambda \quad \dots(13)$$

where,  $l_0 = \frac{1}{2} (s^2 - 2s + \theta)$ .

Using Eqs. (10) and (12), we get  $p_1 = p_3$ . For this value, the above system of Eqs. (10)-(13) reduces to the following equations:

$$t^{-2} [p_1(s-1) - l_0] = - \left( \frac{8\pi + \mu}{2\mu} \right) h^2 - \left( \frac{16\pi + 3\mu}{2\mu} \right) \rho + \frac{\rho}{2} + \Lambda \quad \dots(14)$$

$$t^{-2} [p_2(s-1) - l_0] = - \left( \frac{8\pi + \mu}{2\mu} \right) h^2 - \left( \frac{16\pi + 3\mu}{2\mu} \right) \rho + \frac{\rho}{2} + \Lambda \quad \dots(15)$$

$$t^{-2} \left[ \frac{1}{2} (\theta - s^2) \right] = 3 \left( \frac{8\pi + \mu}{2\mu} \right) h^2 - \left( \frac{16\pi + 3\mu}{2\mu} \right) \rho + \Lambda \quad \dots(16)$$

#### 4. Solutions of Field Equations

We have the set of field equations (14-16) with four unknowns  $h^2, \rho, p, \Lambda$  and three Equations. While more conditions are required to solve the system entirely, we adopt the Equation of State (EoS) of MSQM in the following form:

$$p = \frac{\rho - 4B}{3} \quad \dots(17)$$

where B is bag constant as taken in [33].

There have been many different range values used to describe it. Chakraborty et al. observed that the

value of B varies between 60 and 80 MeV(fm)<sup>-3</sup>. Once more, in equilibrium, B has a value of (150 MeV)<sup>4</sup> at zero temperature [36]. Chamel et al. Considered Bag constant values to be 78.6, 65.5, " and " 56.7 MeV(fm)<sup>-3</sup>, see [37]. The value of B considered as 60 MeV(fm)<sup>-3</sup> by P. K. Sahoo et al. [26]. In this paper we consider B=78 MeV(fm)<sup>-3</sup>

Using Eqs. (14)-(17), we obtain the magnetic flux, energy density, pressure and cosmological constant as follows

$$h^2 = \left\{ \frac{\mu(p_2 - p_1)(s-1)}{(8\pi + \mu)} \right\} t^{-2} \quad \dots(18)$$

$$\rho = B + \frac{3\mu}{4(8\pi + \mu)} \left\{ \frac{(\theta - s^2)}{2} - (2p_2 - p_1)(s-1) + l_0 \right\} t^{-2} \quad \dots(19)$$

$$p = -B + \frac{\mu}{4(8\pi + \mu)} \left\{ \frac{(\theta - s^2)}{2} - (2p_2 - p_1)(s-1) + l_0 \right\} t^{-2} \quad \dots(20)$$

$$\Lambda = - \left( \frac{8\pi + \mu}{\mu} \right) B + \left\{ \left( \frac{\mu}{8\pi + \mu} \right) (\theta - s^2) + \left( \frac{\mu p_2 + (12\pi + \mu) p_1}{16\pi + 2\mu} \right) (s-1) - \frac{(6\pi + \mu)}{(8\pi + \mu)} l_0 \right\} t^{-2} \quad \dots(21)$$

The behaviour of these obtained quantities (18)-(21) versus cosmic time (t) are presented in the Figs. 1-4. As depicted in the Fig.1, the magnetic flux varies from very small negative value and eventually vanishes at late times and hence the influence of a magnetic field is not shown in our model. The graphical presentation of density ( $\rho$ ) versus cosmic time (t) is depicted in the Fig. 2 illustrates that density decreases from a positive value and consequently becomes constant with passage of cosmic time (t). In the Fig. 3, the plot of pressure (p) against cosmic time (t) is depicted from which we observed that the pressure (p) is negative during the evolution of cosmos and this indicates that the expansion of universe is happening in faster way. The value of cosmological constant  $\Lambda$  is negative.

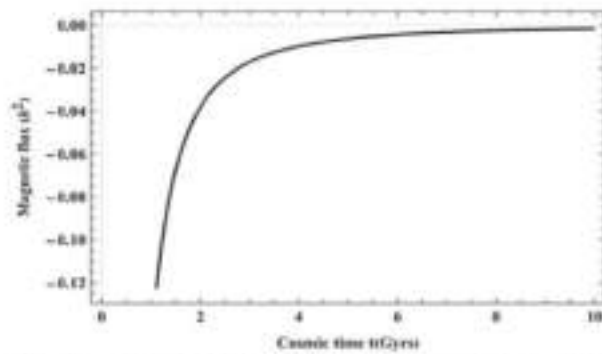


Fig. 1 : Magnetic flux ( $h^2$ ) versus cosmic time ( $t$ ).

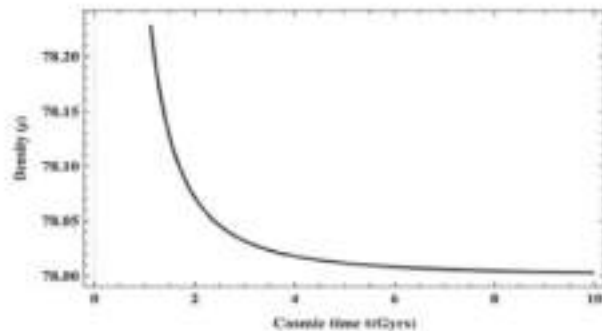


Fig. 2 : Plot of density ( $\rho$ ) versus cosmic time ( $t$ ).

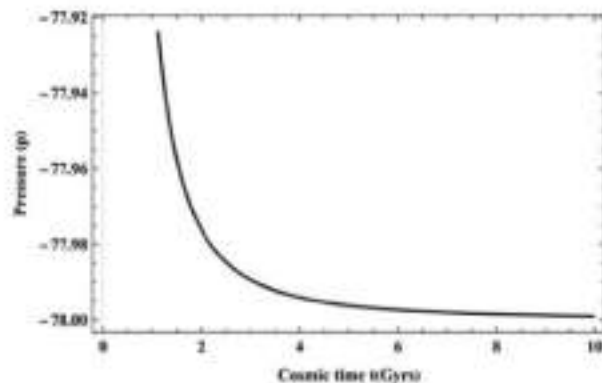


Fig. 3 : Plot of Pressure ( $p$ ) versus cosmic time ( $t$ ).

The Fig. 4 represents the behaviour of EoS parameter ( $\omega$ ) versus cosmic time ( $t$ ). It fluctuates from the quintessence dark era to a constant value that is almost equal to -1, acting similarly to the cosmological constant ( $\Lambda$ ), which is a good fit to describe the behaviour of DE since our derived model eventually becomes the  $\Lambda$ CDM model.

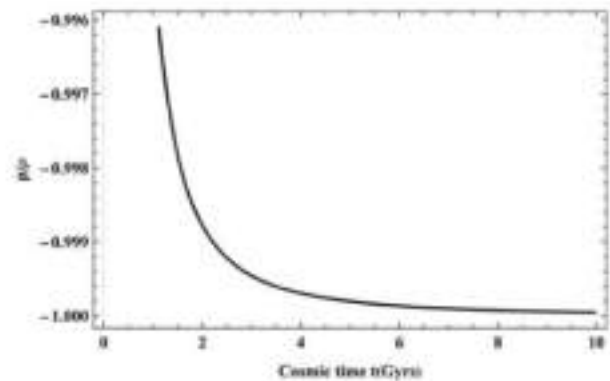


Fig. 4 : Plot of EoS parameter ( $\omega$ ) versus cosmic time ( $t$ ).

## 5. Conclusions :

The cosmological model we have described in this study has magnetised weird quark matter and a linear version of  $f(R,T) = f_1(R) + f_2(T)$  for  $f(R,T)$  gravity. Accurate solutions for the field equations are acquired. It may be observed that the magnetic flux has greater impacts in the early cosmos and that these effects eventually diminish in later stages. The bag constant has a major effect on how fast the universe is expanding. The way we discuss, shows that for our model,  $p \rightarrow -B$  at late time. In this case, the negative sign denotes the universe's late-time expansion. Therefore, more expansion is caused by bigger bag constant values. Energy density of the model rises positively to the bag constant at  $p \rightarrow \infty$ . According to the finding, in the context of the universe's accelerating expansion, the dark energy is the cause of the negative pressure. Thus, the SQM and magnetic field suggest that dark energy may exist in the cosmos and provide evidence for the type Ia Supernovae findings [39]. Also, we found that  $p \rightarrow -\rho$  dark energy model for  $f(R,T)$ . We observed that  $p \rightarrow -B$ ,  $\rho \rightarrow B$  for  $t \rightarrow \infty$ . In the theories under discussion, the cosmological constant, pressure, and energy density all remain constant at late time.

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# Dynamic Analysis of Renyi Holographic Dark Energy with Granda–Oliveros IRCut-off

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## Abstract :

This work examines the Hypersurface-homogeneous cosmological model within the context of gravity, using Renyi holographic dark energy (RHDE). To get exact solutions for the field equations, it is assumed that the shear scalar is proportional to the expansion scalar. Accounting for the time-varying deceleration parameter allows for a thorough analysis of the cosmological model solution. The RHDE is examined using the Granda–Oliveros infrared (IR) cutoff. Various physical and kinematic properties of the model are also investigated. Furthermore, three physically possible cosmological scenarios are presented with respect to the parameter that appears in the space-time metric. It was found that the findings of our investigation agreed with the recent observational data.

## Keywords :

Homogeneous-hypersurface, Renyi holographic dark energy, gravity.

## 1. Introduction :

The expansion of our Universe is currently happening at a faster pace, as evidenced by observational cosmic evidence [1–4]. Dark energy (DE), which has negative pressure and accounts for 70% of the peculiar ingredient [5–8], drives the cosmic expansion of the universe. Even though there is ample evidence, the DE issue in theoretical physics is still unsolved. Researchers are exploring modified gravity further in an attempt to give an explanation for the cosmic acceleration of the universe and to describe the DE. The most fundamental modifications to General Theory of Relativity (GTR) are represented by the  $f(R)$  theories, which introduce the arbitrary function of Ricci scalar in Einstein-Hilbert action. Buchdahl [9] presented  $f(R)$  gravity in an effort to explain the universe's fast expansion and the evolution of its  $f(R)$  structures. Numerous researchers have

investigated  $f(R)$  gravity in different cosmological scenarios [10–20]. Among the several modified theories of gravity,  $f(R)$  gravity is considered one of the most appropriate models with important cosmological implications.

From the perspective of black hole physics, the holographic principle which was initially proposed by G'tHooft [21] seems to be a suitable candidate for the explanation of dark energy, which is why holographic dark energy (HDE) has become the stronger contender. As suggested by Susskind [22] and Bousso [23], the holographic principle states that a system's entropy rises with surface area rather than volume. Extending this, a unique cosmic application of the holographic principle was introduced by Fischer and Susskind [24] and Cohen et al. [25], eclipsing the realm of black hole physics. The way in which these HDE models then correspond with available observational data is illustrated by the analysis presented in [26–29]. Different cosmological models have been illustrated and constructed using a variety of entropy generalisations, including the holographic DE models of Tsallis [30,31], Sharma–Mittal [32], and Renyi [33]. According to [34–39], many researchers have recently concentrated on RHDE in a range of cosmological scenarios as Renyi HDE shows better stability on its own in the non-interacting cosmos.

This paper investigates the analysis of time-varying deceleration parameter in hypersurface-homogeneous space-time with RHDE under the framework of  $f(R)$  gravity. Section 2 discusses the hypersurface-homogeneous space-time, along with Field equations incorporating pressureless dark matter, and the RHDE model with Granda–Oliveros IR Cut-off. In Section 3, the metric potentials are deduced while taking into account the proportional relationship between the expansion and shear scalars. The kinematical and physical properties of the model are covered in Section 4. Lastly, the conclusions and discussion are presented in Section 5.

## 2. Metric and Field Equations :

For  $f(R)$  gravity, its action is presented by

$$S = \int \sqrt{-g} (f(R) + L_m) d^4x, \quad \dots(1)$$

where  $f(R)$  denotes the general function of the Ricci scalar  $R$  and  $L_m$  stands for the usual matter Lagrangian.

The action (1) is varied with respect to the metric  $g_{\mu\nu}$  to derive the associated field equations expressed as

$$F(R)R_{\mu\nu} - \frac{1}{2}f(R)g_{\mu\nu} - \nabla_\mu \nabla_\nu F(R) + g_{\mu\nu} \nabla^\alpha \nabla_\alpha F(R) = -(T_{\mu\nu} + \tilde{T}_{\mu\nu}), \quad \dots(2)$$

where  $F(R) = df(R)/dR$ ,  $\nabla_\mu$  is the covariant differentiation,  $T_{\mu\nu}$  stands for the standard matter energy momentum tensor emanating from the Lagrangian  $L_m$  and  $\tilde{T}_{\mu\nu}$  stands for energy momentum tensor of RHDE.

Several authors have studied hypersurface-homogeneous models with much interest, which is expressed as

$$ds^2 = -dt^2 + A^2(t) dx^2 + B^2(t) [dy^2 + \sum^2 (y, K) dz^2], \quad \dots(3)$$

where  $A$  and  $B$  are the scale factors such that they are functions of  $t$  only and

$\sum (y, K) = \sin y, y, \sin hy$  for  $K = 1, 0, -1$  respectively.

Katore et al. [40] studied the hypersurface-homogeneous space-time with anisotropic dark energy (DE) in Brans-Dicke gravity. Verma et al. [41] and Katore and Shaikh [42] explored this space-time in Saez-Ballester gravity.

The scalar curvature  $R$  for the metric (3) turns out to be

$$R = 2 \left[ \frac{\ddot{A}}{A} + 2 \frac{\dot{A}\dot{B}}{AB} + 2 \frac{\ddot{B}}{B} + \frac{\dot{B}^2}{B^2} + \frac{K}{B^2} \right] \quad \dots(4)$$

where  $\dot{\phantom{x}}$  stands for the differentiation with respect to cosmic time  $t$ .

For pressureless matter along with RHDE, the energy momentum tensors are given by

$$T_{\mu\nu} = \rho_m u_\mu u_\nu; \tilde{T}_{\mu\nu} = (\rho_r + p_r) u_\mu u_\nu + g_{\mu\nu} p_r, \quad \dots(5)$$

where  $\rho_m$  stands for the energy density of matter,  $p_r$  and  $\rho_r$  denote pressure and energy density of the RHDE respectively,  $u_\mu$  are components of the four-velocity vector of fluid for which the relation  $g_{\mu\nu} u^\mu u^\nu = -1$  holds.

Using equations (2) and (5), the field equations are expressed as

$$F \left[ \frac{\ddot{A}}{A} + 2 \frac{\dot{A}\dot{B}}{AB} \right] - \frac{1}{2}f(R) - 2 \frac{\dot{B}}{B} \dot{F} - \ddot{F} = -p_r, \quad \dots(6)$$

$$F \left[ \frac{\ddot{B}}{B} + \frac{\dot{A}\dot{B}}{AB} + \frac{\dot{B}^2}{B^2} + \frac{K}{B^2} \right] - \frac{1}{2}f(R) - \left( \frac{\dot{A}}{A} + \frac{\dot{B}}{B} \right) \dot{F} - \ddot{F} = -p_r, \quad \dots(7)$$

$$F \left[ \frac{\ddot{A}}{A} + 2 \frac{\dot{A}\dot{B}}{AB} \right] - \frac{1}{2}f(R) - \left( \frac{\dot{A}}{A} + 2 \frac{\dot{B}}{B} \right) \dot{F} = \rho_m + \rho_r. \quad \dots(8)$$

## 3. Solution of the Field Equations

The scale factor, which depends on time, is used to define the deceleration parameter. The particular form of the time-varying deceleration parameter that we have examined is given by

$$q = -1 + \frac{\beta}{1 + a^\beta} \quad \dots(9)$$

where  $a$  denotes average scale factor and  $\beta > 0$  is a constant.

Using the relation  $q = -1 + \frac{d}{dt} \left( \frac{1}{H} \right)$  and solving equation (9), we obtained

$$H = 1 + \frac{1}{a^\beta} \quad \dots(10)$$

where unity is taken into consideration for the integrating constant.

And integrating the equation (10) yields

$$a(t) = (e^{k_1 t + k_2} - 1)^{1/\beta} \quad \dots(11)$$

where  $k_1$  is the integration constant.

Using the relation  $a(t) = \frac{1}{1+z}$ , where  $z$  stands for the redshift, we obtained

$$t(z) = \frac{1}{\beta} \left\{ \log \left[ 1 + \frac{1}{(1+z)^\beta} \right] - k_1 \right\} \quad \dots(12)$$

Using the relation (12), the deceleration parameter (9) in terms of redshift ( $z$ ) is expressed as

$$q(z) = -1 + \frac{\beta}{1 + (1+z)^\beta} \quad \dots(13)$$

The deceleration parameter is the measure of how the expansion of the cosmos has changed over time.

In instances when the universe is decelerated over time, this parameter is positive ( $q > 0$ ) and it is negative ( $q < 0$ ) during the accelerating expansion of the cosmos. The behaviour of the deceleration parameter ( $q$ ) against redshift ( $z$ ) is depicted in Fig. 1 which shows that value of the deceleration parameter is negative throughout the evolution of redshift ( $z$ ) and it lies in the range  $-1 \leq q < 0$  which resemble with the current observational data indicating the accelerating model.

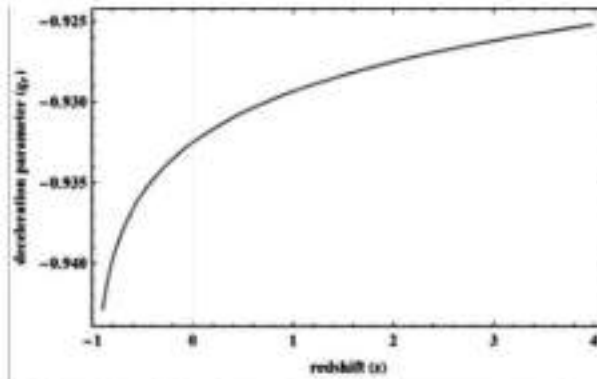


Fig. 1. The behaviour of deceleration parameter ( $q$ ) against redshift ( $z$ ) for  $\beta = 0.125$ .

To obtain the precise solutions to the field equations (6)-(8), we now take into consideration that the expansion scalar is proportional to the shear scalar, which is represented  $A = B^m$  with  $m \neq 1$  as with as an arbitrary constant. Using  $a^3 = AB^2 = V$ , we get

$$A(z) = (1+z)^{\frac{3m}{(m+2)}} \quad \dots(14)$$

$$\text{and } B(z) = (1+z)^{\frac{3m}{(m+2)}} \quad \dots(15)$$

Both the metric potentials  $A$  as well as  $B$  have constant value at  $z = 0$ . This indicates that there is no initial singularity in our model and afterwards, it increases rapidly with the evolution of  $z$  that completely concurs with the Big-Bang model of the Universe.

We consider the result  $F \propto a^i$  as determined by Kotub Uddin et al.[43], where  $i$  is an arbitrary integer. By taking  $i = -2$ , we get  $F = c_1 a^{-2}$ , with  $c_1$  we get with as a constant and using equation (11), it becomes

$$F = c_1 (1+z)^2. \quad \dots(16)$$

#### 4. Physical and kinematical properties :

Using equations(10)-(11), the Hubble parameter ( $H$ ) in terms of the red shift ( $z$ ) can be expressed as

$$H(z) = 1 + (1+z)^{\beta} \quad \dots(17)$$

The mean anisotropic parameter is obtained as

$$\Delta = \frac{32}{75} \left[ \frac{2m}{(m+2)} (1 + (1+z)^{\beta}) \right]^2. \quad \dots(18)$$

The anisotropic parameter (18) has constant value at  $z = 0$  and vanishes at  $z \rightarrow -1$  thereby satisfying the isotropization of the Universe.

The RHDE density has the form

$$\rho_r = \frac{3d^2}{8\pi L^2} (1 + \pi\delta L^2)^{-1}, \quad \dots(19)$$

where  $d$  and  $\delta$  are constants as taken in [44].

Shekh and Ghaderi [45] discussed a hypersurface-homogeneous space-time, incorporating an interacting holographic dark energy (HDE) model with Hubble's and Granda-Oliveros IR cut-offs while Vinutha et al. [46] used Renyi HDE to investigate it with the Hubble horizon in the Saez-Ballester gravity as an IR cut-off.

Without collapsing into a black hole, the RHDE principle ought to be constrained by Granda-Oliveros infrared cut-off scale  $L = (\gamma_1 H^2 + \gamma_2 \dot{H})^{-\frac{1}{2}}$ , where

$\gamma_1$  and  $\gamma_2$  are arbitrary constants. Applying this restriction, the equation (19) of energy density for RHDE becomes

$$\rho_r = \frac{3d^2 \left[ \gamma_1 (1 + (1+z)^{\beta})^2 - \gamma_2 \beta (1+z)^{\beta} (1 + (1+z)^{\beta}) \right]}{8\pi \left( 1 + \pi\delta \left[ \gamma_1 (1 + (1+z)^{\beta})^2 - \gamma_2 \beta (1+z)^{\beta} (1 + (1+z)^{\beta}) \right]^{-1} \right)}. \quad \dots(20)$$

Using the equations (14)-(15), the Ricci scalar(4) reduces to

$$R = 2 \left[ K(1+z)^{\frac{2m}{(m+2)}} + \frac{m}{(m+2)^2} (1+z)^{\beta} (1 + (1+z)^{\beta}) \right] \\ R = 2 \left[ K(1+z)^{\frac{2m}{(m+2)}} + \frac{m}{(m+2)^2} (1+z)^{\beta} (1 + (1+z)^{\beta}) \right] \\ \left( 18m(1 + (1+z)^{\beta}) - 5b(m+2) \right) \quad \dots(21)$$

The scalar function  $f(R)$  is found to be

$$f(R) = \frac{2m\beta c_1}{(m+2)^2} \left[ \frac{10\beta + 5m\beta - 18m}{(\beta+1)(1+z)^{-\beta}} - \frac{10\beta + 5m\beta - 36m}{\beta+2} \right] \\ (1+z)^{\frac{6m+4}{(m+2)}} + \frac{mKc_1}{m+1} (1+z)^{\frac{4(m+1)}{(m+2)}}. \quad \dots(22)$$

The pressure ( $p_r$ ) of Renyi HDE is found to be

$$p_r = -2c_1 (1+z)^{2-\beta} \left( 1 + (1+z)^{-\beta} \right) \beta + 2c_1 (1+z)^{2(1+\beta)}$$

$$\begin{aligned}
& (1+(1+z)^{-\beta})^2 (2+\beta) + \frac{c_1 m K (1+z)^{\frac{4(m+1)}{m+2}}}{2(m+1)} \\
& - \frac{c_1 m (1+z)^{2(1+\beta)}}{(m+2)^2} \left[ (1+(1+z)^{-\beta}) (11m(1+(1+z)^{-\beta}) \right. \\
& \left. - 5(m+2)\beta) - 4(m+2) \right. \\
& \left. - \frac{c_1 m \beta (1+z)^{2(1+\beta)}}{(\beta+1)(\beta+2)(m+2)^2} \left[ ((23m+10)\beta + (1+(1+z)^{-\beta}) \right. \right. \\
& \left. \left. ((1+\beta)(5\beta(m+2)-36)) \right] \right]. \quad \dots(23)
\end{aligned}$$

The energy density of matter ( $\rho_m$ ) is obtained as

$$\begin{aligned}
\rho_m &= \frac{c_2 m (1+z)^{2(1+\beta)}}{(m+2)^2} \\
& \left[ \frac{\beta \left( \beta(23m+10) + (1+\beta)(5b(m+2)) (1+(1+z)^{-\beta}) \right) = 36m}{(1+\beta)(2+\beta)} \right. \\
& \left. + (1+(1+z)^{-\beta}) (11m(1+(1+z)^{-\beta}) - 5b(m+2)) \right] \\
& - \frac{3d^2 \left\{ (1+(1+z)^{-\beta})^2 \gamma_1 - \beta(1+z)^{-2\beta} (1+(1+z)^{-\beta}) \gamma_2 \right\}}{8\pi \left\{ 1 + \pi\delta \left( (1+(1+z)^{-\beta})^2 \gamma_1 - \beta(1+z)^{-2\beta} (1+(1+z)^{-\beta}) \gamma_2 \right)^{-1} \right\}} \\
& - \frac{c_1 m K}{2(m+1)} (1+z)^{\frac{4(m+1)}{m+2}} + \frac{10c_1 m}{m+2} (1+z)^{2(1+\beta)} (1+(1+z)^{-\beta})^2. \quad \dots(24)
\end{aligned}$$

Using baro tropic equation of state  $p_r = \omega_r \rho_r$ , the EoS parameter ( $\omega_r$ ) turns out to be

$$\begin{aligned}
\omega_r &= \left( 3d^2 (1+(1+z)^{-\beta})^2 \left( (1+(1+z)^{-\beta}) \gamma_1 - \beta \gamma_2 \right)^2 \right)^{-1} 8\pi (1+z)^{-3\beta} \\
& \left( \pi\delta + (1+(1+z)^{-\beta})^2 (\gamma_1 + \pi\delta) - (1+(1+z)^{-\beta}) (\beta\gamma_2 + 2\pi\delta) \right) \\
& \left[ \frac{c_2 m}{2(m+1)} K (1+z)^{\frac{4(m+1)}{m+2}} - \frac{c_2 m}{(m+2)^2} (1+z)^{2(1+\beta)} \right. \\
& \left. (1+(1+z)^{-\beta}) (11m(1+(1+z)^{-\beta}) - 5\beta(m+2)) \right. \\
& \left. - \frac{c_1 m \beta (1+z)^{2(1+\beta)}}{(m+2)^2 (\beta+1)(\beta+2)} (\beta(23m+10) + (\beta+1)(-36m \right. \\
& \left. + 5b(m+2)) (1+(1+z)^{-\beta}) \right. \\
& \left. + 2c_1 (1+z)^{2(1+\beta)} (1+(1+z)^{-\beta})^2 \left( (2+\beta) - \frac{4m}{m+2} \right) \right]
\end{aligned}$$

$$-2\beta c_1 (1+z)^{2+\beta} (1+(1+z)^{-\beta}) \dots(25)$$

We obtain the graphical presentations of all these parameters with evolution in the red shift ( $z$ ) for three cases of  $K$  by taking the appropriate choice of various constants involved in it.

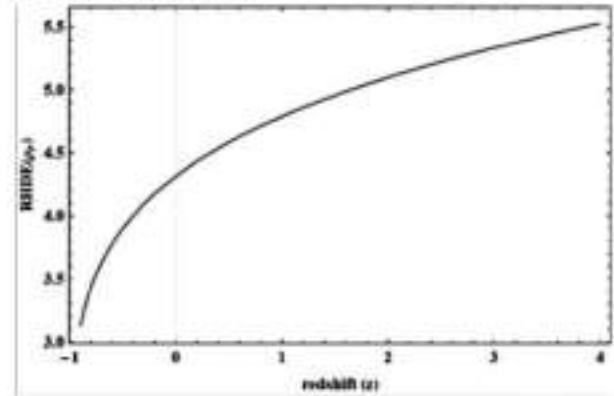


Fig. 2 : The plot of RHDE ( $\rho_r$ ) against redshift ( $z$ ) for  $d = 2, \delta = 1, \gamma_1 = 3, \gamma_2 = 2$  and  $\beta = 0.125$ .

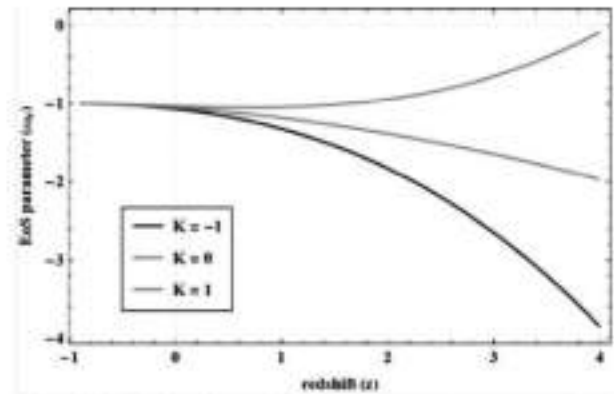


Fig. 3: The behaviour of EoS parameter ( $\omega_r$ ) up against redshift ( $z$ ) for  $d = 2, m = 2, \delta = 1, \gamma_1 = 3, \gamma_2 = 2$  and  $\beta = 0.125$ .

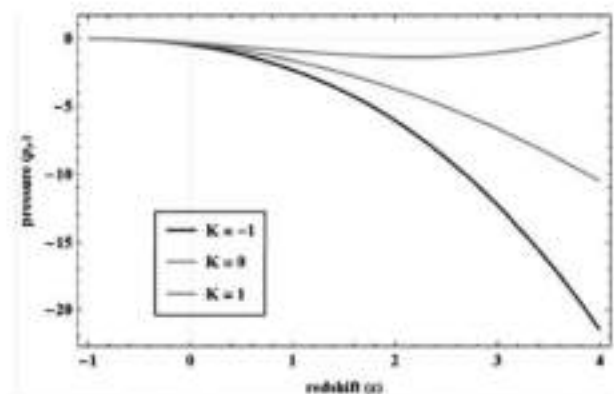


Fig. 4: The plot of pressure ( $p_r$ ) against redshift ( $z$ ) for  $d = 2, m = 2, \delta = 1, \gamma_1 = 3, \gamma_2 = 2$  and  $\beta = 0.125$ .

The plot of RHDE ( $\rho_r$ ) against redshift ( $z$ ) as presented in the Fig. 2 show a clear trend of decreasing behavior of the RHDE ( $\rho_r$ ) as our model progress towards future. The behaviour of EoS parameter ( $\omega_r$ ) up against redshift ( $z$ ) is presented in the Fig. 3 and it varies from  $\omega_r < -1$  for  $K = 0, -1$  i.e. from phantom-dominated region and it varies from  $-1 < \omega_r < 0$  for  $K = 0$  i.e. quintessence region in the past and eventually it tends to a value close to -1 in the near future for all the three cases of indicating the  $\Lambda$ CDM model. Consequently, the current value of EoS parameter ( $\omega_r$ ) in our model aligns closely with recent observational data. As depicted in the Fig. 4, we observed that the pressure ( $p_r$ ) is negative over the course of progression of redshift which imply the speeding up behaviour of our model.

## 5. Conclusions :

This work investigated the study of the  $f(R)$  gravity within the framework of the Hyper surface-homogeneous cosmological model with Renyi holographic dark energy (RHDE). For the purpose of determining the exact solutions to the field equations, we considered the specific form of the deceleration parameter that is time-varying, and the shear scalar is assumed to be proportional to the expansion scalar. At  $z=0$ , both metric potentials exhibit a constant value, suggesting the absence of an initial singularity in our model. Subsequently, they quickly grow with the evolution of  $z$ , which is entirely consistent with the Big-Bang model of the Universe. As depicted in Fig. 1, negative value of deceleration parameter indicates the accelerating model. Moreover, its value lies in the range  $-1 \leq q < 0$  which resemble with the current observational data.

Concerning to the parameter  $K$  that appear in the space-time metric, three physically feasible cosmological cases are presented. The RHDE ( $\rho_r$ ) is investigated by considering the Granda-Oliveros IR cut-off and it show a clear trend of decreasing behavior with passage of redshift towards negative value as depicted in Fig. 2. The behaviour of EoS parameter ( $\omega_r$ ) versus redshift ( $z$ ) as illustrated in the Fig. 3 shows that it varies from phantom-dominated region for  $K = 0, -1$  and from quintessence region for  $K = 1$  in the past which subsequently reach to a value close to -1 in the near future for all the three cases of  $K$  reflecting the  $\Lambda$ CDM model. As depicted in the Fig. 4, the pressure ( $p_r$ ) is negative throughout the passage of redshift ( $z$ ) which adds

additional support that the cosmos is expanding faster. The results obtained and the observed behaviour of our model are in agreement with the recent observations of the cosmos.

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***Dr. Pradnya S. Yenkar***

Principal, Vidya Bharati Mahavidyalaya, Amravati

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## Dynamic Analysis of Renyi Holographic Dark Energy with Hubble's IR Cut-off

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### ABSTRACT

The present study deals with investigation of Hypersurface-homogeneous cosmological model with Renyi holographic dark energy (RHDE) in the confines of the  $f(R)$  gravity. The shear scalar is assumed to be proportional to the expansion scalar in order to achieve the precise solutions of the field equations. Analysis of the solution of cosmological model is done by taking the time-varying deceleration parameter into account. The Hubble horizon is used as an infrared (IR) cutoff when examining the RHDE. Numerous kinematical as well as physical characteristics of the model are also examined. Moreover, regarding the parameter  $K$  that appear in the space-time metric, three physically feasible cosmological cases are described. We found that the outcomes of our study align with recent observational data.

**Keywords:** Renyi holographic dark energy, Homogeneous-hypersurface,  $f(R)$  gravity.

### 1. Introduction

According to observational cosmic evidence, the expansion of our Universe is presently occurring more rapidly [1-4]. The force driving the universe's cosmic expansion is dark energy (DE), which possesses negative pressure and makes up 70% of the peculiar ingredient [5-8]. Notwithstanding all the evidence, the DE issue in theoretical physics remains unsolvable. In an effort to provide a description of the DE and explain the cosmic acceleration of the cosmos, researchers are delving further into modified gravity. With the introduction of the arbitrary function of Ricci scalar  $R$  in Einstein-Hilbert action, the  $f(R)$  theories represent the most basic alterations to General Theory of Relativity (GTR). As a generalisation of Einstein's relativity, Buchdahl [9] presented  $f(R)$  gravity in an effort to explain the universe's fast expansion and the evolution of its structures. Numerous researchers have investigated  $f(R)$  gravity in different cosmological scenarios [10–20]. Among the several modified theories of gravity,  $f(R)$  gravity is deemed highly suitable models with significant cosmological value. From the standpoint of black hole physics, the holographic principle that first put out by G't Hooft [21] seems to be a suitable fit for the explanation of dark energy, which is why holographic dark energy (HDE) has become the stronger contender. As suggested by Susskind [22] and Bousso [23], the holographic principle states that a system's entropy rises with surface area rather than volume. Extending this, a unique cosmic application of the holographic principle was introduced by Fischer and Susskind [24] and Cohen et al. [25], eclipsing the realm of black hole physics. The analysis provided in [26–29] demonstrates how these HDE models then correlate with current observational data. A number of entropy generalisations have now been used to illustrate and build different cosmological models, such as the Tsallis [30,31], Sharma–Mittal [32], and Renyi [33] holographic DE models. Since Renyi HDE exhibits more stability on its own in the non-interacting universe, numerous researchers have recently focused on RHDE in a variety of cosmological situations, as stated in [34–41].

This study explores the analysis of hypersurface-homogeneous space-time with RHDE in the given context of  $f(R)$  gravity, considering time varying deceleration parameter. This is how the paper is organised. Section 2 discusses the hypersurface-homogeneous space-time, along with Field equations incorporating pressureless dark matter, and the RHDE model. Section 3 presents the deduction of the metric potentials considering the proportionately connection between the expansion scalar and shear scalar. Sections 4 addresses physical and kinematical properties of the model. Finally, Section 5 includes the discussion and conclusions.

## 2. Metric and Field Equations

For  $f(R)$  gravity, its action is presented by

$$S = \int \sqrt{-g} (f(R) + L_m) d^4x, \quad (1)$$

where  $f(R)$  denotes the general function of the Ricci scalar  $R$  and  $L_m$  stands for the usual matter Lagrangian.

The action (1) is varied with respect to the metric  $g_{\mu\nu}$  to derive the associated field equations expressed as

$$F(R)R_{\mu\nu} - \frac{1}{2} f(R)g_{\mu\nu} - \nabla_\mu \nabla_\nu F(R) + g_{\mu\nu} \nabla^\mu \nabla_\mu F(R) = -(T_{\mu\nu} + \bar{T}_{\mu\nu}), \quad (2)$$

where  $F(R) \equiv df(R)/dR$ ,  $\nabla_\mu$  is the covariant differentiation,  $T_{\mu\nu}$  stands for the standard matter energy momentum tensor emanating from the Lagrangian  $L_m$  and  $\bar{T}_{\mu\nu}$  stands for energy momentum tensor of RHDE.

Several authors have studied hypersurface-homogeneous models with much interest, which is expressed as

$$ds^2 = -dt^2 + A^2(t)dx^2 + B^2(t)[dy^2 + \Sigma^2(y, K)dz^2], \quad (3)$$

where  $A$  and  $B$  are the scale factors such that they are functions of  $t$  only and  $\Sigma(y, K) = \sin y, y, \sinh y$  for  $K = 1, 0, -1$  respectively.

Katore et al. [42] studied the hypersurface-homogeneous space-time with anisotropic dark energy (DE) in Brans-Dicke gravity. Verma et al. [43] and Katore and Shaikh [44] explored this space-time in Saez-Ballester gravity. Shekh and Ghaderi [45] discussed a hypersurface-homogeneous space-time, incorporating an interacting holographic dark energy (HDE) model with Hubble's and Granda-Oliveros IR cut-offs while Vinutha et al. [46] used Renyi HDE to investigate it with the Hubble horizon in the Saez-Ballester gravity as an IR cut-off.

The scalar curvature  $R$  for the metric (3) turns out to be

$$R = 2 \left[ \frac{\ddot{A}}{A} + 2 \frac{\dot{A}\dot{B}}{AB} + 2 \frac{\ddot{B}}{B} + \frac{\dot{B}^2}{B^2} + \frac{K}{B^2} \right] \quad (4)$$

where ' $\cdot$ ' stands for the differentiation with respect to cosmic time  $t$ .

For pressureless matter along with RHDE, the energy momentum tensors are given by

$$T_{\mu\nu} = \rho_m u_\mu u_\nu; \bar{T}_{\mu\nu} = (\rho_r + p_r)u_\mu u_\nu + g_{\mu\nu} p_r, \quad (5)$$

where  $\rho_m$  stands for the energy density of matter,  $p_r$  and  $\rho_r$  denote pressure and energy density of the RHDE respectively,  $u_\mu$  are components of the four-velocity vector of fluid for which the relation  $g_{\mu\nu} u^\mu u^\nu = -1$  holds.

Using equations (2) and (5), the field equations are expressed as

$$F \left[ \frac{\ddot{A}}{A} + 2 \frac{\dot{A}\dot{B}}{AB} \right] - \frac{1}{2} f(R) - 2 \frac{\dot{B}}{B} \dot{F} - \ddot{F} = -p_r, \quad (6)$$

$$F \left[ \frac{\ddot{B}}{B} + \frac{\dot{A}\dot{B}}{AB} + \frac{\dot{B}^2}{B^2} + \frac{k}{B^2} \right] - \frac{1}{2} f(R) - \left( \frac{\dot{A}}{A} + \frac{\dot{B}}{B} \right) \dot{F} - \ddot{F} = -p_r, \quad (7)$$

$$F \left[ \frac{\ddot{A}}{A} + 2 \frac{\ddot{B}}{B} \right] - \frac{1}{2} f(R) - \left( \frac{\dot{A}}{A} + 2 \frac{\dot{B}}{B} \right) \dot{F} = \rho_m + \rho_r. \quad (8)$$

### 3. Solution of the Field Equations

The scale factor, which depends on time, is used to define the deceleration parameter. As a result, it always encourages researchers to look into the time-varying deceleration parameter as opposed to the constant one. Investigating this parameter is therefore of interest to us. The particular form of the time-varying deceleration parameter that we have examined is given by

$$q = -1 + \frac{\beta}{1 + a^\beta} \quad (9)$$

where  $a$  denotes average scale factor and  $\beta > 0$  is a constant.

Using the relation  $q = -1 + \frac{d}{dt} \left( \frac{1}{H} \right)$  and solving equation (9), we obtained

$$H = 1 + \frac{1}{a^\beta} \quad (10)$$

where unity is taken into consideration for the integrating constant.

And integrating the equation (10) yields

$$a(t) = (e^{\beta t + \gamma} - 1)^{1/\beta} \quad (11)$$

where  $\gamma$  is the integration constant.

Using the relation  $a(t) = \frac{1}{1+z}$ , where  $z$  stands for the redshift, we obtained

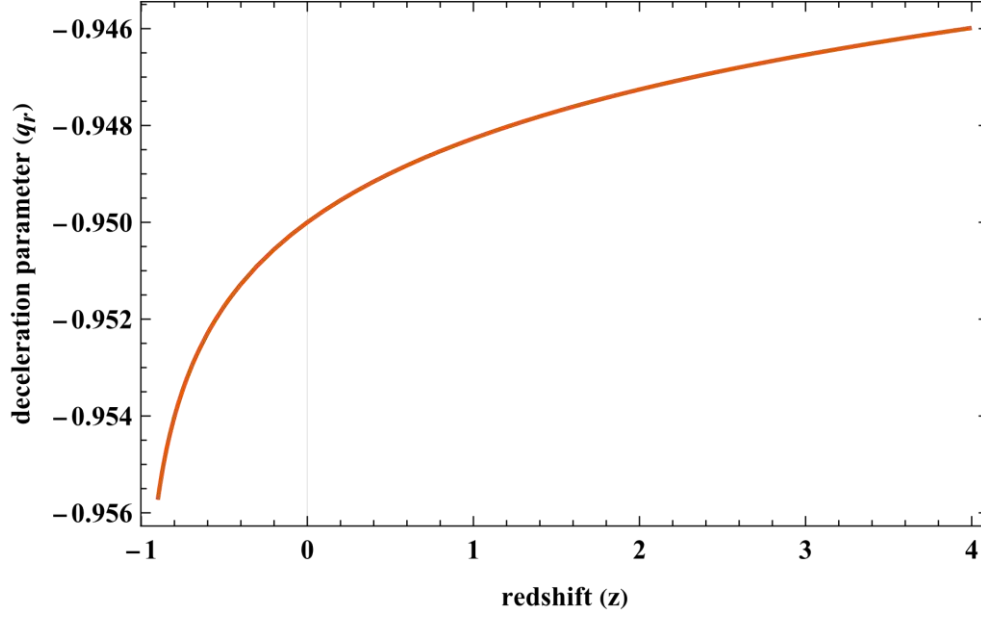
$$t(z) = \frac{1}{\beta} \left\{ \log \left[ 1 + \frac{1}{(1+z)^\beta} \right] - \gamma \right\} \quad (12)$$

Using the relation (12), the deceleration parameter (9) in terms of redshift ( $z$ ) is expressed as

$$q(z) = -1 + \frac{\beta}{1 + (1+z)^{-\beta}} \quad (13)$$

The parameter that characterises how the universe's expansion has evolved is called the deceleration parameter. In instances when the universe is decelerated over time, this parameter is positive ( $q > 0$ ) and it is negative ( $q < 0$ ) during the accelerating expansion of the cosmos.

The behaviour of the deceleration parameter ( $q$ ) against redshift ( $z$ ) is depicted in Fig. 1 and we observed that the value of the deceleration parameter lies in the range  $-1 \leq q < 0$  which resemble with the current observational data indicating the accelerating model.



**Fig. 1.** The behaviour of deceleration parameter ( $q$ ) against redshift ( $z$ ) for  $\beta = 0.0125$ . To obtain the precise solutions to the field equations (6)-(8), we now take into consideration that the expansion scalar is proportional to the shear scalar, which is represented as  $A = B^l$  with  $l \neq 1$  as an arbitrary constant. Using  $a^3 = AB^2 = V$ , we get

$$A(z) = (1+z)^{-\frac{3l}{(l+2)}} \quad (14)$$

and

$$B(z) = (1+z)^{-\frac{3}{(l+2)}} \quad (15)$$

Both the metric potentials  $A$  as well as  $B$  have constant value at  $z=0$ . This indicates that there is no initial singularity in our model and afterwards, it increases rapidly with the evolution of  $z$  that completely concurs with the Big-Bang model of the Universe. Moreover, we consider the result  $F \propto a^m$  as determined by Kotub Uddin et al. [47], where  $m$  is an arbitrary integer. By taking  $m = -2$ , we get  $F = c_1 a^{-2}$ , with  $c_1$  as a constant and using equation (11), it becomes

$$F = c_1 (1+z)^2. \quad (16)$$

#### 4. Physical and kinematical properties

Using equations (10)-(11), the Hubble parameter ( $H$ ) in terms of the redshift ( $z$ ) can be expressed as

$$H(z) = 1 + (1+z)^\beta. \quad (17)$$

The mean anisotropic parameter is obtained as

$$\Delta = \frac{32}{75} \left[ \frac{2l}{(l+2)} \left( 1 + (1+z)^\beta \right) \right]^2. \quad (18)$$

The anisotropic parameter (18) has constant value at  $z=0$  and vanishes at  $z \rightarrow -1$  thereby satisfying the isotropization of the Universe.

The RHDE density has the form

$$\rho_r = \frac{3d^2}{8\pi L^2} (1 + \pi \delta L^2)^{-1}, \quad (19)$$

where  $d$  and  $\delta$  are constants as taken in [48].

Without collapsing into a black hole, the RHDE principle ought to be constrained by an infrared cutoff scale  $L = 1/H$ . Applying this restriction, the energy density for RHDE becomes

$$\rho_r = \frac{3d^2 \left(1 + (1+z)^{-\beta}\right)^2}{8\pi \left(1 + \pi\delta \left(1 + (1+z)^{-\beta}\right)^{-2}\right)} \quad (20)$$

Using the equations (14)-(15), the Ricci scalar (4) reduces to

$$R = 2 \left[ K(1+z)^{\frac{2l}{(l+2)}} + \frac{l}{(l+2)^2} (1+z)^\beta \left(1 + (1+z)^\beta\right) \left(18l \left(1 + (1+z)^{-\beta}\right) - 5b(l+2)\right) \right]. \quad (21)$$

The scalar function  $f(R)$  is found to be

$$\begin{aligned} f(R) = & \frac{lKc_1}{(l+1)} (1+z)^{\frac{4(l+1)}{(l+2)}} - \frac{2l\beta c_1}{(l+2)^2 (\beta+2)} (10\beta + 5l\beta - 36l) (1+z)^{\beta + \frac{6l+4}{(l+2)}} \\ & + \frac{2l\beta c_1}{(l+2)^2 (\beta+1)} (10\beta + 5l\beta - 18l) (1+z)^{2\beta + \frac{6l+4}{(l+2)}}. \end{aligned} \quad (22)$$

The energy density of matter ( $\rho_m$ ) is obtained as

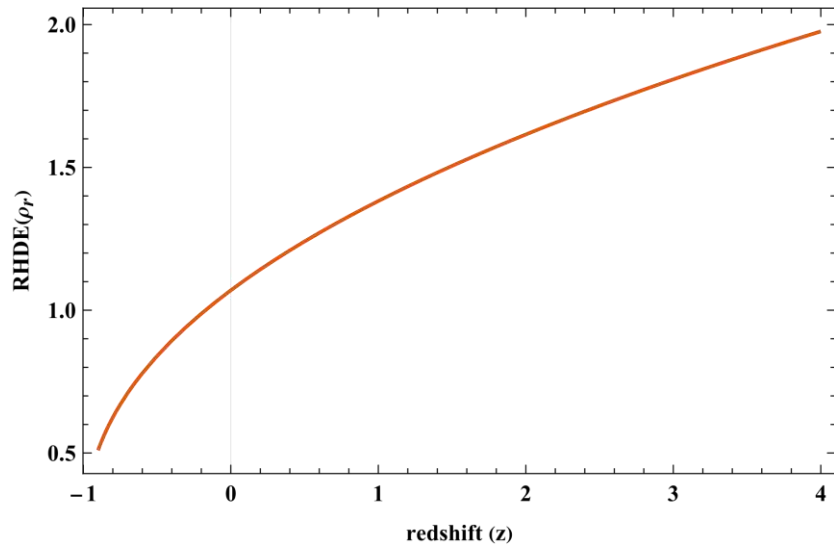
$$\begin{aligned} \rho_m = & \frac{c_1 l (1+z)^{2(\beta+1)}}{2(\beta+1)(l+2)^2} (40 + (42l - 4\beta(l-5))) + \frac{c_1 l (1+z)^{\beta+2}}{2(\beta+2)(l+2)^2} (40(4+\beta) - 8l(\beta-21)) \\ & - \frac{Kc_1 l (1+z)^{\frac{4(l+1)}{2+l}}}{2(l+1)} + \frac{c_1 l (1+z)^2}{2(l+2)^2} (42l + 40) - \frac{3d^2 \left(1 + (1+z)^\beta\right)^4}{8\pi \left( \left(1 + (1+z)^\beta\right)^2 + \pi\delta (1+z)^{4\beta} \right)}. \end{aligned} \quad (23)$$

The pressure ( $p_r$ ) of Renyi HDE is found to be

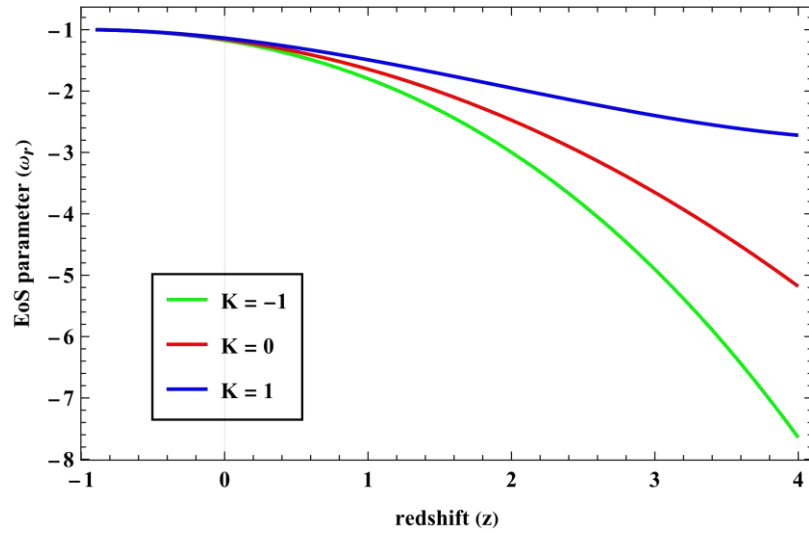
$$\begin{aligned} p_r = & -2c_1 (1+z)^{2-\beta} \left(1 + (1+z)^{-\beta}\right) \beta + 2c_1 l (1+z)^{2(1+\beta)} \left(1 + (1+z)^{-\beta}\right)^2 (2+\beta) + \frac{c_1 l K (1+z)^{4\left(\frac{l+1}{l+2}\right)}}{2(1+l)} \\ & - \frac{c_1 l (1+z)^{2(1+\beta)}}{(l+2)^2} \left[ \left(1 + (1+z)^{-\beta}\right) \left(11l \left(1 + (1+z)^{-\beta}\right) - 5(2+l)\beta\right) - 4(l+2) \left(1 + (1+z)^{-\beta}\right)^2 \right] \\ & - \frac{c_1 l \beta (1+z)^{2(1+\beta)}}{(\beta+1)(\beta+2)(l+2)^2} \left[ \left( (23l+10)\beta + \left(1 + (1+z)^{-\beta}\right) (1+\beta) (5\beta(2+l) - 36l) \right) \right]. \end{aligned} \quad (24)$$

Using barotropic equation of state,  $p_r = \omega_r \rho_r$ , the EoS parameter ( $\omega_r$ ) turns out to be

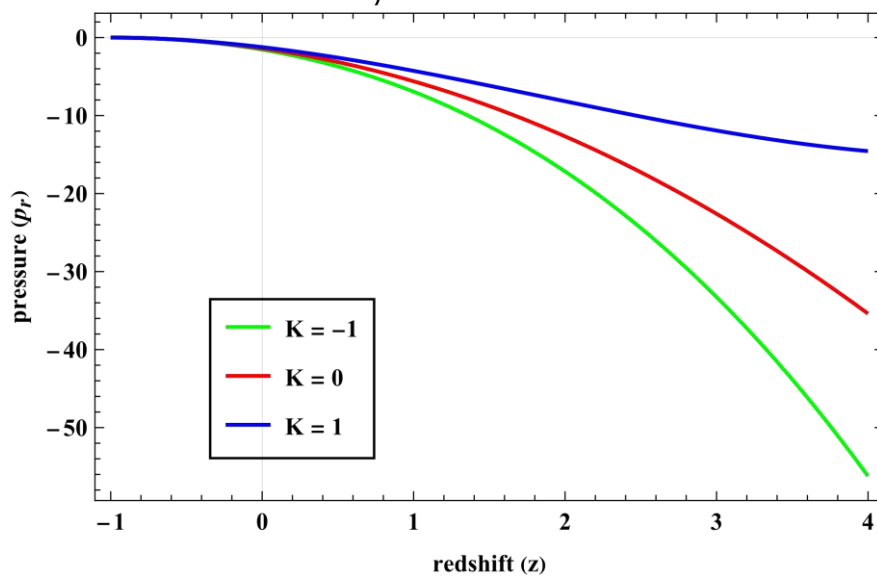
$$\begin{aligned} \omega_r = & \frac{8\pi c_1 (1+z)^2}{3d^2 \left(1 + (1+z)^b\right)^2} \left( \left(1 + (1+z)^b\right)^2 + \pi\delta \right) \\ & \times \left[ -\frac{l\beta \left(1 + (1+z)^{-\beta}\right)^{-2}}{(\beta+1)(\beta+2)(l+2)^2} \left( (10+23l)\beta + \left(1 + (1+z)^{-\beta}\right) (1+\beta) ((2+l)5\beta - 36l) \right) \right. \\ & \left. + 2(2+\beta) - 2\beta \left(1 + (1+z)^{-\beta}\right)^{-1} + \frac{lK}{2(1+l)} \left(1 + (1+z)^{-\beta}\right)^{-2} (1+z)^{\frac{2l}{2+l} - 2\beta} \right. \\ & \left. - \frac{l}{(2+l)^2} \left( 4(2+l) - \left(1 + (1+z)^{-\beta}\right)^{-1} \left(11l \left(1 + (1+z)^{-\beta}\right) - 5(2+l)\beta\right) \right) \right]. \end{aligned} \quad (25)$$



**Fig. 2.** The plot of RHDE ( $\rho_r$ ) against redshift ( $z$ ) for  $d = 2$ ,  $\delta = -1$  and  $\beta = 0.0125$ .



**Fig. 3.** The plot of EoS parameter ( $\omega_r$ ) against redshift ( $z$ ) for  $d = 2$ ,  $l = 2$ ,  $\delta = -1$  and  $\beta = 0.0125$ .



**Fig. 4.** The plot of pressure ( $p_r$ ) against redshift ( $z$ ) for  $d = 2$ ,  $l = 2$ ,  $\delta = -1$  and  $\beta = 0.0125$ .

We obtain the graphical presentations of all these parameters with evolution in the redshift ( $z$ ) for three cases of  $K$  by taking the appropriate choice of various constants involved in it. The plot of RHDE ( $\rho_r$ ) against redshift ( $z$ ) as presented in the Fig. 2 show a clear trend of increasing behavior of the RHDE ( $\rho_r$ ) with passage of redshift. The behaviour of EoS parameter ( $\omega_r$ ) up against redshift ( $z$ ) is presented in the Fig. 3 and it varies from  $\omega_r < -1$  i.e. from phantom-dominated region in the past whereas it tends to a value close to  $-1$  in the near future indicating the  $\Lambda$ CDM model. Consequently, the current value of EoS parameter ( $\omega_r$ ) in our model aligns closely with recent observational data. As depicted in the Fig. 4, we observed that the pressure ( $p_r$ ) is negative over the course of progression of redshift which imply the speeding up behaviour of our model concurs with the investigations of Samanta [49].

## 5. Conclusions

In this paper, we explored the analysis of Hypersurface-homogeneous cosmological model with Renyi holographic dark energy (RHDE) in the confines of the  $f(R)$  gravity. The shear scalar is taken to be proportional to the expansion scalar in order to obtained the precise solutions of the field equations and is analysed by assuming the time-varying deceleration parameter ( $q$ ). Both the metric potentials have constant value at  $z=0$  which indicates that there is no initial singularity in our model and afterwards, it increases rapidly with the evolution of  $z$  that completely concurs with the Big-Bang model of the Universe. As depicted in Fig. 1, negative value of deceleration parameter ( $q$ ) indicates the accelerating model. Moreover, its value lies in the range  $-1 \leq q < 0$  which resemble with the current observational data. Regarding the parameter  $K$  that appear in the space-time metric, three physically feasible cosmological cases are described. The RHDE ( $\rho_r$ ) is investigated by considering the Hubble horizon as an infrared (IR) cutoff and it show a clear trend of increasing behavior with passage of redshift as depicted in Fig. 2. The behaviour of EoS parameter ( $\omega_r$ ) versus redshift ( $z$ ) as depicted in the Fig. 3 shows that it varies from phantom-dominated region in the past whereas it tends to a value close to  $-1$  in the near future indicating the  $\Lambda$ CDM model. As depicted in the Fig. 4, the pressure ( $p_r$ ) is negative over the course of progression of redshift ( $z$ ) which provides additional backing for the universe to be expanding faster. The outcomes attained and the behaviour of our model as seen align with the recent observational evidence of the universe.

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## Exploration of Barrow Holographic Dark Energy in Modified Theory of Gravitation

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### Abstract:

In this paper, we consider the Bianchi-I Kasner type space-time in the presence of Barrow Holographic Dark Energy in the context of  $f(R,T)$  theory of gravitation. It is observed that universe is accelerating through the variation of the equation of state (EoS) parameter. In addition, stability of the BHDE model has been examined by squared sound speed  $v_s^2$ .

**Keywords:** Kasner metric,  $f(R,T)$  gravity, Barrow Holographic Dark Energy.

### 1. Introduction

One of the most straightforward methods for replicating the observed late-time expansion of the Universe is through alternative theories of gravity [1-3]. Furthermore, there are a number of consistency issues with general relativity (GR) [4, 5] that need to be resolved in the end. The question therefore becomes, which gravity theories preserve the positive aspects of General Relativity while addressing some of the unanswered problems? The most logical and natural extension of the Einstein-Hilbert action is to substitute any function  $f(R)$  for the Ricci scalar  $R$ . This is the widely recognized Gravitation hypothesis  $f(R)$ . The late-time cosmic acceleration has been tested to be explained by this modified gravity hypothesis, and it is consistent with the local gravitational tests [6–12]. Harko et al. [13] have recently suggested an additional adjustment that takes the Einstein-Hilbert action into consideration and represents it as  $f(R,T)$ , where  $T$  is the trace of the energy-momentum tensor. The incorporation of the matter element in the gravity Lagrangian may have been justified by the quantum effect manifested as conformal anomaly. Nevertheless, because of the interaction between matter and gravity, this gravity model depends on the source term. As a result, test particles lack a geodesic path and a hypothetical force term exists perpendicular to the four velocities. Moreover, the field equations get extremely complex.

The authors are motivated to investigate various cosmological issues because of the crucial role that the Kasner [14, 15] metric has played in clarifying the existence, composition, and singularities of anisotropic cosmological models in general relativity. One of the metrics that is studied the most is the Kasner metric. Its applicability in building of cosmological models and its usefulness for specific investigations of basic particles have made it especially appealing for use. Due to its simplicity, it has been "rediscovered" numerous times and shares a close relationship with measures provided by Weyl, Levi-Civita, and Wilson several years prior. The dynamic form of the synchronous Bianchi I metric has virtually replaced the one in which Kasner first described it. The space-time is invariant under a three-dimensional Abelian translation group, and the Kasner solution generally gives an anisotropic metric in which the space directions are Killing translations. The Kasner metric is a one-parameter family of solutions for a four-dimensional space-time because it contains three parameters, or the Kasner indices, which must fulfil the two so-called Kasner algebraic relations. In particular, the intersection of a three-dimensional sphere with radius unity and a plane in which the total of those parameters equals one defines the values of the parameters on the real number line.

The Holographic Dark Energy (HDE) provides a helpful paradigm. Such a method, which starts from the holographic principle with Bekenstein-Hawking (BH) entropy and the Hubble horizon as its IR cutoff, offers a precise quantitative analysis of DE in its original formulation. However, several hesitant modifications to this model have been inspired by its difficulties in explaining the history of a flat Friedmann-Robertson-Walker (FRW) Universe. For example, HDE has been used in the BD framework to address the DE problem by taking into account various IR cutoffs or appropriate interactions with DM. The holographic dark energy proposed by Barrow [16] has a complex structure that lead to a finite volume but with infinite (or finite) area, which is given by

$$S_B = \left( \frac{A}{A_0} \right)^{\frac{2+\Delta}{2}}, \text{ where } A \text{ represents standard horizon area and } A_0 \text{ is the Planck area. The new}$$

form of the exponent  $\Delta$  was introduced by Barrow, which lies in the range  $0 \leq \Delta \leq 1$ . For  $\Delta = 0$ , the expression reduces to the standard Bekenstein-Hawking entropy. The standard holographic dark energy is given by the inequality  $\rho_B L^4 \leq 4$ , where  $L$  is the horizon length, and imposing the inequalities  $S \propto A \propto L^2$ . We consider here a modified form of density introduced by Barrow to define the entropy caused by quantum-gravitational effects, which yields  $\rho_B = C L^{\Delta-2}$ . The energy density of Barrow HDE is  $\rho_B = C H^{2-\Delta}$ .

In this paper, we consider the Bianchi-I Kasner type space-time in the presence of Barrow Holographic Dark Energy in the context of  $f(R, T)$  theory of gravitation.

## 2. METRIC AND FIELD EQUATIONS

We consider an anisotropic [Bianchi type-I] metric in Kasner form as

$$ds^2 = dt^2 - t^{2p_1} dx^2 - t^{2p_2} dy^2 - t^{2p_3} dz^2 \quad (1)$$

where  $p_1, p_2, p_3$  are three parameters satisfying  $p_1 + p_2 + p_3 = 1$ ,  $p_1^2 + p_2^2 + p_3^2 = 0$ . The parameters  $p_1, p_2, p_3$  will require to be constants and if at least two of the three are different, the space is anisotropic.

The action of  $f(R, T)$  in the presence of matter with Lagrangian is

$$S = \frac{1}{16\pi} \int f(R, T) \sqrt{-g} d^4x + \int L_m d^4x \quad (2)$$

The field equations of  $f(R, T)$  gravity model discovered by Harko et al. [13]:

$$f_R(R, T) R_{ij} - \frac{1}{2} f(R, T) g_{ij} + (g_{ij} - \nabla_i \nabla_j) f_R(R, T) = 8\pi T_{ij} - f_T(R, T) T_{ij} - f_R(R, T) \Theta_{ij} \quad (3)$$

$$\text{where, } T_{ij} = \frac{-2\partial(\sqrt{-g})}{\sqrt{-g} \partial g^{ij}} L_m, \quad \Theta_{ij} = -2T_{ij} - p g_{ij}, \quad f_R(R, T) = \frac{\partial f(R, T)}{\partial R}, \quad f_T(R, T) = \frac{\partial f(R, T)}{\partial T},$$

$$\text{As a popular choice, } f(R, T) = R + 2f(T) \quad (4)$$

where the function  $f(T)$  depends only on the trace of the matter field. Using the above equation, the gravitational field equations reduce to:

$$G_{ij} = R_{ij} - \frac{1}{2} R g_{ij} = 8\pi T_{ij} + 2f'(T) T_{ij} + [2p f'(T) + f(T)] g_{ij}, \quad (5)$$

where the prime indicates the differentiation with respect to the argument. We choose the function of matter as:  $f(T) = \mu T$ , (6)

where  $\mu$  is constant. The energy momentum tensor for matter ( $T_{ij}$ ) and BHDE (Barrow Holographic dark energy ( $\bar{T}_{ij}$ )) is given by :

$$T_{ij} = \rho_m u_i u_j \text{ and } \bar{T}_{ij} = (\rho_B + p_B) u_i u_j - g_{ij} p_B, \quad (7)$$

where  $\rho_B, \rho_m, p_B$  are the energy densities of BHDE, dark matter and the BHDE pressure. It satisfies the condition  $u^i u_i = 1$ . In co-ordinate system  $u^1 = u^2 = u^3 = 0, u^4 = 1$  we get,

$$T_1^1 = T_2^2 = T_3^3 = 0, \quad T_4^4 = \rho_m, \quad \bar{T}_1^1 = \bar{T}_2^2 = \bar{T}_3^3 = -\omega_B \rho_B, \quad T_4^4 = \rho_B. \text{ We have the following relation} \quad (8)$$

$$T = -3\omega_B \rho_B + \rho_m + \rho_B.$$

In co-moving coordinate system, from equations (1)-(8), it is easy to write down the expression for the field equation:

$$[p_1(s-1) - K_0]t^{-2} = -(8\pi + 3\mu)\omega_B \rho_B + \mu(\omega_m + \rho_B), \quad (9)$$

$$[p_2(s-1) - K_0]t^{-2} = -(8\pi + 3\mu)\omega_B \rho_B + \mu(\omega_m + \rho_B), \quad (10)$$

$$[p_3(s-1) - K_0]t^{-2} = -(8\pi + 3\mu)\omega_B \rho_B + \mu(\omega_m + \rho_B), \quad (11)$$

$$\left[\frac{1}{2}(\theta - s^2)\right]t^{-2} = (8\pi + 3\mu)(\rho_m + \rho_B) + 2p_B \mu - 3\omega_m \rho_B \mu, \quad (12)$$

$$\text{where, } K_0 = \frac{1}{2}(s^2 - 2s + \theta).$$

Using equations (9), (10) & (11), we get  $p_1 = p_2 = p_3 = p^*$  (say).

Hence equations (9)-(11) yield

$$[p^*(s-1) - K_0]t^{-2} = -(8\pi + 3\mu)\omega_B \rho_B + \mu(\omega_m + \rho_B) \quad (13)$$

The energy density of Barrow HDE is:

$$\rho_B = c \left( \frac{p^*}{t} \right)^{2-\Delta} \quad (14)$$

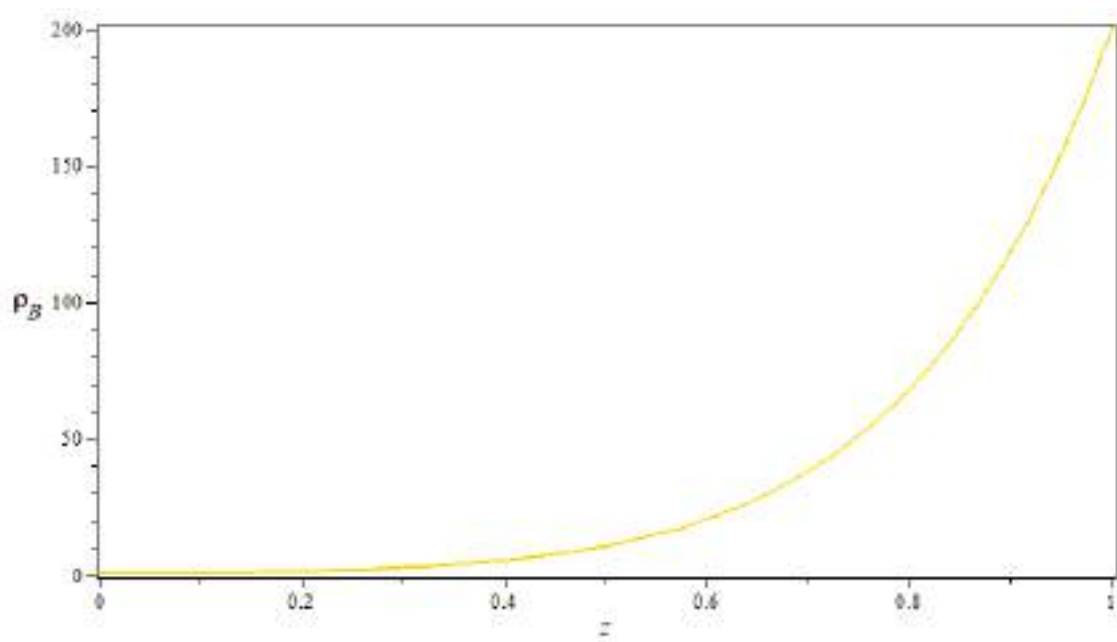


Fig 1. Plot of energy density  $\rho_B$ , of Barrow holographic dark energy against Red-shift  $z$ . The behavior of energy density for our model versus redshift is shown in Fig. 1. From this figure, it is observed that the energy density is positive and is a decreasing function of redshift. Also, when  $z = 0$ , the energy density of Universe is positive and increases with the escalation in the value of  $z$ .

The EoS parameter, matter density and pressure are expressed as

$$\omega_B = \frac{1}{c(p^*/t)^{2-\Delta} [(8\pi + 3\mu)^2 - \mu^2]} \left\{ \frac{\mu(\theta - s^2)}{2} - (8\pi + 3\mu)[p^*(s-1) - k_0] \right\} t^{-2} \quad (15)$$

$$\rho_m = \left\{ \frac{[p^*(s-1) - k_0]}{\mu} - \frac{(8\pi + 3\mu)^2}{[(8\pi + 3\mu)^2 - \mu^2]} \frac{[p^*(s-1) - k_0]}{\mu} + \frac{(8\pi + 3\mu)}{[(8\pi + 3\mu)^2 - \mu^2]} \frac{(\theta - s^2)}{2} \right\} t^{-2} - \rho_B \quad (16)$$

$$p_B = \left\{ \frac{[1-16\pi]}{[1-(1-16\pi)^2]} \{2(s-1) - (s^2 - 2s + \theta) - (1-16\pi)(\theta - s^2)\} \right\} t^{-2} - (\theta - s^2)t^{-2}. \quad (17)$$

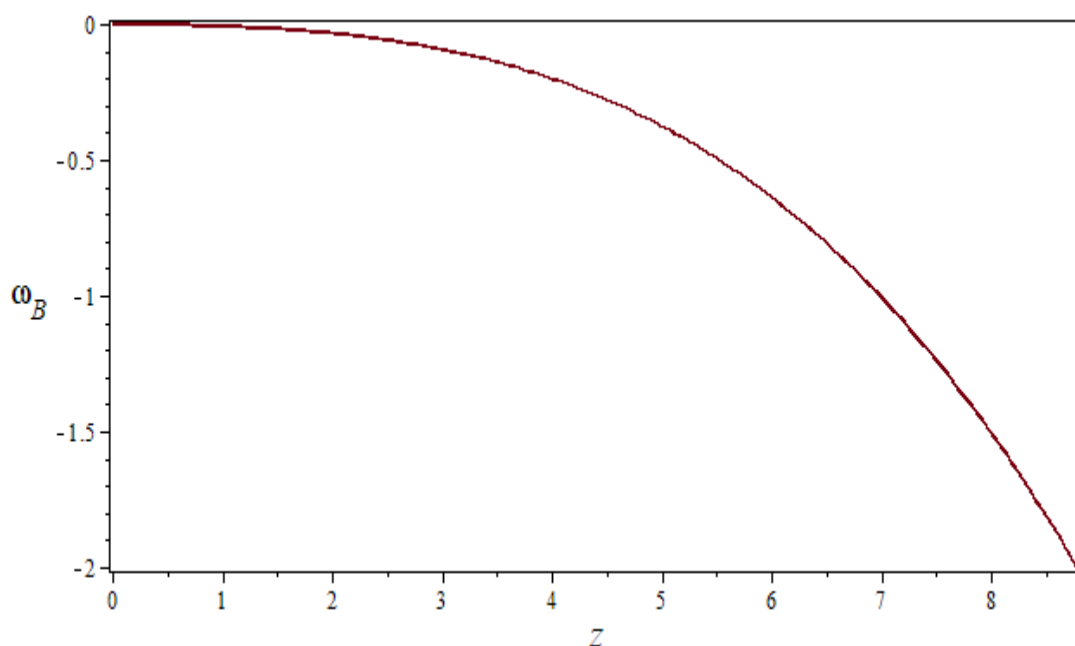


Fig 2. The behaviour of EoS Parameter  $\omega_B$ , against redshift  $z$ .

Figure 2 illustrates the evolution of the equation of state as a function of red-shift  $z$ . The outcomes of our model align with the limitations of the equation of state parameter for the Planck Collaboration and WMAP, which provide the parameter ranges:  $-0.92 \leq \omega \leq -1.26$  (Planck+ WP+ Union 2.1),  $-0.89 \leq \omega \leq -1.38$  (Planck +WP+BAO),  $-0.983 \leq \omega \leq -1.162$  (WMAP+eCMB+BAO+H0). Lastly, the behaviour of the developed model agrees well with current SNe-Ia observational data.

We can test the stability of our BHDE model against perturbations by using the squared sound

speed  $v_s^2 = \frac{dp_B}{d\rho_B}$ , which is given

$$V_s^2 = \frac{(1+z)^{\frac{\Delta}{p}}}{c(2-\Delta)p^{2-\Delta}} \frac{1}{[(8\pi + 3\mu)^2 - \mu^2]} \{ \mu(\theta - s^2) - (16\pi - 6\mu)[p(s-1) - k_0] \}. \quad (18)$$

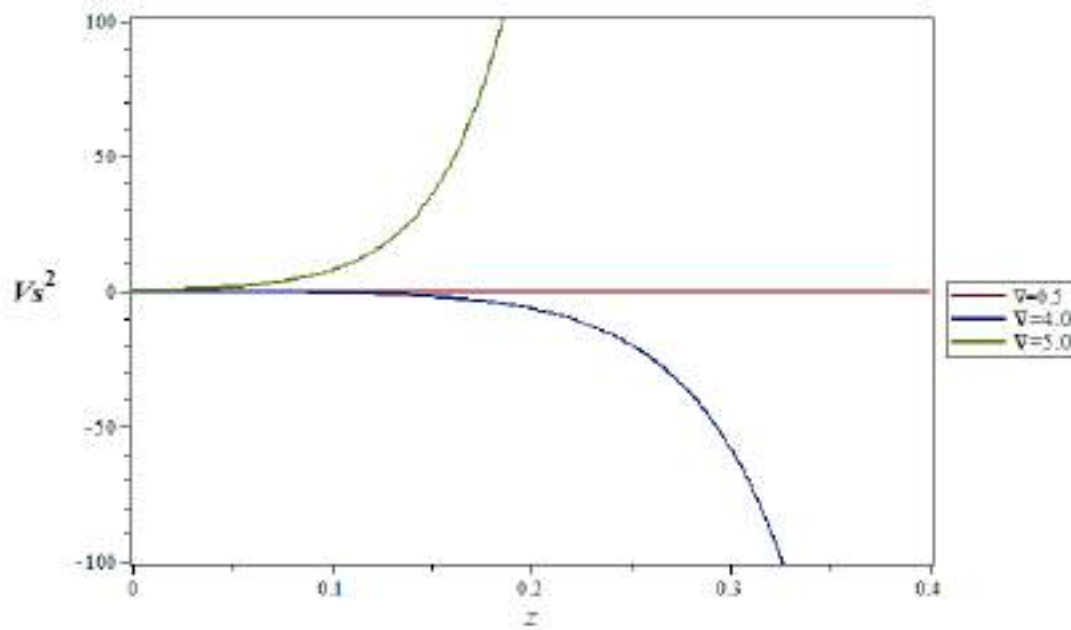


Fig. 3. The behaviour of squared sound speed  $v_s^2$  as a function of redshift  $z$  for distinct values of  $\Delta$ .

The behaviour of squared sound speed  $v_s^2$  given in Eq. (18) is plotted against redshift  $z$  show in Fig. 3. We observed that as  $z \rightarrow -1$  i.e. in the future, stability of our BHDE models occurs for  $\Delta = 5.0, 0.5$  (for large scale), while for  $\Delta = 4.0$  an instability persists.

### 3. Conclusions:

In this presented paper, we have explored the Kasner space-time in the presence of Barrow holographic dark energy in the context of modified  $f(R, T)$  theory of gravitation. It is observed that the energy density of BHDE is positive and decreases as universe expands. In addition, the equation of state parameter of our model shows the transition from zero to negative value with cosmic evaluation where as the stability parameter in term of squared speed is stable for some values of  $\Delta$ .

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## Panoramic Behaviour of Magnetized Strange Quark Matter in Modified Theory of Gravitation

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### ABSTRACT

In this paper, The Bianchi-I Kasner type metric with magnetized strange quark matter (MSQM) distribution in  $f(R, T)$  theory of gravitation is considered, where  $R$  is the Ricci scalar and  $T$  the trace of matter source. For examination, one functional version of the function  $f(R, T)$  is selected. We discovered that the strings are there in the early phases of the universe's evolution and vanish with the passage of time. The action of the string may be the cause of the fluctuation in the equation of state (EoS) parameter  $\omega = p/\rho < -1$ . We discover that the magnetic flux and string tension are constant throughout the evolution of cosmos.

**Keywords:** Kasner metric, magnetized strange quark matter, modified theory of gravitation.

### 1. Introduction

The study of cosmic accelerated expansion, which has been validated by various observations over the last two decades, is one of the most important cosmological enigmas among cosmologists. It is believed that cosmic acceleration is driven by some kind of energy with negative pressure known as dark energy (DE). Instead of resorting the mysterious concept of DE, there is an alternative way to reproduce the dynamics of the expanding universe through modified theories of gravity which is an extension of general relativity (GR). These theories are gaining more and more attention every day, due to the possibility that dark energy and the universe's expansion may be explained by these ideas. Some of these theories are called  $f(R)$  theory [1], Brans-Dicke Cosmology [2],  $f(T)$  gravity [3], and so on, each theory has its own importance. A fascinating extension of GR that has drawn a lot of interest recently is the  $f(R, T)$  theory of gravity, which is one of the various modified theories of gravitation that Harko et al. [4] presented. The gravity hypothesis represented by  $f(R, T)$  can account for the universe's late-time cosmic rapid expansion. By reconstructing  $f(R, T) = f(R) + f(T)$ , Houndjo et al. [5] were able to establish a transition from a matter-dominated phase to an accelerated phase using an auxiliary scalar field with two known forms of scale factor. The law of thermodynamics in  $f(R, T)$  gravity theory has been investigated by Sharif and Zubair [6]. However, it is important to investigate magnetic fields and quark gluon plasma to understand the early universe. Recent observations indicate that neutron stars, pulsars also galaxy clusters have magnetic fields [7]. Although their origin is still largely unknown, magnetic fields had a significant influence in the creation of structures in the early cosmos. This work uses magnetic fields to be connected to strange quark matter in gravitational models using  $f(R, T)$  for the Kasner metric.

The universe appears homogeneous and isotropic at large scales. However, there isn't any observable evidence to support the isotropy of a pre-recombination period. Anisotropic models were investigated as a result of the reported local anisotropies in galaxies, clusters, and superclusters [8]. An Abelian translation group in three dimensions does not affect the Kasner metric. The Kasner solution, which Taub developed, depicts an idealised universe expanding in a more anisotropic way. According to Palathansis et al. [9], the Kasner solution is crucial for the study of anisotropy in the generation of quantum particles, inflation, large particle survival,

magnetic field evolution, primordial nucleosynthesis, temperature isotropy, and statics of the microwave background. Clifton studies the existence of solutions in higher order theories [10]. In the  $f(T)$  cosmology, Skugoreva and Toporensky have studied the Kasner solution [11]. Additionally, Clifton and Barrow have studied the initial singularity by using the Kasner metric to find accurate cosmological solutions in the fourth order gravity theory [12]. A new approach to static and spherically symmetric solutions in the  $f(R)$  theory of gravity was discovered by Gao and Shen [13]. New integrable  $f(R)$  models have been developed using the Killing tensors by Paliathansis [14]. Pure Lovelock equations for the Kasner measures have been examined by Camanho et al. [15].

There are several studies in the literature that include both alternative theories and quark and strange quark matter solutions in general relativity theory (GRT). Yilmaz and associates have examined quark and odd quark elements in GRT and certain adjusted theories [16–19]. The geometry and thermodynamics of SQM have been explored by Gholizade et al. [20]. Quark and strange quark matter have been studied in the Kantowski-Sachs universe model for  $f(R)$  gravity by Adhav et al. [21]. The Kaluza-Klein universe model with SQM has been researched by Namrata et al. [22] and S. D. Katore et al. [23]. Researchers Khadekar and Rajani [24] have studied quark and strange quark matter in a higher dimensional cosmological model. String clouds and domain barriers with quark matter have been examined by Sahoo and Bivudutta in the context of the kink cosmological model and bimetric theory with plane symmetric metric [25]. Based on observations of type Ia Supernovae, the behaviour of strange quark matter combined with magnetic epoch suggests a faster expansion of the cosmos [26]. In the FRW universe, Aktas and Aygun examined the evolution of the MSQM distribution using reconstructed  $f(R, T)$  gravity [27]. Furthermore, spatially homogeneous and anisotropic cosmos models are so significant because homogeneous and anisotropic cosmological models define the large-scale structure of the universe in its early phases. Generally, Bianchi type-I universes behave like Kasner universes when they are close to the unique point.

In this paper, The Bianchi-I Kasner type metric with magnetized strange quark matter (MSQM) distribution in  $f(R, T)$  theory of gravitation is considered, where  $R$  is the Ricci scalar and  $T$  the trace of matter source. This is how the paper is organised. Section 2 includes gravitational field equations of  $f(R, T)$  gravity. The Space-time Metric of the Kasner type and Solution to the Field equations are covered in section 3. At last, section 4 includes the discussion and conclusion.

## 2. Gravitational field equations of $f(R, T)$ gravity

The action in  $f(R, T)$  gravity, is given by

$$s = \frac{1}{16\pi} \int f(R, T) \sqrt{-g} d^4x + \int L_m \sqrt{-g} d^4x \quad (1)$$

here  $R$  is Ricci scalar,  $T$  is the trace of  $T_{ij}$ ,  $g$  is the determinant of  $g_{ij}$  also  $f(R, T)$  is the arbitrary function of  $R$  and  $T$ . Also,  $L_m$  indicates Lagrangian and  $T_{ij}$  is defined as

$$T_{ij} = -\frac{2}{\sqrt{-g}} \frac{\partial(-gL_m)}{\partial g^{ij}}. \quad (2)$$

The Lagrangian  $L_m$  is depends only on  $g_{ij}$  and not on its derivatives and hence reduces to

$$T_{ij} = g_{ij} L_m - \frac{2\partial L_m}{\partial g^{ij}}. \quad (3)$$

The  $f(R, T)$  gravity field equations are obtained by varying the action (1) with respect to the metric tensor components  $g_{ij}$ ,

$$f(R, T) R_{ij} - \frac{1}{2} f(R, T) g_{ij} + \left( g_{ij} \nabla^i \nabla_j - \nabla_i \nabla_j \right) f(R, T) = 8\pi T_{ij} - f_T(R, T) T_{ij} - f_T(R, T) \Xi_{ij} \quad (4)$$

where,  $\nabla_i$  is the covariant derivative,  $f_R = \frac{\partial f(R, T)}{\partial R}$ ,  $f_T = \frac{\partial f(R, T)}{\partial T}$

and  $\Xi_{ij} = -2T_{ij} + g_{ij}L_m - 2g^{kp} \frac{\partial^2 L_m}{\partial g^{ij} \partial g^{kp}}$ .

### 3. Space-time Metric and Solution to the Field equations

In this study we, consider the Kasner type Bianchi type-I space-time is given by

$$ds^2 = dt^2 - t^{2p_1} dx^2 - t^{2p_2} dy^2 - t^{2p_3} dz^2 \quad (5)$$

where  $p_1, p_2, p_3$  are three parameters satisfying  $p_1 + p_2 + p_3 = s$ ;  $p_1^2 + p_2^2 + p_3^2 = \theta$ . The parameters  $p_1, p_2, p_3$  will require to be constants and if at least two of the three are different, the space is anisotropic.

In this study, we consider the source of gravitational as magnetized strange quark matter. We consider the energy momentum tensor as taken in [28,29] which can be expressed as

$$T_{ij} = (p + \rho + h^2)u_i u_j + \left(\frac{h^2}{2} - p\right)g_{ij} - h_i h_j \quad (6)$$

here  $\rho$  is the energy density,  $p$  is the pressure,  $h^2$  represents the magnetic field and  $u_i$  is the four velocities. We can choose magnetic flux in the direction of  $x$ -axis satisfying  $u_i h^i = 0$  [7,28].

The solutions of  $f(R, T)$  gravity Harko et al. [4] represented three classes of  $f(R, T)$  models as follows

$$f(R, T) = \begin{cases} R + 2f(T) \\ f_1(R) + f_2(T) \\ f_1(R) + f_2(T)f_3(R) \end{cases} \quad (7)$$

In order to analyse the exact solutions of the Kasner universe, we consider the model  $f(R, T) = R + 2f(T)$ , where  $f(T)$  is an arbitrary function of the trace of the stress-energy tensor of matter.

We choose the arbitrary function  $f(T)$  given by,

$$f(T) = \mu T, \Rightarrow f'(T) = \mu \quad (8)$$

where  $\mu$  is a constant and dash (') denotes differentiation with respect to the argument.

For this choice, the  $f(R, T)$  gravity field equation (4) becomes

$$R_{ij} - \frac{1}{2}Rg_{ij} = (8\pi + 2\mu)T_{ij} + (2\mu p + \mu T)g_{ij} \quad (9)$$

Using co-moving coordinates, field equations of  $f(R, T)$  gravity for the given metric (5) are obtained as

$$t^{-2}[p_1(s-1) - l_0] = (\mu - 4\pi)h^2 - (8\pi + 3\mu)p + \mu\rho \quad (10)$$

$$t^{-2}[p_2(s-1) - l_0] = (4\pi + 3\mu)h^2 - (8\pi + 3\mu)p + \mu\rho \quad (11)$$

$$t^{-2}[p_3(s-1) - l_0] = (4\pi + 3\mu)h^2 - (8\pi + 3\mu)p + \mu\rho \quad (12)$$

$$t^{-2}\left[\frac{1}{2}(\theta - s^2)\right] = (12\pi + 5\mu)h^2 - \mu p + (8\pi + 3\mu)\rho \quad (13)$$

where,  $l_0 = \frac{1}{2}(s^2 - 2s + \theta)$ .

Using equation (10) and (12), we get  $p_1 = p_3$ . For this value, the above system of Eqs. (10)-(13) reduces to the following equations:

$$t^{-2}[p_1(s-1) - l_0] = (\mu - 4\pi)h^2 - (8\pi + 3\mu)p + \mu\rho \quad (14)$$

$$t^{-2}[p_2(s-1) - l_0] = (4\pi + 3\mu)h^2 - (8\pi + 3\mu)p + \mu\rho \quad (15)$$

$$t^{-2}\left[\frac{1}{2}(\theta - s^2)\right] = (12\pi + 5\mu)h^2 - \mu p + (8\pi + 3\mu)\rho \quad (16)$$

Using Eqs. (14)-(16), we obtain the magnetic flux, pressure and rest density can be expressed as

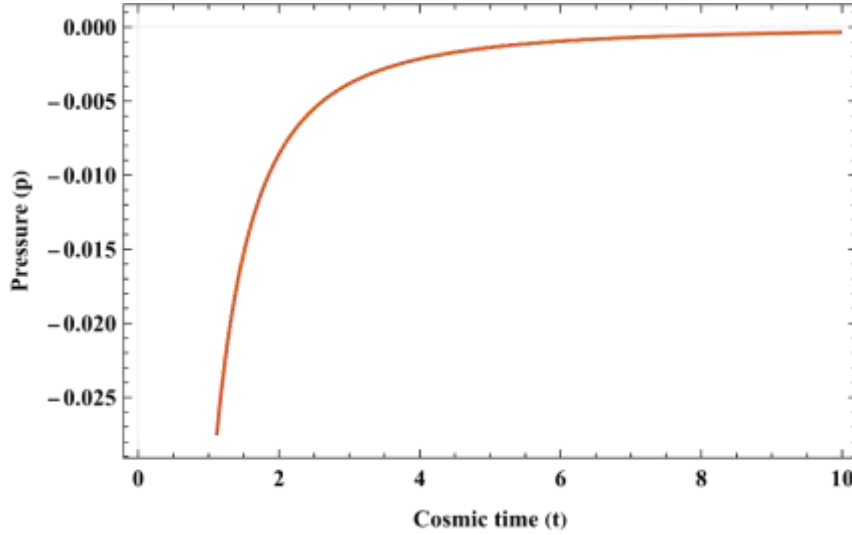
$$h^2 = t^{-2} \left[ \frac{(p_2 - p_1)(s-1)}{(8\pi + 2\mu)} \right]. \quad (17)$$

$$p = \left\{ \frac{\mu(\theta - s^2)}{2} + (8\pi + 3\mu) \left( p_2(s-1) - \frac{(s^2 - 2s + \theta)}{2} \right) + l_1(p_2 - p_1)(s-1) \right\} t^{-2} k^{-1}. \quad (18)$$

$$\rho = \left\{ \begin{aligned} & p_1(s-1) - \frac{(s^2-2s+\theta)}{2} + \frac{(4\pi-\mu)(p_2-p_1)(s-1)}{(8\pi+2\mu)} \\ & + \frac{(8\pi+3\mu)}{k} \left[ \frac{\mu(\theta-s^2)}{2} - (8\pi+3\mu) \left( p_2(s-1) - \frac{(s^2-2s+\theta)}{2} \right) \right] \\ & + l_1(p_2-p_1)(s-1) \end{aligned} \right\} t^{-2} \mu^{-1}. \quad (19)$$

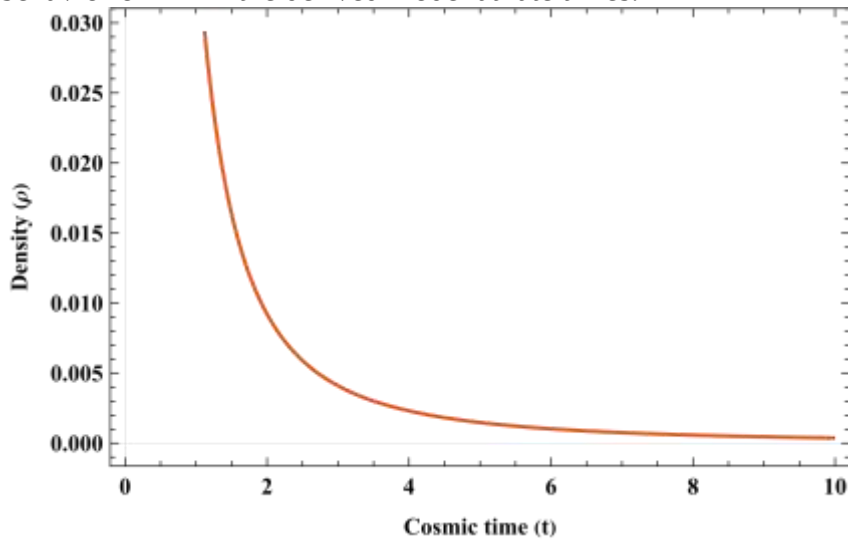
where,  $l_1 = \frac{(32\pi^2+12\pi\mu+4\mu^2)}{(8\pi+2\mu)}$  and  $k = (8\pi+2\mu)(8\pi+4\mu)$ .

From the equation (17), it is clear that the magnetic flux  $h^2$  vanishes for  $p_1 = p_2$ .

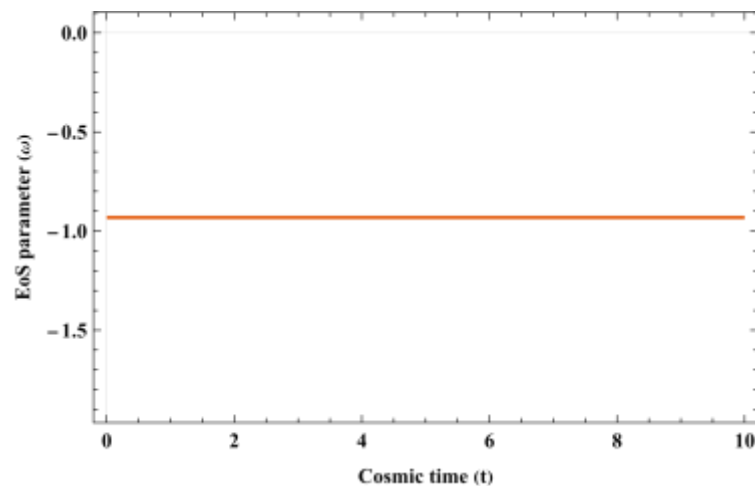


**Figure 1.** Plot of Pressure ( $p$ ) versus cosmic time ( $t$ ).

The figure 1 and figure 2 give the graphical presentation of pressure and density with the passage of cosmic time and from these figures, we observed that the pressure is negative and tends to be vanished at late times whereas density is positive and vanishes at late times. The EoS parameter ( $\omega$ ) is obtained from barotropic equation of state,  $p = \omega\rho$  and it turns out to have constant value. If  $\omega < -1$  then we observe the phantom-dominated universe and the quintessence dark era occurs for  $\omega < -1$ . As depicted in figure 3, it is interesting to observe that the EoS parameter  $\omega$  lies near to  $-1$  thereby behaving like cosmological constant, this is mathematically equivalent to cosmological constant  $\Lambda$  which is a suitable candidate to represent the behavior of DE in the derived model at late times.



**Figure 2.** Plot of density ( $\rho$ ) versus cosmic time ( $t$ ).



**Figure 3.** Plot of EoS parameter ( $\omega$ ) verses cosmic time ( $t$ ).

#### 4. Conclusions

In this paper, we have investigated the Bianchi-I Kasner type metric with magnetized strange quark matter (MSQM) distribution in  $f(R, T)$  gravity. In order to analyse the exact solutions of the Kasner universe, we consider the model  $f(R, T) = R + 2f(T)$ , with  $f(T) = \mu T$  and we obtain the rest density, pressure and magnetic flux. It is interesting to see that the magnetic flux vanishes for  $p_1 = p_2$ . The pressure is found to be negative and density is positive with the passage of cosmic time as depicted in figures 1-2. Moreover, the EoS parameter  $\omega$  lies near to  $-1$  thereby behaving like cosmological constant  $\Lambda$  which is a suitable candidate to represent the behavior of DE in the derived model at late times and provide a simple explanation for the Universe to be expanding faster.

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Several decades ago, the fields of astronomy and particle physics began to combine, forming the shared discipline of cosmology. The general populace has consistently shown greater fascination with the observable entities of astronomy rather than imperceptible atoms, and most likely encountered the field of cosmology for the first time through Steven Weinberg's renowned publication, "The First Three Minutes." While there is already a wide selection of popular monographs on cosmology, there is a lack of beginning textbooks specifically designed for university undergraduate level. Introductory works on relativity or astronomy have chapters on cosmology, although these chapters provide just a partial coverage of the subject. Undoubtedly, there are already excellent publications available on the subject of cosmology. The reader will indeed discover several references to such publications, which have proven to be an essential source of information for me. Cosmology, being expressly cross-disciplinary, does not hold a significant role in either physics or astronomy courses. Specifically, this text does not presume any prior understanding of general relativity.



Alfred Shaikh

# Introduction to Cosmology



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## Photovoltaic applications of SnO<sub>2</sub> gas sensor

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### Abstract

Tin oxide is a remarkable chemical in today's research because to its unique electrical and optical properties. Because of its huge band gap (3.6 eV), it is used as a core material in a wide range of important applications, including optoelectronics, spintronics, photovoltaics, thin-film transistors, photocatalysis, dielectrics, sensors, and transparent electronics. Thin film technology provides various advantages in the solar industry, including low cost, low material and energy consumption, and ease of use. Solar cells made from SnO<sub>2</sub> thin films have the potential to open up new technical paths for power production, with conversion efficiencies ranging from 15% to 20%. The authors examine and outline potential areas of SnO<sub>2</sub> research for photovoltaic and gas sensor applications. The data obtained will indicate the possibility of designing physical, chemical, magnetic, and optical characteristics of SnO<sub>2</sub> for sensing and photovoltaic applications.

**Keywords:** Tin oxide, Photovoltaic, Thin film, Gas sensors.

### 1. Introduction

Material science is the systematic investigation of any material to determine its varied characteristics and qualities. It covers a wide variety of applications, from manufacturing nanoscale gadgets to developing novel materials at the atomic level. In the current context, we are dealing with a number of difficulties linked to traditional energy sources, global warming, soil and water contamination, climate change, sanitation, and so on. Our primary objective is to alleviate these issues by bringing new technologies and advanced materials. Nanotechnology and thin films play an essential role in dealing with such challenges. As stated by [1], this can be used to enhance the performance of currently used materials and develop new functional materials. This is because they not only offer good opportunities to study the optical, electrical, and thermal properties in quantum confinement, but they also provide crucial understandings of the functional units involved in the fabrication of nanoscale electronic, optoelectronic, and magnetic devices.

ZnO, TiO<sub>2</sub>, and SnO<sub>2</sub> are the most studied metal oxides due to their unique global uses. Tin oxide is the best option for photovoltaic investigations since it is plentiful, affordable, and non-toxic. The primary goal of this research is to learn more about the functioning of SnO<sub>2</sub> and to identify potential research topics for future applications in photovoltaics and gas sensors [2].

### 2. Overview of Tin Oxide and its Properties

From the past several decades semiconducting (Metal) oxides such as ZnO, TiO<sub>2</sub> and SnO<sub>2</sub> have been demonstrated to be an essential class of transparent conducting oxides (TCO) for use in solar cells and gas sensors. Tin oxide is the most common material used in optoelectronics because to its low electrical resistance and high transmittance in the visible range [3]. Tin oxide is a good option for these uses due to its large band gap (3.6 eV) and strong excitation binding energy (130 MeV). It is the only group-IV oxide that exhibits transparent properties and excellent conductivity in the visible range of (300–800 nm). Bulk

$\text{SnO}_2$  is unable to achieve effective UV emission because of the dipole-forbidden rule. Structural morphology, tetragonal structure of pure and  $\text{SnO}_2$  thin films doped with TM of material is clearly visible by AFM measurements as shown in Fig.1.

### 3. Methodology

$\text{SnO}_2$  films may be grown using a variety of deposition processes, including chemical vapor deposition, spray pyrolysis, thermal evaporation, sol-gel, and sputtering. Recently, the Sol-Gel process was employed to create several high-quality thin films for photovoltaics and gas sensors.

#### 3.1 Chemical deposition technique

##### 3.1.1 Chemical vapor deposition (CVD)

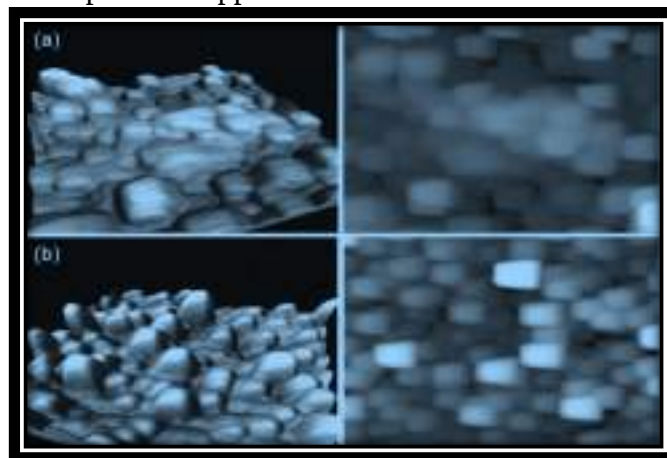
CVD is a chemical approach for vacuum deposition in which gaseous precursors are transferred into a chamber with the substrate. At high temperatures, the chemical interaction between the precursor and the substrate can provide the needed thin layer thickness. This is a prominent method in the semiconductor industry for producing high-quality, high-performance semiconductors [4]. There are numerous CVD methods for producing thin films, including thermal chemical vapor deposition, APCVD (Atmospheric-pressure CVD), MOCVD (Metalorganic chemical vapor deposition), PECVD (Plasma-enhanced chemical deposition), LCVD (Laser Assisted Vapor Deposition), and PACVD (Photo-assisted chemical vapor deposition).

##### 3.1.2 Atomic layer deposition (ALD)

The atomic layer deposition process is also known as vapor phase deposition. In this approach, the reactions between gaseous precursors and substrate occur one at a time. This process uses two or more gaseous precursors to produce a thin coating of the appropriate thickness. ALD is a step-by-step method in which precursors react exclusively with the available substrate and no further reactions occur after the surface is saturated. As a result, it is a slower process, but it allows for fine thickness control of the film even at lower temperatures [5,6].

##### 3.1.3 Sol- Gel Method

Sol-Gel is a chemical solution deposition process in which precursor materials generate a solution known as 'sol'. This 'sol' was placed on the substrate using a carefully regulated method. The Sol-Gel approach comprises a gelation process in which the precursor material converts from a liquid 'sol' to a solid 'gel' form [6]. This solution is known as a sol-gel, which is a continual mixture of suspended precursor particles and substrate. The sol-gel process includes spin coating, dipping, and spraying. Table 1 is a brief summary of various ways for synthesizing a thin film for practical applications.



**Fig. 1** — 3D AFM images of (a) pure  $\text{SnO}_2$  and (b) doped  $\text{Sn}_{0.095}\text{Mn}_{0.005}\text{O}_2$  thin films.

### 3.2 Physical deposition technique

#### 3.2.2 Sputtering

Sputtering is a physical thin film deposition process in which surface atoms are liberated by blasting the surface of a target material with ions before coming to rest on the substrate. At low temperatures, the target material for this deposition process is Nobel gas Argon. Normally, Nobel gas is less reactive, thus it acts neutrally during any chemical reaction in the chamber, making it a quick and reliable approach. Sputtering is obviously an etching method, making it suitable for surface cleaning applications [7]. We grouped the sputtering process into four types: diode sputtering, reactive sputtering, bias sputtering, and ion beam sputtering.

#### 3.2.3 Thermal evaporation

In thermal evaporation, the material is heated in a vacuum chamber until its surface atoms have sufficient energy to leave the surface. The evaporated material then condensed on the substrate for synthesis of thin film of desired thickness.

#### 3.2.4 Spray pyrolysis deposition

Spray pyrolysis involves spraying a solution over a heated surface to form a thin layer. Spray pyrolysis is the chemical dissociation or evaporation of droplets containing a solute of the desired nanomaterial [8]. As a result, it has been adopted by both gas-phase and liquid-phase approaches. The spray pyrolysis technique works by creating an aerosol from a variety of precursor solutions, such as a metallic salt solution or a colloidal solution<sup>25</sup>. It is a non-reversible method that achieves great efficiency.

### 4. Tin Oxide as Photovoltaic Cell

PV materials for photovoltaic applications work via the photoelectric effect. In this process, the exposed PV material turns electromagnetic energy (sunlight) into electrical energy. Photovoltaic cells are the most demanding renewable energy sources [9]. It offers several benefits over other sources of energy such as fossil fuels and petroleum. It is a viable and sustainable energy source that will meet growing energy demand without harming our environment. Zhu et al.[10] successfully used solution-processed SnO<sub>2</sub> nanocrystals to build an effective ETL for inverted thin film photovoltaic solar cells.

**Table 1 — A glance of various preparation methods of thin film deposition of SnO<sub>2</sub> material.**

| Thin Films Deposition Techniques                 |              |       |                                              |            |
|--------------------------------------------------|--------------|-------|----------------------------------------------|------------|
| Chemical Process (Non-equilibrium reaction)<br>↓ |              |       | Physical Process (Equilibrium reaction)<br>↓ |            |
| Plating                                          | Sol Gel      | CVD   | Evaporation                                  | Sputtering |
| Electroplating                                   | Dipping      | MOCVD | Ion Plating                                  | RF         |
| Electrolysis                                     | Spraying     | PECVD | MBE                                          | DC         |
| Flame Hydrolysis deposition (FHD)                | Spin Coating | ALD   | Laser ablation & Electron Beam               | Magnetron  |

They proposed that due to several unique features, SnO<sub>2</sub> is more suitable than ZnO and TiO<sub>2</sub>. In their article, Dong et al. [11] investigated compact SnO<sub>2</sub> ESL and compact TiO<sub>2</sub> ESL, as well as their PCEs. Fabrication of thin films using the sol-gel technique. They characterized the films using SEM, J-V curves, PL, XRD, and IPCE. In their article, Roose et al. [12] detailed the UV instability of a perovskite solar cell employing my TiO<sub>2</sub>. They came to the conclusion that employing a thin coating of m- SnO<sub>2</sub> may solve this instability. In their trials, they reached a high efficiency of around 16.4%. The solar cell is made from Ga doped SnO<sub>2</sub> film. The authors reported an approximate PCE of up to 23% for perovskite solar cells using the spin

coating and single gel procedures for deposition of SnO<sub>2</sub> thin films and examination of their characteristics by comparing thermally annealed SnO<sub>2</sub> TF (T-SnO<sub>2</sub>) and P- SnO<sub>2</sub> TF [13-14].

### 5. Tin Oxide as Gas Sensors

Nowadays, gas sensors are the most exciting study topic because they are effective in monitoring environmental concerns based on the needs of physical, chemical, and biological processes in the Earth's atmosphere. Researchers want to increase its durability, responsiveness, and sensitivity. Gas sensors have an essential role in environmental monitoring, medical applications, breath analysis for medical diagnostics, industrial applications, food processing, and so on [15]. Gas sensors are primarily used to differentiate odors, detect gases, and monitor changes in specific gases in the atmosphere. Material selection has a significant impact on gas sensor performance.

Beniwal A et al. [15] explored a SnO<sub>2</sub> sensor for detecting low-concentration ammonia at ambient temperature. They synthesized SnO<sub>2</sub> thin films using the sol-gel process and characterized them using XRD, AFM, XPS, and SEM. They concluded

that it is a highly promising sensor for detecting Ammonia concentration at extremely low temperatures, and that it would have a wide range of applications in the future due to its outstanding stability, adequate recovery time, and good responsiveness. Gupta P et al. [16] proposed that doping Zn improves the gas sensing characteristics of SnO<sub>2</sub>, such as surface shape, crystallinity, crystal size, and so on. They found that SnO<sub>2</sub> has higher sensitivity for O<sub>2</sub> gas sensing than pure and Zn doped SnO<sub>2</sub>. Khuspe G D et al. [17] found in their investigation that SnO<sub>2</sub> is more sensitive and stable to NO<sub>2</sub> gas. They reported a higher sensor response of 19% and stability of 77.90%. Zhou Q et al. [18] found that Ni and Zn doped SnO<sub>2</sub> gas sensors recovered and responded more quickly than specific Zn or Ni doped SnO<sub>2</sub> nanomaterials did. They conducted several studies on the concentration of harmful CO gas and discovered improved sensitivity and stability.

### 6. Results and Discussion

The authors of the current study looked into recent improvements in tin oxide. A study on alternate methods for producing SnO<sub>2</sub> thin films in pure, composite, and doped with transition metals to exhibit structural and electrical properties has been presented. This article describes many methods of synthesizing SnO<sub>2</sub> films to highlight their merits and drawbacks, as well as numerous advances and their different effects and potential applications, notably in photovoltaics and gas sensors. With so many fascinating applications for SnO<sub>2</sub> thin films, we are concentrating on the most demanding ones: photovoltaics and sensors. Excellent charge collecting qualities in solar cells and a promising future for green energy technology are two of SnO<sub>2</sub>'s many advantages. Pure SnO<sub>2</sub> thin films produced using a variety of techniques, including sol-gel, ALD, spin coating, PLD, and sputtering, had the highest PCE of 19.56% [14]. The PCEs of Nb doped SnO<sub>2</sub> thin film, Mg doped SnO<sub>2</sub> thin film, and Ga doped SnO<sub>2</sub> thin film, with doping of transition metals, are 17.57%, 14.60%, and 16.40%, respectively [35–37]. According to the inquiry, the Composite thin film of SnO<sub>2</sub>-TiO<sub>2</sub> acquired the greatest PCE of all the studies, 21.10%. Comparably, pure SnO<sub>2</sub> thin films made using the Sol-gel process respond to ammonia (NH<sub>3</sub>) gas with a 28% reaction and NO<sub>2</sub> gas with a 19% response [15, 17]. The authors have reported an enhanced high response and sensitivity of 37.6% for the monitoring of O<sub>2</sub> gas by doping of Zn in SnO<sub>2</sub> thin film [16]. Researchers used Ni and Zn doping in their studies to monitor CO gas, and they discovered that the responses were 7.28 and 5.90, respectively.

## 7. Conclusions

The fabrication of SnO<sub>2</sub> thin films using the Sol gel technique still has a lot of untapped potential. It is worth noting that, among the alternative synthesis technologies, the Sol gel technique is the most appropriate due to its clear advantages of precision, simplicity, flexibility, homogeneity, and uniformity. However, one of its advantages is that the manufacture of SnO<sub>2</sub> thin films by sol gel allows for essential characterizations such as XPS and VBS studies on SnO<sub>2</sub> materials. We hope that the study of this characterization technique may explore the new path of photovoltaic and gas sensor applications, which can be useful to achieve the desired efficiencies of solar cells for future aspects as well as excellent performance (gas response, selectivity, stability, sensitivity) in gas sensor.

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## Humidity Sensors: $\text{AlCl}_2$ -Dipped Nanocrystalline Magnesium Oxide

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### ABSTRACT

The investigation, magnesium oxide and  $\text{AlCl}_2$  were combined in varying mol% w/w stoichiometry. Thick layers of humidity sensors are made using the screen printing method. After testing every humidity sensor device, it was determined that the sample T-1, which was kept at a constant temperature between 400 and 700 degrees Celsius, had a high sensitivity and a quick response time to humidity sensing at room temperature. Curves in the case of conductivity are often jumbled and congested. Relative humidity has a linear effect on sample film conductivity. When sensors are kept at room temperature and their surface oxygen vacancies operate as electron donors, the resistance of thick films reduces.

**KEYWORDS:** Thick films,  $\text{MgO-AlCl}_2$ , Sensitivity, and Humidity sensors.

### 1. INTRODUCTION

The operator can manage the temperature and relative humidity in these humidity chambers at predetermined levels via the front panel.[1-4] The chamber's air is continuously circulating, scheduled to be compared to predetermined points. Electric resistance heaters, which regulate temperature by turning on and off, produce heat. There is a refrigeration unit that runs constantly on units with cooling. A low-pressure vapor generator injects water vapor into the chamber via a tiny opening to achieve chamber humidification. At the blower discharge, the water vapor enters the chamber. Test chambers were programmable, and they could be networked or connected to the Internet. The goal of the current work is to create and characterize the structure of magnesium oxide nanoparticles using the liquid phase method, which has the advantage of producing a greater surface area in a shorter amount of time at room temperature. This approach is also the most straightforward, economical, and environmentally benign. Through XRD analyses of  $\text{MgO}$  nanoparticles, its impact on the nanocrystalline size structure is also investigated.[5–12]

### 2. EXPERIMENTAL METHOS:

All of the chemicals utilized in this work were 99.99% pure GR grade chemicals that were bought from Sd-fine chemicals, India. The sol-gel technique is utilized to synthesize  $\text{MgO}$  nanoparticles. There are several processes involved in the synthesis of  $\text{MgO}$  nanoparticles, including stirring, drying, filtration, mixing, and calcination. Ultimately, the powder is calcined for three hours at 300 °C to produce  $\text{MgO}$  in the form of nanoparticles.

In screen printing, a mesh is used to transfer ink onto a substrate, with the exception of places blocked with a blocking stencil to prevent ink from penetrating such areas. In order to fill the gaps in the mesh with ink, a substance or gel is pushed over the screen, and vice versa, causing the screen to briefly make contact with the substrate along a line of contact. When the screen springs back after the blade has passed, the material gets moist on the substrate and is drawn out of the mesh holes. Similar to this, we utilize glass slides as the substrate and a paste made of nanomaterials in place of ink. Thus, instead of using the glass slide that we are using here, we are using mesh that has a less permeable stencil area. First, we take the 90% nanomaterial and use a solid binder (10%) called ethyl cellulose to build a paste out of it. Drop by drop, liquid binder is added to a well-ground mixture of nanomaterial and solid binder. Making sure the right amount of liquid binder is added requires caution. Thus, the ideal thick nanomaterial paste is made. Next, we proceed to apply a paste made of permeable mesh for well-layered nanomaterials to substrates (glass slides) using a squeegee. First, we let these thick

sheets of magnesium oxide nanoparticles dry in the air while they are being made. After that, they spend an hour in a vacuum oven set at 80°C. After that, we heated these thick sheets for three hours at 250°C in a muffle furnace. These thick films are now dipped in aluminum chloride for varying lengths of time [13–16].

Aluminum and chlorine make up the bulk of aluminum chloride ( $\text{AlCl}_3$ ). The substance is frequently mentioned as a Lewis acid. Aluminum chloride has been utilized in the dipping process by us. We produced an  $\text{AlCl}_3$  solution and then dipped a thick layer of magnesium oxide for varying durations of time. After dipping the slides for one, two, or three minutes, we fire them for one hour at 250°C to create three thick film slides for varying dipping times, and one thick film slide is taken for purity.

A measurement of humidity indicates how much water vapor is present in a gas or the atmosphere. The relative humidity and the ambient temperature work together to determine the comfort level.

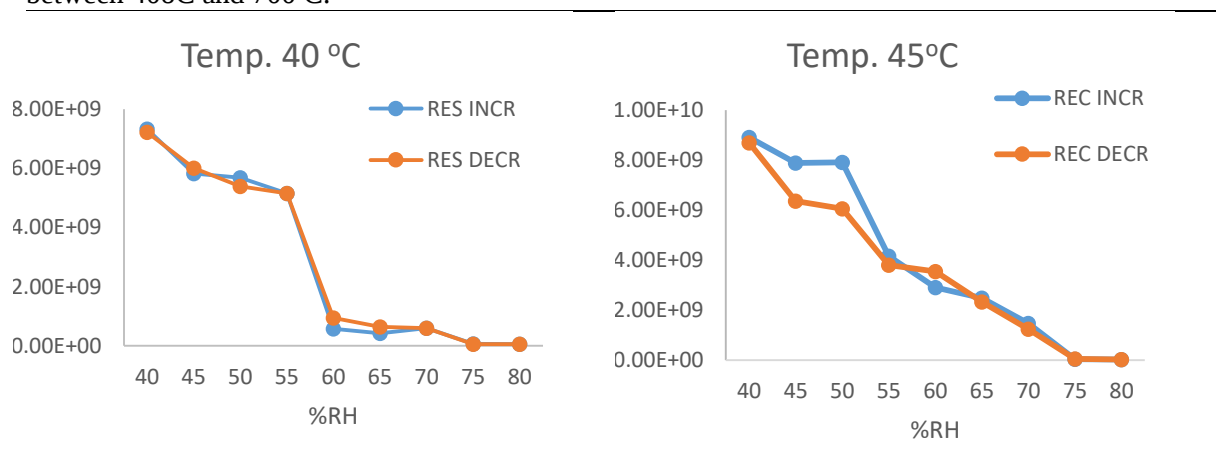
Measuring humidity is crucial for using some pieces of equipment. As a general rule, maintain a relative humidity of about 50% RH at a typical room temperature of 20 to 25 degrees Celsius. This can range from as low as 40% RH in clean rooms to 60% RH in operating rooms of hospitals.

Hygrometers are used to measure humidity. Sir John Leslie invented the first hygrometer. Measuring humidity is crucial for both controlling the indoor climate and forecasting the outdoor climate. [17–20]

### 3. RESULTS AND DISCUSSION:

#### 3.1 Hysteresis:

Hysteresis is the term for the phenomena when changes in an effect cause a physical property's value to lag behind. Our current study, which uses MgO nonmaterial thick films for humidity sensing, displays the hysteresis plot of samples M-1, M-2, M-3, and M-0 at a constant temperature of 40°C. The hysteresis plot illustrates the change in the sample's resistance in relation to relative humidity in stages of 5% RH, from 40 to 80% RH, and in both increasing and decreasing orders. Using a Keithley 2400 source meter, the resistance was measured in increments of 10–0C at various constant temperatures between 40oC and 700 C.



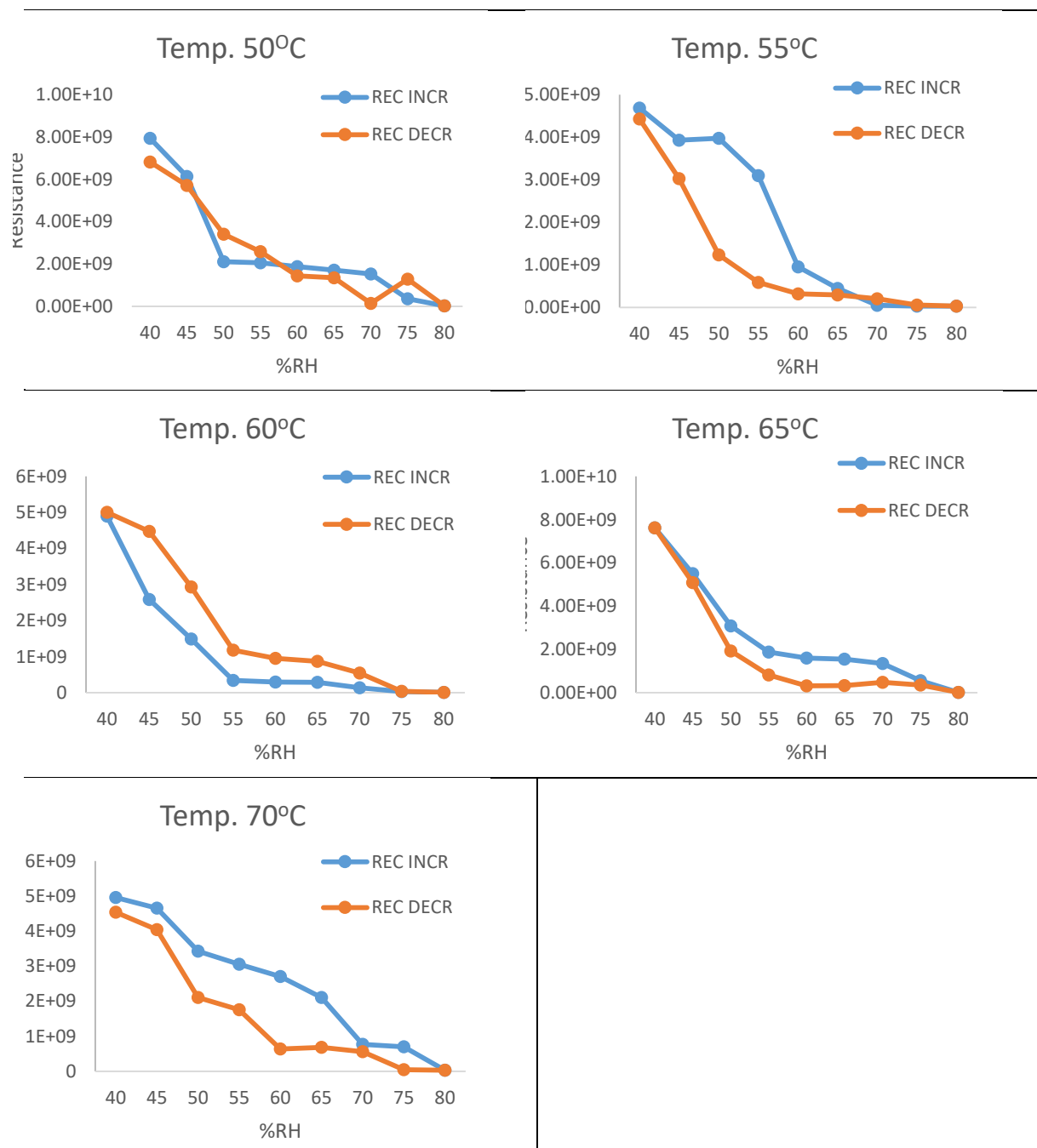


Figure 3.1 M-1 Metal oxide Thick Film (1-minute) hysteresis plot

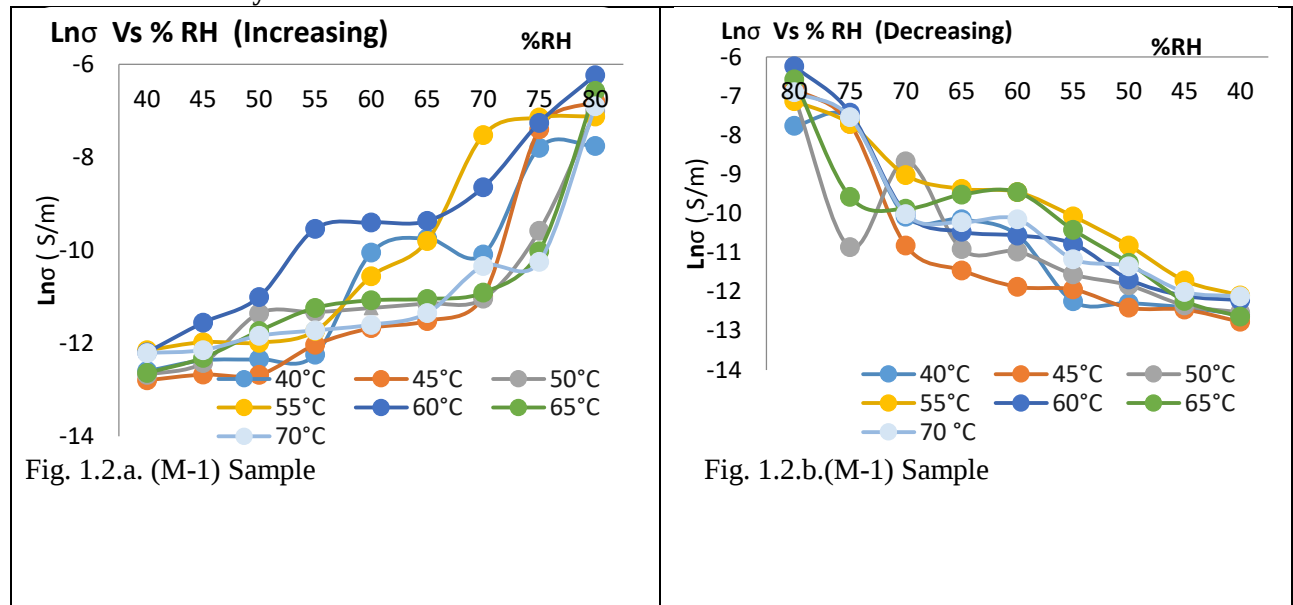
We may plot the graphs for the remaining samples in a similar manner. The hysteresis plot series of a sample, MgO nanomaterial film M-1, M-2, and M-3, dipped in aluminum chloride for varying dipping times, i.e., for 1, 2, and 3 minutes, respectively, and the hysteresis plot of a pure sample of MgO nanoparticle film at corresponding constant temperature are observed in the current work. It is evident from the hysteresis plot that relatively little hysteresis occurs during the forward (increasing) and reverse (decreasing) cycles of RH. The resistance value of the sample was found to have changed on average by a fairly substantial amount between 1010 and 108Ω.m. With the exception of sample M-1 (1 minute), the resistance value changes from 109 to 107Ω.m. between 40 and 80% RH. Sample M-1's resistance value noticeably changes from 40°C to 70°C at constant temperature.

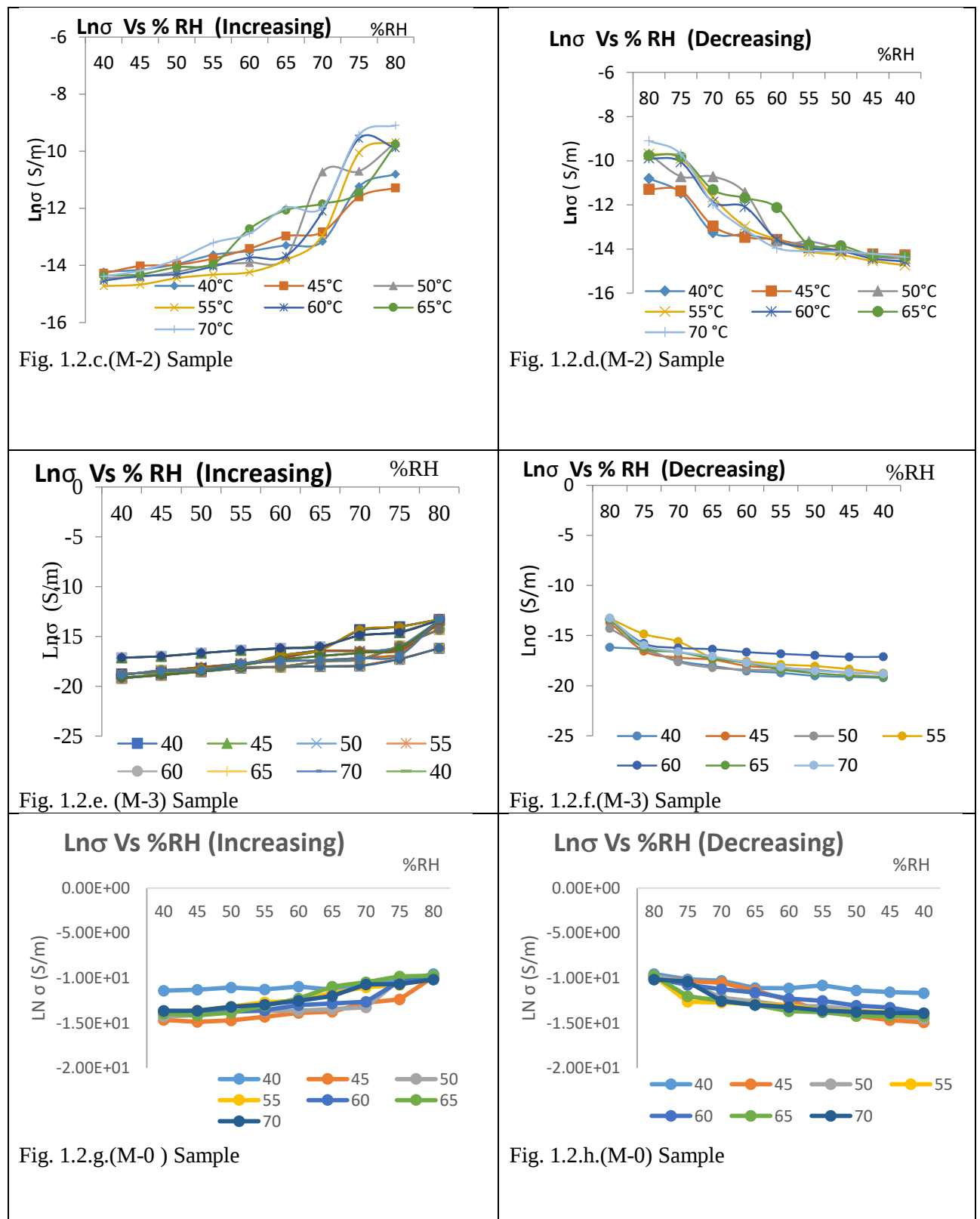
Table 2.1 Sample Codes

| Sr. No. | Sample | Thickness<br>$\times 10^{-6}$ m | Material                                                                                                                 |
|---------|--------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| 1.      | M-0    | 26                              | Pure MgO                                                                                                                 |
| 2.      | M-1    | 20                              | MgO +Dipped with $\text{AlCl}_3$ for 1 minutes dipping and after firing these slides for 1 hour at $250^\circ\text{C}$ . |
| 3.      | M-2    | 21                              | MgO +Dipped with $\text{AlCl}_3$ for 2 minutes dipping and after firing these slides for 1 hour at $250^\circ\text{C}$ . |
| 4.      | M-3    | 22                              | MgO +Dipped with $\text{AlCl}_3$ for 3 minutes dipping and after firing these slides for 1 hour at $250^\circ\text{C}$ . |

Because the processes of adsorption and desorption are not as quick at a given humidity, hysteresis was seen. The physisorbed water molecules are changed into chemisorbed by donating the surface electron at a constant temperature, as adsorption would not be effective and would result in a modest change in the value of resistance. Desorption necessitates a high activation energy. However, as we have shown, the sample in question exhibits a similar drop in resistance as the percentage RH increases, suggesting that conduction happens at the grain surface as a result of the release of electrons from the water molecule. As a result, the sample clearly demonstrates a shift in resistance between values in the humidity range of 40% to 80% RH. [21–28]

### 3.2 DC Conductivity

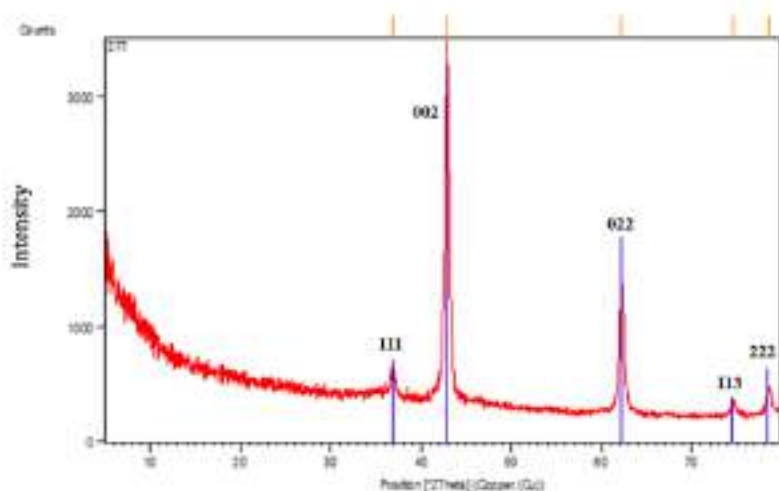




**Fig. 1.2 Variation (a-d)  $\text{Ln}\sigma$  Vs RH at different constant temperature (40°C to 80°C)**

The  $\text{Ln}\sigma$  fluctuation as the series sample's RH increases and decreases (from 40 to 80% RH and from 80 to 40% RH). correspondingly between 40°C and 70°C at constant temperature. From 40 to 80% relative humidity, it has been found that conductivity increases somewhat linearly and vice versa. The conductivity of sample M-1 rises in tandem with its temperature. The conductivity was found to be highest at high temperatures and lowest at 40°C for all sample series.[28–29]

### 3.2 XRD OF MAGNESIUM OXIDE



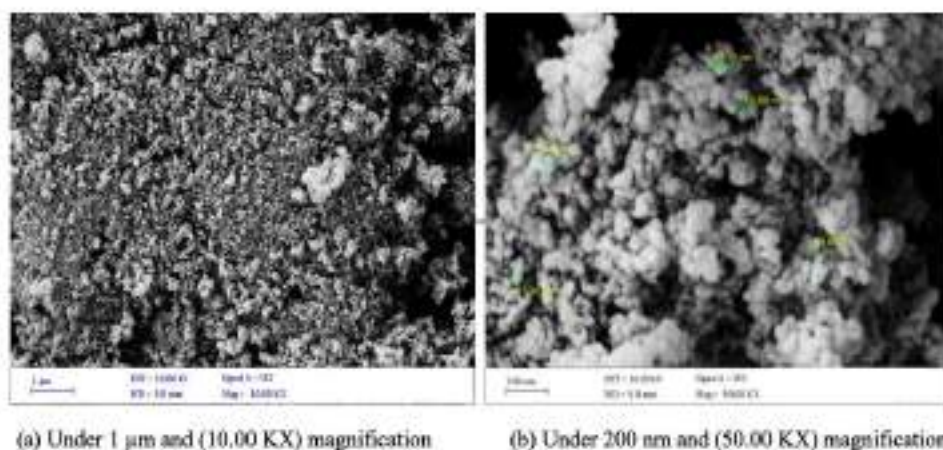
**Fig. 1.3 XRD pattern of Periclase Magnesium oxide (MgO)**

XRD peaks for sol-gel-synthesised MgO nanoparticles. These peaks, which are formed at (111), (002), (022), (113), and (222) planes, respectively, at  $2\theta = 36.862, 42.824, 62.167, 74.516,$  and  $78.443$  degrees, are compared with the ICSD, powder diffraction card of MgO file No. 43-1022. Moreover, the  $\text{Mg}(\text{OH})_2$  phase is absent from XRD patterns that highlight excellent purity. The diffraction peaks of the MgO nanoparticles made by sol-gel are slightly broadened, indicating a return to a tiny size of nanoparticles, but the sharp peaks in the XRD data for the microwave approach and the sol-gel route suggest uniform crystallinity. The Scherrer formula, found in Equation (1), was used to calculate the average crystalline size.

$$D = 0.9 \lambda \beta \cos \theta \dots (1)$$

Where  $D$  is the average crystalline size,  $\lambda$  is the X-ray wavelength,  $\beta$  is the Full Width at Half Maximum, and  $\theta$  is the Bragg diffraction angle.  $D$ , on the other hand, stands for the average crystal size determined by the diffraction peaks. For the sample made using the sol-gel method, it is visible at 33 nm.[30]

### 3.3 SEM PICTURES:



SEM pictures of MgO.

The morphology of nanocomposites as revealed by FE-SEM reveals that the particles are tiny, spherically-shaped, and nanoporous. On the surface, one can observe the formation of porous and nanocrystalline magnesium oxide. The prepared sample has an aggregated appearance. Along with a range of shapes and sizes, grains also have a nanoporous structure and organization at the nanoscale. The large surface area of the structure and the micro capillary pore are expected to facilitate the adsorption and condensation of water molecules. This porosity allows for good response to and recovery from humidity.

#### 4. CONCLUSIONS:

The investigation of humidity sensors has produced a novel detecting mechanism that may be used under many circumstances. The resistance value of the sample was found to have changed on average by a fairly substantial amount between 1010 and 108 ohm. Sample M-1's resistance value noticeably changes from 40°C to 70°C at constant temperature. When it comes to conductivity, curves are usually jumbled and packed. Sample film conductivity reacts to relative humidity in a linear fashion. The sample films demonstrate the noteworthy outcomes related to humidity sensing. The fact that every peak matches the MgO nanostructure exactly suggests that MgO nanoparticles were produced. Within the XRD instrument's detection limit, no more peaks were seen in the spectrum, showing the pure MgO Nanomaterial is synthesized.

#### 5. ACKNOWLEDGEMENT:

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## Advances and Perspectives in Nanotechnology: A Short Review

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### Abstract:

The process of modifying the shape and size of structures, electronics, and systems at the nanometer scale, i.e., 1 nm to 100 nm (10<sup>-9</sup>m), is known as nanotechnology. The prefix nano derives from the Greek word "nano," which meaning "very little". Because of their small size, they have larger surface areas than bulk forms, better reactivity, and the ability to control numerous features. These unique qualities have fueled the expansion of nanoscience and the use of nanoparticles in a variety of sectors such as biomedicine, cosmetics, electronics, food analysis, environmental and remediation, and painting. Nanoscale science and engineering enable us to understand and control matter at the atomic and molecular levels [1,2].

### Brief overview of nanotechnology's historical development

Nanotechnology's historical development traces back to a series of theoretical concepts and experimental observations. Here's a brief overview:

#### 1. Early Concepts (1950s-1960s):

The term "nanotechnology" was first coined by physicist Richard Feynman in his 1959 lecture, "There's Plenty of Room at the Bottom," where he discussed the possibilities of manipulating individual atoms and molecules. Physicist Eric Drexler expanded on these ideas in the 1980s with his book "Engines of Creation," envisioning nanoscale machines and their potential applications.

#### 2. Scanning Tunneling Microscopy (1981):

The development of the scanning tunneling microscope (STM) by Gerd Binnig and Heinrich Rohrer in 1981 revolutionized nanotechnology. It allowed researchers to visualize and manipulate individual atoms, opening the door to nanoscale exploration.

#### 3. Fullerenes and Nanotubes (1985):

In 1985, the discovery of fullerenes (buckyballs) by Robert Curl, Sir Harold Kroto, and Richard Smalley introduced a new class of nanomaterials. Later, carbon nanotubes, cylindrical structures with remarkable properties, were identified.

#### 4. Development of Nanolithography (1980s-1990s):

Advancements in nanolithography techniques, such as electron-beam lithography and photolithography, enabled precise control over nanoscale structures. This was crucial for the fabrication of nanodevices.

#### 5. Nobel Prize in Chemistry (1996):

The Nobel Prize in Chemistry was awarded to Robert Curl, Sir Harold Kroto, and Richard Smalley for their discovery of fullerenes. This recognition significantly boosted interest and research in nanotechnology.

**6. Bottom-Up Approaches (1990s-2000s):**

Scientists increasingly explored bottom-up approaches, involving self-assembly and molecular manipulation to create nanoscale structures. This shift in focus led to the development of nanomaterials and nanodevices with unique properties.

**7. Interdisciplinary Growth (2000s-Present):**

Nanotechnology became a highly interdisciplinary field, incorporating knowledge from physics, chemistry, biology, and engineering. Collaborative efforts led to breakthroughs in various applications, including medicine, electronics, energy, and materials science.

**8. Advancements in Nanomedicine (2000s-Present):**

Nanotechnology has made significant contributions to medicine, with developments in targeted drug delivery, imaging, and diagnostics. Nanoparticles are engineered for precise interactions with biological systems, improving treatment efficacy and reducing side effects. Nanotechnology continues to evolve, with ongoing breakthroughs shaping its future applications and impact across diverse scientific and industrial domains.

**9. Highlight major achievements and breakthroughs in the field.****1. Scanning Tunneling Microscopy (STM):**

Gerd Binnig and Heinrich Rohrer's creation of the STM in 1981 enabled scientists to observe and manipulate individual atoms, marking a watershed moment in nanoscale observation and manipulation.[3-4]

**2. Discovery of Fullerenes (1985):**

The discovery of fullerenes, particularly buckyballs (C<sub>60</sub>), by Robert Curl, Sir Harold Kroto, and Richard Smalley ushered in a new era of nanomaterials with distinct features, earning them the Nobel Prize in Chemistry in 1996. [5]

**3. Carbon Nanotubes (1991):**

Sumio Iijima's discovery and characterisation of carbon nanotubes gave rise to a new class of nanomaterials with exceptional mechanical, thermal, and electrical properties. [6]

**10. Types of Nanomaterials:**

NPs are divided into numerous classes based on their morphology, size, and chemical properties. Based on physical and chemical properties, some of the most well-known classes of NPs are mentioned below [7].

**10.1. Carbon-based NPs.**

Carbon nanotubes (CNTs) and fullerenes are two main groups of carbon-based NPs.

**10.1.1. Fullerenes.**

Fullerenes (C<sub>60</sub>) are spherical carbon molecules composed of carbon atoms joined by sp<sup>2</sup> hybridization. The spherical structure consists of around 28 to 1500 carbon atoms, with diameters ranging from 8.2 nm for single layers to 4 - 36 nm for multi-layered fullerenes [8]. Fullerenes contain nanomaterials comprised of globular hollow cages, such as allotropic forms of carbon. Commercial interest has been generated by their electrical conductivity, high strength, structure, electron affinity, and flexibility [9].

**10.1.2. Graphene.**

Graphene is a kind of carbon. Graphene is a two-dimensional planar hexagonal honeycomb lattice network of carbon atoms. A graphene sheet typically has a thickness of 1 nm [10].

**10.1.3. Carbon nanotubes (CNT).**

Carbon nanotubes (CNT) are made from graphene nano sheets with a honeycomb structure of atoms arranged into hollow coils to form nanotubes with sizes as small as 0.7 nm for single-layered CNT and 100 nm for multi-layered CNT, with lengths ranging from a few micrometers to several millimeters. The ends can be empty or closed with half fullerene molecules[11]. These have a structure that is akin to a graphite sheet rolling on itself [12]. The rolled sheets are referred to as single-walled (SWNTs), double-walled (DWNTs), or multi-walled carbon nanotubes (MWNTs) since they can have one, two, or multiple walls. It is common to create carbon precursors by deposition, particularly atomic carbon precursors. Carbons are vaporized from graphite and deposited on metal particles using a laser or an electric arc. Recently, they have been produced using the chemical vapor deposition (CVD) method [13].

**10.1.4. Carbon nanofiber.**

Carbon nanofiber is created in the same way that graphene nano foil and carbon nanotubes are. The distinction is that instead of conventional cylindrical tubes, it is twisted into a cone shape [14].

**10.1.5. Carbon black.**

Amorphous carbon is typically spherical in shape, with diameters ranging from 20 to 70 nm. They aggregate because the particles interact quickly, resulting in roughly 500 nm agglomerates [15].

**10.2. Metal NPs.**

Metal-based nanoparticles are created by reducing metals to nanometric sizes through destructive or constructive processes. Almost all metals may be produced using nanoparticles [16]. Aluminum, cadmium, cobalt, copper, gold, iron, lead, silver, and zinc are often utilized in the synthesis of nanoparticles. Nanoparticles have unique characteristics such as diameters ranging from 10 to 100nm, surface characteristics such as pore size, high surface to volume ratio, surface charge with density, crystalline structures, spherical morphologies, color, reactivity, and sensitivity . Metal precursors are employed in the creation of metal nanoparticles. These NPs have distinct optoelectrical properties due to restricted surface plasmon resonance (SPR). In the solar electromagnetic spectrum, noble metal and alkali NPs such as Cu, Au, and Ag exhibit a notable absorption band. In today's cutting-edge materials, the synthesis of size and shape-controlled metal NPs is critical [17].

**10.3. Metal oxide nanoparticles synthesis.**

Metals such as Cu and Ag, for example, can be extremely toxic to bacteria in trace amounts. Metals have been widely used as antimicrobial agents in a variety of applications in industry, healthcare, and agriculture in general due to their biocidal influence. Metals, unlike other antibacterial agents, are stable under present manufacturing settings and can thus be employed as additions [58,59]. These metal-based additives are currently available in a variety of forms, such as particles, ions absorbed/exchanged in different carriers, salts, hybrid structures, and so on. Many metal oxide nanoparticles have been investigated for electrochemical detection of biomolecules, including ZnO, NiO, MnO<sub>2</sub>, TiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub>, and Co<sub>3</sub>O<sub>4</sub>. Furthermore, mixed metal oxides have gotten a lot of attention in this field. CuO-NPs have distinct properties that make them valuable in a variety of applications, including super-strong materials, sensors, antibacterial agents, and catalysts. Because of the large surface area to volume ratio, it can also interact with other nanoparticles. CuO-NPs have recently been proven to be more effective against E coli and B subtilis than Ag-NPs. Because they are polymer-coated, CuO-NPs are

extensively used as antibacterial agents in paints and textiles.  $\text{TiO}_2$  and  $\text{ZnO}$  are often used because of their photolytic properties. Other fascinating metal-oxide NPs include  $\text{CeO}_2$ ,  $\text{CrO}_2$ ,  $\text{MoO}_3$ ,  $\text{Bi}_2\text{O}_3$ , and  $\text{LiCoO}_2$ .  $\text{CeO}_2$  is increasingly being employed as a combustion catalyst in diesel fuels to improve emission quality. Under biological conditions, iron oxide NPs (IO-NPs) must be highly crystalline, monodisperse, and water-soluble, with high magnetization values, reproducible quality, and acceptable biocompatibility. The two forms of superparamagnetic IONP-based nanoparticles are superparamagnetic iron-oxide (SPIO) nanoparticles with a mean crystal size of 50-100 nm and ultra-small superparamagnetic iron-oxide (USPIO) nanoparticles with a size less than 50 nm.[18-20]

#### 10.4. Ceramics NPs.

Ceramic nanoparticles (NPs) are nonmetallic inorganic solids formed by heating and cooling. They are available in a variety of shapes and sizes, including amorphous, polycrystalline, dense, porous, and hollow materials. Researchers are paying close attention to these NPs because to their use in applications such as catalysis, photo-degradation of dyes, photo-catalysis, and imaging [21].

#### 10.5. Semiconductor NPs.

Semiconductor materials have qualities that are halfway between metals and nonmetals, providing them a wide range of applications in the literature. Bandgap tuning resulted in considerable changes in the characteristics of semiconductor NPs due to their large bandgaps. As a result, they play an important role in photocatalysis, photo optics, and electronic devices. Several semiconductor NPs are very efficient in water splitting applications due to their ideal bandgap and band edge placements [22].

#### 10.6. Polymeric NPs.

These are often organic-based NPs that are referred to in the literature as polymer nanoparticles (PNPs). They are often nano-spherical or nano capsular in shape. The former are matrix particles with a solid overall mass, whilst the other molecules are adsorbed at the spherical surface's outside edge. The solid mass is entirely enclosed within the particle in the later scenario. Because PNPs are easy to functionalize, they have a wide range of applications in the literature. Lipid nanotechnology is a subfield that focuses on the design and fabrication of lipid nanoparticles for a variety of applications, including drug delivery and RNA release in cancer.[23]

### 11. Conclusions

Nanoparticles with varying properties are a common form of nanomaterial that has contributed in the growth of nanotechnology. Scientists interested in such approaches have lately produced their nanocomposites as a result of recent advances in the properties of new nanomaterials and their applications. This article defined nanotechnology and explained the procedures used to create nanomaterials from metals, metal oxides, graphene oxides, and polymers. Green techniques, such as plant extracts and microorganism biomolecules, are promising possibilities for synthesis of nanoparticles with low or no toxicity when compared to other methods. This review opens up new avenues for the creation and application of different nanomaterials.

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## Comparative Study Of Electrical Conductivity Of Proton Polymer Electrolyte With Different Nanofiller

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### Abstract

Polyvinyl alcohol doped with Ammonium nitrate and aluminum oxide ( $PVA+CH_3COONH_4+Al_2O_3$ ) synthesized by solution casting method. The comparatively study of AC, DC conductivity of ( $PVA+CH_3COONH_4+Al_2O_3$ ) and ( $PVA+CH_3COONH_4+SiO_2$ ) were studied. The AC and DC conductivities were increasing with respect to the temperature and frequency as compares to the individual conductivity of pristine materials. The dielectric study also reported.

**Keywords:**  $PVA+CH_3COONH_4+Al_2O_3$ , AC and DC Conductivity, dielectric constant

### Introduction

A polymer is a large molecule which is composed of many repeated subunits. Both synthetic and natural polymers play an important role in everyday life because of their wide range. Polymers, both natural and synthetic, are created via polymerization of many small molecules, known as monomers [1-5]. Poly (vinyl-alcohol) (PVOH, PVA, or PVA) is a water-soluble synthetic polymer. It has the idealized formula  $[CH_2CH(OH)]_n$ . It is used as an emulsion polymerization aid, as protective colloid, to make polyvinyl acetate dispersions. Examples of ammonium salts are ammonium chloride,  $NH_4Cl$ , ammonium nitrate,  $NH_4NO_3$ , and ammonium carbonate,  $(NH_4)_2CO_3$ . The chemical compound formula of ammonium acetate is  $[NH_4CH_3CO_2]$ . It is a white, hygroscopic solid and can be derived from the reaction of ammonia and acetic acid [6-8]. The present work devoted to study of AC and DC conductivity of Poly (vinyl-alcohol) and Ammonium nitrate doped with Aluminum Oxide ( $Al_2O_3$ ) and Silicon dioxide as Nanofillers.

### Experimental Technique

#### Method of preparation of PVA: Ammonium acetate Films

In the present work, isothermal evaporation technique has been used for the preparations of samples. Polymers PVA and ammonium salts were taken in pure form by mole percent and dissolved separately in double distilled water by mole percent. These solutions are mixed together by magnetic stirrer in the ratio 80:20. The solution mixture was then heated for 1 hour at  $70^\circ C$  to get completely homogeneous solution. A glass plate (15 cm x 15 cm) thoroughly cleaned with water and later with acetone was used as a substrate [9-10]. To achieve perfect leveling (and uniformity in thickness of the films), a pool of mercury was used in a plastic tray. The solution was poured on the glass plate and was allowed to spread uniformly in all directions on the substrate. The whole assembly was placed in a dust free chamber at room temperature. The solvent in the solution was thus allowed to evaporate completely and get air-dried. The film on the glass substrate was then removed and cut into small pieces of suitable sizes. Further it was dried for 3 days to remove any traces of solvent [10-14].

#### Method of preparation of PVA Ammonium acetate Films using Nanofiller

The nanofiller were dissolved in PVA with ammonium nitrate by different mole percent.

### Equipment Used For Material Preparation

#### Sonicator

Sonication is the act of applying sound energy to agitate particles in a sample, for various purposes. Ultrasonic frequencies ( $>20$  kHz) are usually used, leading to process also being known as ultra sonication. In the laboratory, it is usually applied using an ultrasonic bath or ultra sonic probe, colloquially known as sonicator.



**Fig (a).Sonicator**

## Electrode Coating

In thin a highly conducting, quick drying silver paint is applied on both side of the film by using a fine brush. It develops excellent adhesion & conductivity after 3-4 hours at room temperature. They have a current carrying capacity of 1.5 A.

## Lcr Meter

AC Conductivity and Dielectric Constant will be measured by using 4284 A Precision LCR meter (20 Hz-1 MHz) supplied by Agilent Technology, Singapore.



## Xrd Of Sample

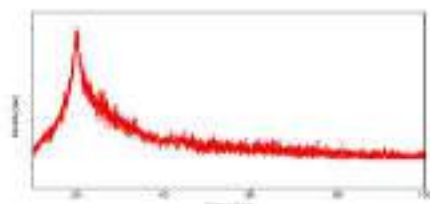


Fig.(a) XRD for pure PVA

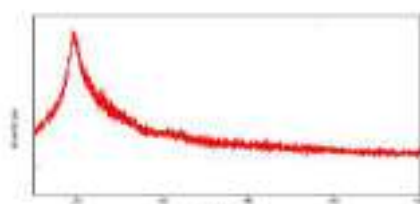


Fig.(b) XRD for PVA+AAC (80:20)

## Interpretation Of Xrd Graphs

The X-ray Diffraction Pattern of pure PVA and Complex with 20 mole % of Ammonium Acetate as shown in Fig (a) & Fig (b). Fig (a) & Fig (b) exhibits the Broad peak in the  $2\theta$  range from  $18-22^\circ$ , which matched well with (110) reflection due to pure PVA reported in the Literature. According to literature, there is a correlation between the intensity of the peak and the degree of crystallinity. The absence of peaks corresponding to ammonium acetate confirms the complete dissociation of it in the polymer matrix. The concentration of ammonium acetate increases then the crystallinity decreases and amorphosity increases.

## Results And Discussion

### Dc Conductivity

#### I/V Characteristics

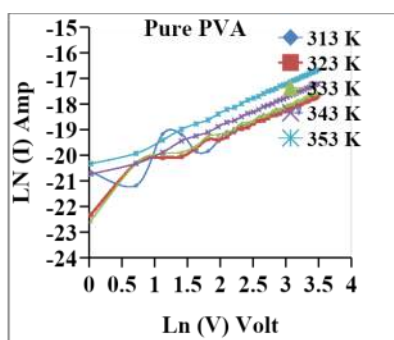


Fig 3.1. (a)

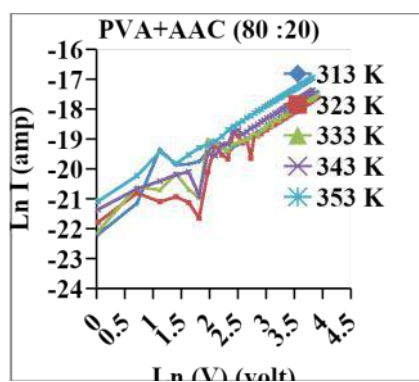


Fig 3.1. (b)

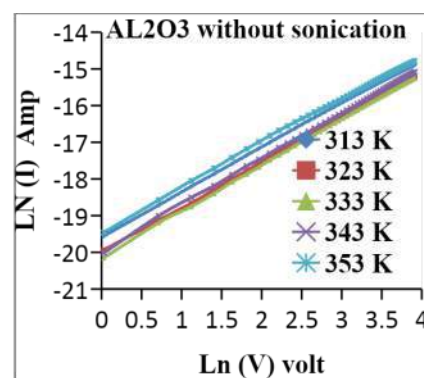
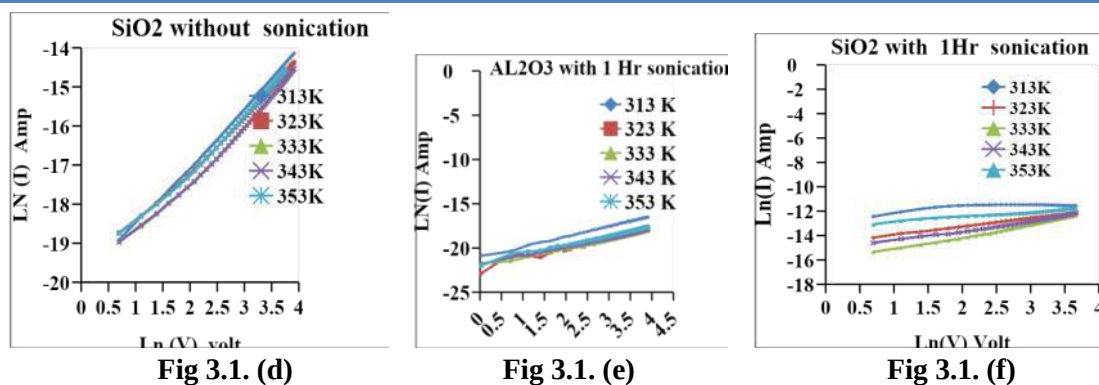
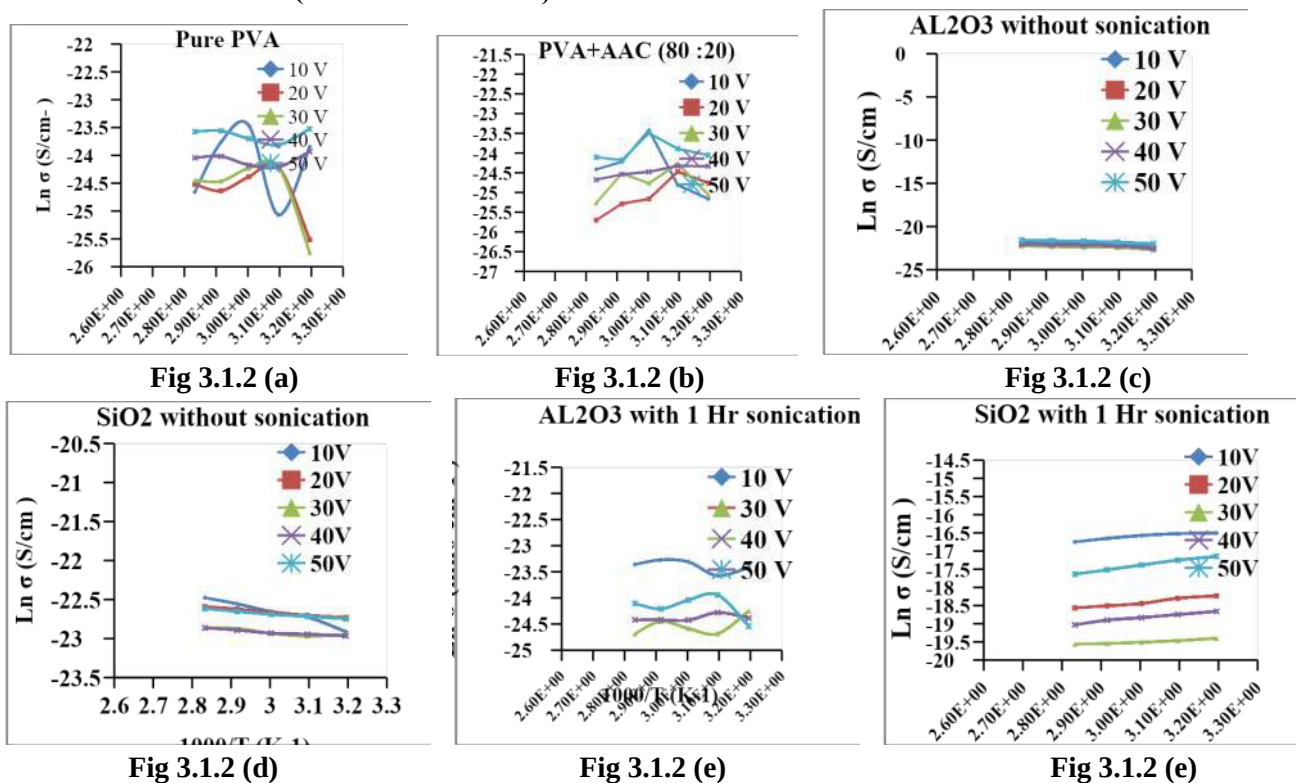


Fig 3.1. (c)



From the above graphs Fig 3.1(a,b,c,d,e & f) it is observed that for pure PVA and PVA+AAc when the voltage is increases there is also increase in the current so that it nearly obeys the ohm's law. But, when nanofillers are doped to the sample there was also observed that the voltage is increasing with the increasing current and it perfectly obeys the ohm's law.

• Arrhenius Plot (1000/T V/S Ln  $\sigma$ ) :



The temperature dependence of proton conductivity for all the prepared doped blend polymer electrolyte over the temperature range 313-K 353-K as shown in fig 3.1.2(a, b, c, d, e & f). It is seen that the conductivity increases linearly with an increase of temperature for PVA:  $\text{NH}_4\text{COOCH}_3$  (80:20). This is favorable to high conductivity of high temperature. The polymer complex PVA:  $\text{NH}_4\text{COOCH}_3$  (80:20) exhibits the highest ionic conductivity. The DC conductivity values follow the Arrhenius type thermally activated process given by the following relation

$$\sigma = \sigma_0 \exp(-E_a/kT) \quad (1)$$

Where  $\sigma_0$  is the pre-exponential factor,  $E_a$  is the activation energy and  $k$  is the Boltzmann constant. The temperature dependence of ionic conductivity for the composition PVA :  $\text{NH}_4\text{COOCH}_3$  (80 : 20) polymer electrolyte, it has been observed that the proton conductivity of electrolyte increases with increasing in temperature for all complexes. The linear variation of ionic conductivity with inverse of absolute temperature reveals the Arrhenius type thermally activated process given by the relation

$$\sigma T = \sigma_0 e^{(-E_a/kT)} \quad (2)$$

Where  $\sigma_0$  is the pre-exponential factor,  $E_a$  is the activation energy,  $T$  is the absolute temperature and  $k$  is the Boltzmann constant. Drudger et al. have attributed the increasing conductivity with temperature in solid

polymer electrolyte to segmental motion, which results in an increasing in the free volume of system. Thus the segmental motion either permits the ions to hop from one site to another or provides a pathway for ions to move. As the amorphous region increases, the polymer chain acquires faster internal modes in which bond rotation produces segmental motion to favor inter and interchange ion hopping, thus the conductivity become high.

### Ac Conductivity

#### • Dielectric Constant V/S Frequency

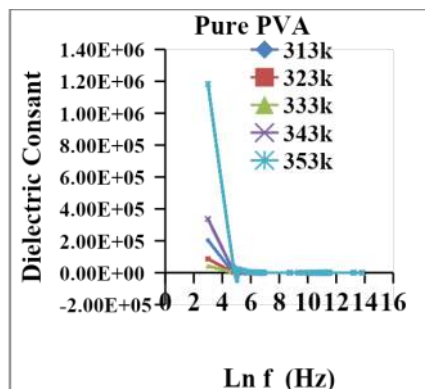


Fig 3.2.1(a)

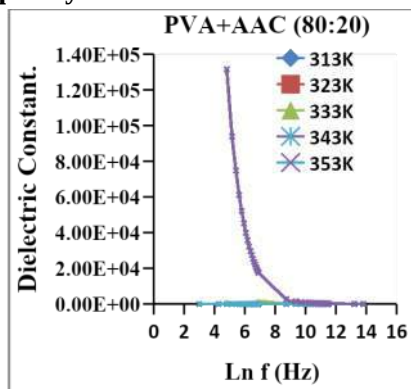


Fig 3.2.1(b)

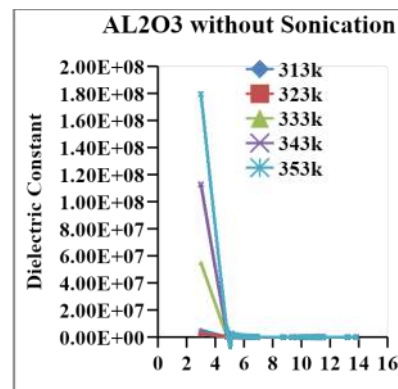


Fig 3.2.1(c)

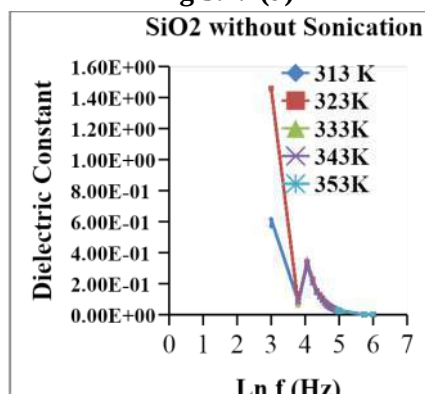


FIG 3.2.1(d)

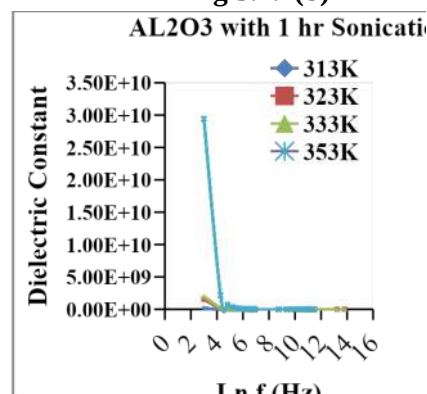


Fig 3.2.1(e)

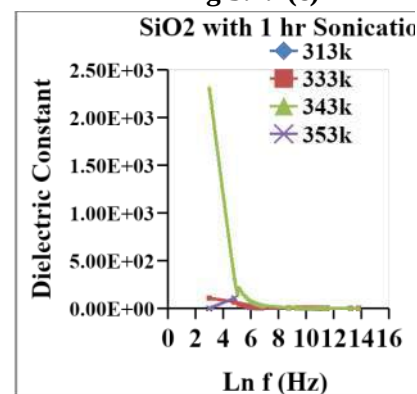


Fig 3.2.1(f)

From the above graphs fig 3.2.1 (a, b, c, d, e & f) it is observed that dielectric constant decreases with increase in the frequency and attain a constant value at higher frequency range similar to that for the polar material. The initial value of permivity is high but with the increase in the frequency, this value begins to decrease. This is expected behavior in most dielectric materials. We have also noticed that there is increase of dielectric constant with the increase in temperature.

Figure 3.2.1 (a, b, c, d, e, f, g & h) represents frequency dependence of dielectric constant for room temperature and 20 mol% of  $\text{NH}_4\text{COOCH}_3$  doped with PVA. In the above figure the observed variation in dielectric constant with frequency could be attributed to the formation of space charge region at the electrode and electrolyte interface, which is familiarly known as the non-Debye type of behavior, where the space charge region with respect to frequency are explain in terms of ion diffusion. The increase in the dielectric constant represents a fractional increase in charge within the polymer electrolyte. It is clear that the value of dielectric constant is very high at very low frequency region. It is due to the presence of space charge effects which is contributed by the accumulation of charge carriers near the electrode. At high frequency, dielectric constant has been found to be relatively constant with frequency. This is because periodic reversal of the field takes place so rapidly that the charge carries will be able to orient themselves in the field direction resulting in a decrease of dielectric constant. An increase in value of dielectric constant has been observed at higher temperature and is attributed to the higher charge carrier density. Same result occurs in composite polymer electrolyte.

### • Arrhenius Plot

#### Frequency V/S Ln $\Sigma$

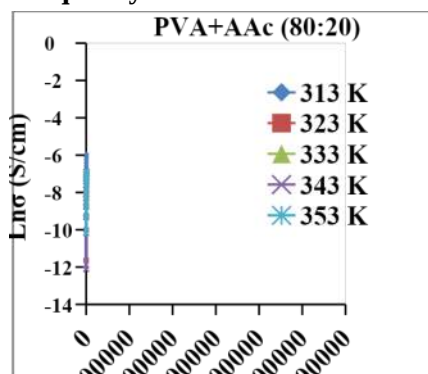


Fig 3.2.2(a)

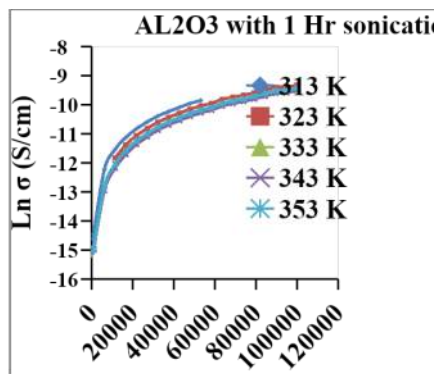


Fig 3.2.2(b)

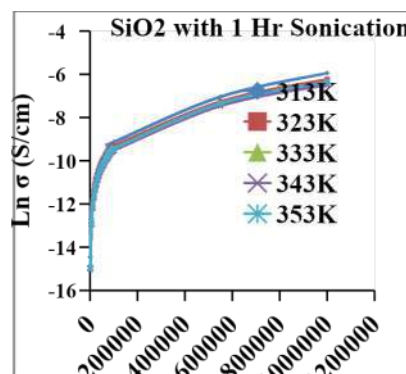


Fig 3.2.2(c)

From the above graphs, fig 3.2.2(a), fig 3.2.2(b) and fig 3.2.2(c) it is concluded that the AC conductivity of pure PVA increases when it is doped with 20 mole% of ammonium acetate concentration. As shown in graph the conductivity of pure PVA at room temperature increases with addition of ammonium acetate. The conductivity increases with increase of ammonium acetate up to 20 mole%, because the number of mobile charges increases which is useful for the purpose of conduction. After adding nanofiller such as  $\text{Al}_2\text{O}_3$  &  $\text{SiO}_2$  there is observed a gradual increase in the conductivity of the polymer electrolyte. The frequency dependence conductivity of polymer electrolyte obeys Jonscher's power law. The conductance spectra consist of three distinct regions. The low frequency dispersion region can be ascribed to the space charge polarization at the blocking electrode. The final high frequency region conductivity dispersion has been observed, and it is predominant at low temperature. The high frequency region for different temperature has been explained through Jonscher's universal power law.

$$\sigma(\omega) = \sigma_{dc} + A \omega^\alpha$$

$\sigma_{dc}$  is the frequency independent conductivity of the prepared polymer electrolyte.  $A$  is the temperature-dependent dispersion parameter, and  $\alpha$  is the power law exponent ( $0 < \alpha < 1$ ) that has been fitted to experimental data at medium and high frequency region using non-linear least square fitting procedure. From the result, it has been found that the DC conductivity values are in good agreement with this obtained from Cole-Cole plot. It has been found that the DC conductivity increases with an increase of temperature which suggests that the free volume around the polymer chain causes the increase in mobility of ions and polymer segments, and hence the conductivity increases.

### Conclusions

PVA based polymer electrolyte with concentration of ammonium acetate and doped with  $\text{Al}_2\text{O}_3$  &  $\text{SiO}_2$  have been prepared by solution cast technique. The XRD spectrum confirms the amorphous nature of the polymer electrolyte with the addition of  $\text{NH}_4\text{COOCH}_3$  salt of solid polymer electrolyte. The highest ionic conductivity has been found to be PVA:  $\text{NH}_4\text{COOCH}_3$  (80:20) polymer electrolyte from the Cole-Cole plot and also confirms the conduction spectrum. The increase in conductivity may be due to increase in amorphous nature and complex formation confirmed by XRD spectrum. The temperature dependence conductivity of proton conductor polymer electrolyte PVA:  $\text{NH}_4\text{COOCH}_3$  and composite polymer electrolyte PVA:  $\text{NH}_4\text{COOCH}_3$ :  $\text{Al}_2\text{O}_3$  and PVA:  $\text{NH}_4\text{COOCH}_3$ :  $\text{SiO}_2$  obeys the Arrhenius behavior. The temperature dependence conductivity of PVA:  $\text{NH}_4\text{COOCH}_3$ :  $\text{Al}_2\text{O}_3$  ( $1.60 \times 10^{-1}$ ) is greater than electrolyte PVA:  $\text{NH}_4\text{COOCH}_3$ :  $\text{SiO}_2$ . Frequency dependence conductivity of proton conductor polymer electrolyte PVA:  $\text{NH}_4\text{COOCH}_3$  and composite polymer electrolyte PVA:  $\text{NH}_4\text{COOCH}_3$ :  $\text{Al}_2\text{O}_3$  and PVA:  $\text{NH}_4\text{COOCH}_3$ :  $\text{SiO}_2$  obeys Jonscher's power law. The low value of  $n$  ( $n = \text{exponent value}$ ) shows less coulombic interaction between ions which enhances the ionic conductivity. The proton conductor polymer electrolyte PVA:  $\text{NH}_4\text{COOCH}_3$  and composite polymer electrolyte PVA:  $\text{NH}_4\text{COOCH}_3$ :  $\text{Al}_2\text{O}_3$  has the highest dielectric constant indicating highest storage capacity.

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या संपादकीय ग्रंथात समाविष्ट सर्व संशोधनपर लेखांशी संपादक मंडळ सहमत असेलच असे नाही. समाविष्ट सर्व लेखांची जबाबदारी ही सर्वेक लेखकांची असते.

## A Multidisciplinary Approach to Higher Education / Volume I

Edited By

Dr. Vikrant R. Wankhade, Dr. Khushal J. Alaspure

Dr. Akash V. More, Dr. Shrikant S. Mahulkar

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#### Abstract :

Holistic nutrition is gaining recognition as a crucial component in optimizing athletic performance and overall well-being. This abstract explores the integration of holistic nutrition principles into athletic training programs, emphasizing a comprehensive approach to address the diverse needs of athletes. By considering not only macronutrient and micronutrient intake but also factors such as meal timing, hydration, and individualized dietary plans, athletes can achieve enhanced performance, improved recovery, and reduced risk of injury. Incorporating holistic nutrition into athletic training programs involves collaboration among coaches, nutritionists, and other healthcare professionals to develop personalized dietary plans tailored to athletes' specific needs and goals. Moreover, the abstract discusses the significance of education and ongoing support in fostering sustainable dietary habits among athletes.

#### Introduction :

In the realm of athletic training and performance enhancement, the role of nutrition has evolved beyond mere fuel provision to encompass a holistic approach that considers the interconnectedness of various physiological, psychological, and environmental factors. Holistic nutrition recognizes that optimal athletic performance is not solely determined by macronutrient ratios and caloric counts but also by the quality, timing, and individualized nature of dietary intake. This introduction sets the stage for exploring the various dimensions of holistic nutrition in athletic training programs, from the scientific basis of nutrient metabolism to practical strategies for implementation and ongoing support. By examining nutrition through a holistic lens, we aim to empower athletes to achieve their full potential, not only as competitors but also as individuals striving for holistic well-being. Athletes are constantly pushing the boundaries of human performance, striving to achieve their utmost potential in their respective sports, considering not only the macronutrient and micronutrient composition of foods but also the broader aspects of dietary quality, timing, and individualization.

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#### The Athletes Diet :

Athletes engaged in daily sports training require a well-balanced diet that provides the necessary nutrients, and hydration to support their training and promote recovery, and optimize performance.

- **Carbohydrates :** Carbohydrates are the primary source for high-intensity exercise and should comprise a significant portion of an athlete's diet. Athletes consume complex carbohydrates from sources such as whole grains, fruits, vegetables, and legumes to provide higher carbohydrate needs on days of intense training or competition.

- **Protein :** Protein is essential for muscle type growth, and recovery, especially after strength training or endurance exercise. Include high-quality protein sources in each meal, such as lean meat, poultry, fish, eggs, dairy products, legumes, tofu, and plant-based protein sources.

- **Fats :** Healthy fats play a role in providing sustained energy, supporting cellular function, and aiding in the absorption of fat-soluble vitamins. Incorporate sources of unsaturated fats, such as avocados, nuts, seeds, olive oil, and fatty fish like salmon and mackerel, into the diet.

- **Micronutrients :** Ensure adequate intake of vitamins and minerals essential for overall health and performance, including vitamin D, calcium, iron, magnesium, and antioxidants. Consume a variety of fruits, vegetables, whole grains, nuts, seeds, and proteins to meet micronutrient needs.

- **Hydration :** Hydration is critical for maintaining balance, regulating body temperature, and supporting performance and recovery. Drink water regularly throughout the day, aiming for at least 8-10 cups (64-80 ounces) per day, or more depending on the route, climate, and training duration.

#### Nutrition for Sportsmen :

- **Macronutrients :** Athletes require a balance of intake of carbohydrates, proteins, and fats to fuel

their training and performance. Carbohydrates serve as the primary energy source, especially during high-intensity exercise, while proteins support muscle repair and growth, and fats provide sustained energy and support cellular function.

- **Macronutrients :** Essential vitamins, minerals, and antioxidants play crucial roles in various physiological processes, including energy metabolism, immune function, and tissue repair. Athletes should consume a variety of fruits, vegetables, whole grains, lean proteins, and healthy fats to meet their micronutrient needs.

- **Nutrient Timing :** Timing nutrient intake around workouts is important for optimizing performance and recovery. Consuming carbohydrates before exercise can help fuel workouts, while consuming protein and carbohydrates post-exercise supports muscle repair and glycogen replenishment.

### Exercise for Sportsmen :

- **Training Types :** Athletes engage in a variety of training modalities, including endurance, strength, power, and flexibility training, depending on the requirements of their sport. Each type of training elicits specific physiological adaptations and requires tailored exercise programming.
- **Periodization :** Periodization involves systematically varying training volume, intensity, and recovery to optimize performance and prevent overtraining. By incorporating different phases of training throughout the season, athletes can maximize gains in strength, endurance, and skill development while minimizing the risk of injury and burnout.

- **Recovery :** Adequate rest and recovery are essential components of an athlete's training regimen. Rest days, proper sleep, nutrition, hydration, and recovery modalities such as foam rolling, stretching, and massage help athletes recover from intense workouts, reduce muscle soreness, and promote adaptation.

- **Pre-Exercise Nutrition :** Consuming carbohydrates with a moderate to high glycemic index before exercise can provide a quick source of energy for immediate use. Foods such as white bread, white rice, and sports drinks have a high GI and can be beneficial for athletes looking to top up their glycogen stores before a workout or competition.

- **During Exercise :** For prolonged endurance exercise lasting longer than 60-90 minutes, consuming carbohydrates with a moderate to high glycemic index during exercise can help maintain blood sugar levels and delay fatigue. Sports drinks, energy gels, and easily digestible carbohydrates like bananas or

raisins are examples of high-GI foods that can be consumed during exercise to provide a quick energy boost.

- **Exercise Duration and Intensity :** The glycemic index may be more relevant for endurance athletes engaging in prolonged, high-intensity exercise compared to athletes participating in shorter, lower-intensity activities.

### Pre-event meal :

The pre-event meal is a crucial component of an athlete's nutrition strategy, providing the fuel and nutrients necessary to optimize performance while minimizing the risk of digestive discomfort during exercise. Here's a guide to crafting an effective pre-event meal for sportsmen:

- **Timing :** Aim to consume the pre-event meal approximately 2-4 hours before the start of the event. This allows adequate time for digestion and absorption of nutrients while minimizing the risk of gastrointestinal distress during exercise.
- **Carbohydrates :** Prioritize carbohydrates as the main component of the pre-event meal. Carbohydrates serve as the primary fuel source for high-intensity exercise and help replenish glycogen stores in the muscles and liver.
- **Protein :** Include a moderate amount of protein in the pre-event meal to support muscle repair and satiety. Opt for lean protein sources that are easy to digest, such as grilled chicken, turkey, fish, tofu, or legumes.
- **Low-Fat :** Limit the amount of fat in the pre-event meal, as high-fat foods can slow digestion and increase the risk of gastrointestinal distress during exercise. Choose lean protein sources and avoid fried or greasy foods. However, including a small amount of healthy fats, such as avocado or nuts, can provide additional energy and satiety without compromising digestion.
- **Hydration :** Hydrate adequately before the event by drinking water or a sports drink with electrolytes. Dehydration can impair performance and increase the risk of heat-related illnesses, so it's essential to start the event well-hydrated. Avoid excessive consumption of caffeinated or sugary beverages, as they may cause dehydration or rapid changes in blood sugar levels.
- **Carbohydrates :** Choose easily digestible carbohydrates that provide a quick source of energy. Examples include sports drinks, energy gels, bananas, raisins, dates, or carbohydrate-rich snacks like rice cakes or pretzels. Carbohydrate intake during exer-

cise helps replenish glycogen stores and maintain blood sugar levels to sustain performance.

- **Hydration** : Drink fluids regularly to maintain hydration during exercise. Water is sufficient for shorter durations or low-intensity activities, but for prolonged or intense sessions, consider consuming a sports drink containing electrolytes (e.g., sodium, potassium) to replace fluids lost through sweat and maintain electrolyte balance.

- **Electrolytes** : In addition to hydration, replenishing electrolytes lost through sweat is essential, especially during prolonged exercise or in hot and humid conditions. Sports drinks, electrolyte tablets, or salt-containing snacks (e.g., pretzels) can help maintain electrolyte balance and prevent dehydration and muscle cramps.

- **Protein** : While carbohydrates are the primary fuel source during exercise, some athletes may benefit from consuming small amounts of protein to support muscle repair and reduce muscle breakdown, especially during ultra-endurance events or prolonged resistance training sessions. Choose easily digestible protein sources such as protein bars, shakes, or snacks containing whey protein isolate.

- **Portion Control** : Avoid consuming large or heavy meals during exercise, as they may lead to gastrointestinal discomfort or cramping. Instead, opt for small, easily digestible snacks or fluids that provide quick energy without causing digestive issues.

#### Water and sporting performance :

Water plays a critical role in sporting performance, as hydration status can significantly impact athletic abilities, endurance, and overall health. Proper hydration is essential for maintaining physiological function, regulating body temperature, and supporting optimal performance during exercise. Here are some key ways in which water influences sporting performance:

- **Recovery** : Proper hydration supports post-exercise recovery by facilitating nutrient delivery to muscles, removing metabolic waste products, and restoring fluid and electrolyte balance. Rehydrating after exercise helps replenish fluid losses, accelerate muscle recovery, and reduce the risk of post-exercise muscle soreness and fatigue.
- **Optimal Performance**: Maintaining optimal hydration status before, during, and after exercise is essential for maximizing sporting performance and achieving peak physical and mental performance. Hydration needs vary depending on factors such as exercise intensity, duration, environmental conditions, sweat rate, and individual sweat electrolyte composition.

#### Conclusion :

In conclusion, athletes, nutrition plays a pivotal role in optimizing athletic performance, supporting training, and promoting overall health and well-being in athletes. By adopting a holistic approach to nutrition, athletes can address the interconnected aspects of diet, lifestyle, and individual needs to achieve peak performance and long-term success in their respective sports.

1. **Whole-Food Emphasis** : Prioritizing nutrient-dense whole foods over processed options provides athletes with the essential vitamins, minerals, phytonutrients needed to fuel workouts, support muscle repair, and enhance recovery.
2. **Dietary Diversity** : Incorporating a wide variety of foods ensures adequate intake of macronutrients, micronutrients, and antioxidants, which are essential for optimizing performance, supporting immune function, and reducing inflammation.
3. **Individualization** : Tailoring nutrition plans to the specific needs, goals, and preferences of athletes is essential for optimizing performance and promoting adherence to dietary recommendations.
4. **Balance and Moderation** : Avoiding extreme diets and fad trends helps athletes maintain a balanced approach to nutrition, supporting long-term health, sustainability, and enjoyment of food.
5. **Hydration and Gut Health** : Prioritizing hydration and supporting gut health through proper hydration, electrolyte balance, and consumption of probiotics and prebiotics are integral components of holistic nutrition for athletes.

By integrating these principles into athletic training programs, coaches, sports nutritionists, and athletes collaborate to develop personalized nutrition strategies that enhance performance, support recovery, and promote overall well-being.

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Cell Biology and Developmental Biology

Semester - III

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**Volume - II**

**Edited By**

**Dr. Vikrant R. Wankhade**

**Dr. Khushal J. Alaspure**

**Dr. Akash V. More**

**Dr. Shrikant S. Mahulkar**

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# Study On Plankton Biodiversity with respect to Fish Production in Borgon Dam Yavatmal, Taluka Yavatmal, Dist. Yavatmal, (M.S.) India

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## Abstract :

Water resources are natural resources of water that are potentially useful for animals. Zooplankton holds a key position in the food web as it was directly related to the consumption of organic energy produced through photosynthesis by phytoplanktonic and then by transforming it to the higher trophic levels of heterotrophs such as fish. In this investigation, samples were gathered using fishing nets with the assistance of local fishermen, and they were recognized using identification keys. Eleven fish species from the area were identified, categorized into six orders and seven families. Family Cyprinidae species of the order Cypriniformes was the most dominating order. Second dominating Order Siluriforms family Siluridae have species *ompak pobda* and Bagridae family have species *Mystus carasius*. Anguilliformes have family Anguillidae having species *Anguilla bengalensis*. Order Anabantiformes have family channidae have species *chana striata*. Order Ostioglossiforms have family notopteridae have species *notopterus notopterus*. Order Percuiformes forms have family ambassidae have species *Ambassis ranga*. Plankton diversity and diversity of fish are important criteria for evaluating the suitability of water for culture practices. Borgon Dam is degraded by both natural and anthropogenic activities, which deteriorate their quality of dam water. Due to increased human population, industrialization, use of fertilizers and man-made activity water is highly polluted with different harmful contaminants. It is necessary that the quality of drinking water should be checked at regular time interval. Limnological parameter and plankton diversity are important criterion for determining the suitability of water for irrigation and drinking purpose. Therefore, structure of different fish food organisms assumes greater significance to fisheries management. An attempt was made to study the abiotic parameters of Borgon dam along with their impact on distribution and presence of zooplankton. The total of 30 organism species belonging to five groups of zooplankton viz Protozoa, Rotifera, Cladocera, Copepoda and Ostracoda were identified.

**Keywords :** Phytoplankton, Biodiversity, Borgon Dam, zooplankton.

## Introduction :

Water resources are natural resources of water that are potentially useful for humans,<sup>[1]</sup> for example as a source of drinking water supply or irrigation water. 97% of the water on Earth is salt water and only three percent is fresh water; slightly over two-thirds of this is frozen in glaciers and polar ice caps.<sup>[2]</sup> The remaining unfrozen freshwater is found mainly as groundwater, with only a small fraction present above ground or in the air.<sup>[3]</sup> Natural sources of fresh water include surface water, under river flow, groundwater and frozen water. Artificial sources of fresh water can include treated wastewater (wastewater reuse) and desalinated seawater. Human uses of water resources include agricultural, industrial, household, recreational and environmental activities.

Water resources are under threat from water scarcity, water pollution, water conflict and climate change. Fresh water is a renewable resource, yet the world's supply of groundwater is steadily decreasing, with depletion occurring most prominently in Asia, South America and North America, although it is still unclear how much natural renewal balances this usage, and whether ecosystems are threatened.<sup>[4]</sup>

Biodiversity plays a central role in making life sustainable on this planet for all organisms. The fate of human species is interlinked with fates of all organisms whether plant, animals or microbes living around us and directly or indirectly affecting our lives. The simplest way to understand this is to just remember the mode of energy transfers, nutrient, oxygen and water cycling going on. Our planet is tightly linked by global communication systems, exchange of materials and their maintenance where all of them are being interdependent. For example our health depends upon the environment we live in and food we eat. To protect our self we need to protect our planet, the ecosystems and individual species present around the globe. Biodiversity is crucial to the



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Volume - I

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# EDITORIAL

A Multidisciplinary Approach to Higher Education is a book that explores the intersection of various disciplines in academia, offering insights into how collaboration across fields can enrich learning and research. It delves into the benefits and challenges of interdisciplinary studies, making it a valuable resource for educators, students, and researchers navigating the complex landscape of higher education. We explore how traditional disciplinary boundaries are becoming increasingly porous, giving rise to new opportunities for collaboration and innovation. Through this book, we aim to shed light on the importance of multidisciplinary approaches in higher education, emphasizing the value of diverse perspectives in addressing complex challenges. Drawing on insights from educators, researchers, and practitioners across various fields, we invite readers on a journey to explore the rich tapestry of interdisciplinary scholarship and its transformative potential in shaping the future of higher education.

In this light, we are going to publish Edited Books on the theme of "A Multidisciplinary Approach to Higher Education" to make available a platform to academicians, researchers, sports personnel, students and other stakeholders for exchange of ideas, experiences, collection and dissemination of information on various subjects at National Level with a wide range of sub themes covering different dimensions and their relevance to the need of 21<sup>st</sup> century. We are proud to state that we got overwhelming response from the researchers all over India. The papers included in this book deal with a wide range of studies. We hope that this book will definitely be appreciated by the readers and it will provide a wide spectrum about different areas of education.

We express our sincere thanks to Dr. Satish Kulkarni, President, Bharatiya Vidya Mandir, Amravati; Shri. Ashish Malu, President, Shri Gajanan Maharaj Shikshan Sanstha, Amravati; Shri. Vilas M Ingole, President Yuvashakti Samajik va Shaikshanik Sanstha, Amravati; Smt.Vrushali S. Pusatkar, President, Late Dattatraya Pusadkar Arts College, Nandgaon Peth, for their scholarly guidance and inspiration through all the stages of this work.

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In closing, We extend my heartfelt gratitude to the contributors who have joined us on this journey. May this book serve as a catalyst for dialogue, reflection, and action, inspiring us to embrace the multidisciplinary approach as a guiding principle for Indian higher education and a pathway to a more inclusive, equitable, and sustainable future.

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# New Education Policy (NEP-2020) and Role of Academic Libraries

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## Abstract :

The National Education Policy (NEP) 2020 has set out to revolutionize the education system in India by prioritizing comprehensive and interdisciplinary education, encouraging critical thinking, and adopting a student-centric approach. In light of this, academic libraries have a vital part to play in advancing the objectives of the NEP. This concise summary is based on an analysis of literature pertaining to the role of academic libraries in supporting the NEP 2020. Academic libraries play a significant role in supporting the NEP 2020 by granting access to a wide range of high-quality resources, fostering lifelong learning, facilitating research and innovation, promoting collaboration and networking, and enhancing digital literacy skills. Additionally, academic libraries can contribute to the NEP's aim of promoting multilingualism by offering resources in various languages. Academic libraries hold a vital position in supporting the NEP 2020's vision of transforming the education system in India. Through the provision of different and high-quality resources, the creation of lifelong literacy, and the improvement of the digital literacy skill, academic libraries can contribute to the creation of student-centric and comprehensive education.

**Key Words :** Digital Library, Resources, Education system, NEP.

## Introduction :

The New Education Policy of India, NEP- 2020, was officially announced on 29<sup>th</sup> July 2020, with the goal of revolutionizing the country's education system through a series of reforms spanning from primary to higher education. Dr. K.Kasturirangan, former chairman of the Indian Space Research Organization (ISRO), led the committee that formulated the policy. In 2019 the draft policy was presented for review and revision to the Ministry of Human Resource Development (MHRD) and finalized the approval from the Central Government.

NEP-2020 supersedes the National Policy on Education of 1986, which was later amended in 1992. To

meet the demands of the 21st century, this new policy is designed to tackle the existing challenges in the education system and adapt. Some important changes of NEP-2020 include the restructuring of school education into a 5+3+3+4 format, focus on multi-disciplinary and vocational education, increased financial support for education, the implementation of a common entrance exam for universities, the integration of technology in learning, and promotion of Indian languages. There have extensive discussions and debates in India, with various stakeholders uttering both their support and apprehensions regarding its provision.

## NEP for Libraries :

NEP has formulated a policy for the promotion of national books. The initiative aims to ensure that learning materials are available in any language and anywhere. This indicates that the government will focus on promoting the use of libraries and their resources, such as books, e-journals, and other reading materials, without any barriers related to distance, language, or Information Communication Technology. The NEP-2020 emphasizes several key points from a library perspective:

1. Development of audio books for differently-abled individuals.
2. Cultivating a culture of reading and writing
3. Ensuring availability and accessibility of reading materials through ICT nationwide.
4. Improving digital libraries and enhancing online access to academic library materials.
5. Establishing Book Club/NDL Club facilities to encourage widespread reading.
6. Increasing the procurement of reading materials in the Higher Education System.
7. Creating e-content in regional languages to support Institutional/Academic Libraries.
8. Providing appropriate infrastructure for lifelong learning and adult education, utilizing ICT-equipped library spaces.
9. Establishing suitable career pathways for library staff to ensure proper functioning

## **The Role of Academic Libraries in Achieving the Objectives of NEP-2020 :**

In the achievement of the objectives outlined in the NEP -2020 academic libraries play a vital role. Several ways in which academic libraries can contribute to the fulfilment of NEP-2020 objectives are as:

1. **Enabling access to high-quality educational resources :** NEP-2020 places great importance on providing students with quality education. Academic libraries can support this objective by granting access to a diverse range of educational resources, such as books, journals, research papers, and electronic resources.
2. **Promoting research and innovation :** NEP-2020 aims to foster research and innovation in the field of education. Academic libraries can contribute to this objective by offering resources and facilities to researchers and students. Additionally, libraries can collaborate with other institutions and organizations to encourage research and innovation.
3. **Cultivating digital literacy :** NEP-2020 acknowledges the importance of digital literacy in today's world. Academic libraries can support this objective by providing access to digital resources and tools. Furthermore, libraries can offer training and assistance to students and faculty members to enhance their digital literacy skills.
4. **Supporting interdisciplinary education :** NEP-2020 recognizes the significance of interdisciplinary education. Academic libraries can aid in achieving this objective by providing resources related to various fields of study. Libraries can also organize interdisciplinary events and activities to facilitate collaboration among different departments and faculties.
5. **Encouraging lifelong learning :** NEP 2020 highlights the value of lifelong learning. Academic libraries can contribute to this objective by providing resources and facilities for continuing education and professional development. Libraries can also organize workshops and events to promote lifelong learning opportunities. By actively fulfilling these roles, academic libraries can effectively contribute to the realization of NEP-2020 objectives and facilitate the overall advancement of education in the country.

## **Challenges of Academic Libraries in Archiving:**

Goals of NEP- 2020 The National Education Policy (NEP-2020) is a comprehensive policy that aims to revolutionize the Indian education system. Academic libraries have a crucial role to play in achieving the goals set by NEP-2020, but they encounter various obstacles. Some of these challenges include .

1. **Funding :** Academic libraries require substantial funding to acquire and maintain resources, upgrade technology, and provide services. However, they often struggle to secure adequate funds from their institutions or the government.
2. **Digital Divide :** NEP-2020 emphasizes the significance of digital resources and online learning, but not all students have access to the internet and digital devices. This digital divide poses a challenge for academic libraries as they strive to ensure equal access to their resources and services.
3. **Limited Physical Space :** Academic libraries often face constraints in terms of physical space to store their collections and provide study areas. This limitation presents a challenge as they must strike a balance between the space requirements and the demand for services.
4. **Evolving User Needs :** NEP-2020 focuses on fostering critical thinking, problem-solving, and communication skills, which necessitate a diverse range of resources and services. Academic libraries must adapt to the changing needs of their users and provide the necessary resources and services to support the development of these skills.
5. **Technology Integration :** NEP-2020 envisions the integration of technology in all aspects of education. Academic libraries need to incorporate new technologies to support teaching, learning, and research. However, this requires significant investment and training for library staff.
6. **Outreach and Engagement :** Academic libraries need to actively engage with the student and faculty community to understand their needs and promote their resources and services. However, outreach and engagement efforts demand substantial resources and efforts, which can be challenging for libraries with limited staff and budget.

## **Conclusion :**

To enhance teaching, learning and research the NEP 2020 recognizes the significance of academic libraries in providing access to digital resources such as e-books, journals, and databases. It stresses the value of open access to research outputs and urges academic libraries to advocate for open access publishing and the establishment of institutional repositories. Besides the NEP 2020 underscores the role of academic libraries in fostering interdisciplinary research and collaboration among faculty, students, and researchers. The policy promotes the creation of spaces and amenities within academic libraries that facilitate collaboration, experimentation, and innovation. Ultimately, the NEP 2020 acknowledges the evolving role of academic libraries in the digi-

tal era and underscores the importance of adopting innovative practices to support teaching, learning, and research. It identifies academic libraries as key contributors to research and innovation, encouraging collaboration with other institutions to promote interdisciplinary research and innovation.

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New Syllabus (under CBCS)



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# **BOTANY**

Angiosperm Systematics, Anatomy, Embryology

Semester - III

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Dr. Akash V. More

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# Climate Change and Impact on Agriculture

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## Abstract :

Climate change is one of the most significant challenges facing human being in the 21st century, which impacts on various sectors, including agriculture. Rising temperatures, decreases in rainfall, and a rise in weather shows significant challenges to agricultural productivity and food security. Growth in temperature influence on the crop phenology, growth, and development, leading to changes in crop yields and distribution patterns. Moreover, changes in precipitation patterns, including alterations in the timing and intensity of rainfall, affect soil moisture levels, water availability, and irrigation requirements. Droughts, floods, and heatwaves disrupt agricultural activities, compromise soil fertility, and increase the attack of pests and diseases, result yield losses. This abstract provides an overview of the complex relationship between climate change and agriculture, highlighting the diverse impacts on crop production and food security, suggesting required adaptations including new techniques for improvement of crop yield.

**Keywords :** Challenges, Rainfall, Floods, Agricultural, Yield.

## Introduction :

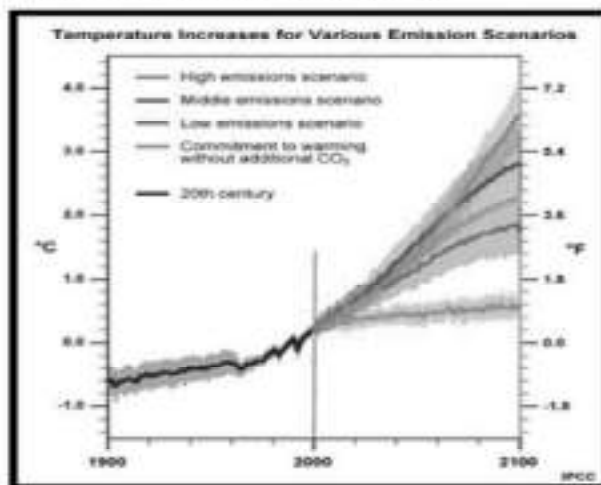
"Climate change refers to long-term shifts in temperatures and weather patterns." Climate change is one of the most worldwide concerns of the twenty-first century, affecting many aspects of human such as human existence, health, and the environment, including agriculture. As the Earth's climate continues to undergo rapid transformations due to human-induced activities, such as industrialization, urbanization, deforestation modernisation, etc. The Climate change included higher temperatures, higher atmospheric CO<sub>2</sub> concentrations, changes in precipitation. Climate change may have a wide-ranging impact on agriculture, including crop quality and quantity, growth rates, photosynthesis and transpiration rates, moisture availability, and so on. Climate change is directly impact on food production across the world. So, in future sense and growing global

population need of food. We have to need to focused to resolve this issue or adapt new crops patterns, techniques in agriculture sector for better yield.

## Climate Change :

The climate is important for all life's including human being. The climate included all factors like temperature, Humidity, wind, etc. Due to human activities that increase greenhouse gas concentrations in the atmosphere. These activities include deforestation, urbanisation, industrialization, burning fossil fuels, and agricultural practices. Greenhouse gases such as carbon dioxide (CO<sub>2</sub>), and nitrous oxide (N<sub>2</sub>O), methane (CH<sub>4</sub>) trap heat in the Earth's atmosphere, leading to a warming effect known as the greenhouse effect. Which is mostly responsible for global warming i.e. rise in earth temperature which shows effects like melting ice caps and glaciers, and rising sea levels, droughts, floods, etc. The Intergovernmental panel on climate change (IPCC) has projected that the average global surface temperature increases by 1.4°C to 5.8°C in 21<sup>st</sup> century with significant regional variations (IPCC, 2007).

## Global Scenario of Climate Change :



Source : IPCC, 2007.

### Impact of Climate Change on Agriculture :

The agriculture sector is the most important sector for human being for full fill their food needs. Climate change's impact on agriculture could lead to food security issues and altered the livelihood activities in which much of the population depends. Climate Change can affect crop yield and crop pattern that can be grown in certain areas, by impacting agricultural inputs such as water, amount of solar radiation that affect plant growth as well as the prevalence of pests. The increase in seasonal temperature can reduce the duration of many crops and hence reduce final crop yield. World agriculture faces a serious decline within this century due to climate change. Overall, agricultural productivity for the entire world is projected to decline between 5 to 16 % by 2080. More countries, which have an average temperature that are already near or above crop tolerance levels, are predicted to suffer an average 10 to 25% decline in agricultural productivity by 2080s.

India's agriculture sector is mostly dependent on monsoon rainfall for water from the ancient periods. Any change in monsoon has a drastic and significant impact on agricultural yield. Even the increasing temperature is affecting the Indian agriculture field. The states like Jharkhand, Odisha and Chhattisgarh, Andhra Pradesh are mostly rice producing state, rice production losses during severe droughts average about 40% of total production, with an estimated value of \$800 million (Pandey, 2007). Many other states like Madhya Pradesh, Punjab, Maharashtra, which are mostly wheat, soybean, producing states decreases by 3-7% due to increases in temperature, and decreases water rainfall. The major impacts of climate change will be on rain fed or un irrigated crops, which is cultivated in nearly 60% of crop land all over the India. A temperature increases by 0.5°C in winter temperature is projected to reduce rain fed wheat yield by 0.45 tonnes per hectare in India (Jai et al., 1998). Increased droughts and floods are likely to increase production variability. According to the Agricultural Research Institute, every degree Celsius that the temperature rises during the growing season could result in a loss of 4-5 million tons of wheat production in the near future.

\*\*\*

### Adaptation Strategies in Agriculture :

Adaptation strategies to deal with the impact of climate change are developing cultivars tolerant to heat, water and salinity stresses and resistant to flood and drought, modifying crop management practices, improving water management, adopting new farm techniques such as resource conserving technologies (RCTs), improving pest management, crop diversification, and using the indigenous technical knowledge of farmers. Some strategies like development of new crop varieties by using plant breeding, genetic engineering techniques with higher yield potential and resistant to drought, flood, heat, water and salinity stresses will be the key to maintain yield stability.

### Conclusion :

Climate change has resulted in the large-scale change in the weather pattern due to periodic modifications of earth's climate. It shows serious effect on human health, ecosystem and agriculture etc. There is urgent need to recognize and adopt the innovative and creative strategies for climate change. There is need to manage the emission of CO<sub>2</sub> to reduce greenhouse effect for the sustainable development. Also adopt new practices and techniques for increases in crop yield of agriculture.

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# MODERN EMERGING TRENDS IN CHEMICAL SCIENCES

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**Dr. Satish Babulal Jadhav**

**Mr. Prashant Kantrao Vibhute**



# MODERN EMERGING TRENDS IN CHEMICAL SCIENCES

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**Chapter****9****UV- VISIBLE SPECTROSCOPY: BASIC CONCEPTS**

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**INTRODUCTION**

What is spectroscopy? Spectroscopy is nothing but the study of how electromagnetic radiations interact with matter. Each interaction can give us different insights into the properties of the subject, and using different energies can provide different information. The most exciting part of spectroscopy is predicting the chemical makeup of unknown compounds. There are lots of ways to do this, from physical methods like boiling point and melting point to chemical methods like unsaturation testing and functional group testing. All types of electromagnetic radiation travel at the same speed, but they have different frequencies and wavelengths. The two types of electromagnetic radiation have a dual nature - wave and particle. We know that particles have a particle nature because the energy of certain types of radiation is stored in tiny packets called photons. Every photon has its own energy, and the different kinds of radiation are determined by how much energy they contain. The energy of certain electromagnetic radiation is related to its frequency ( $E = h\nu$ ), and the photons with the highest energy are the ones with the longest wavelengths.

Spectroscopy is a great way to figure out what's in a substance, and it can be used for a bunch of different types of stuff like UV and IR, as well as other types like NMR and Raman. As we know spectroscopy is the study of how electromagnetic radiations interact with matter, depending on the nature of the interaction. There are several possible processes that can occur, such as absorption, emission, and elastic scattering and reflection.

1. Absorption is the process of the absorption of energy from a radiative source by a material. The extent of absorption is determined by the proportion of energy that passes through the material, and absorption will reduce the amount of energy that is

transmitted. This is achieved through the use of spectroscopy techniques such as UV-visible absorption.

2. Emission is the process of releasing energy that has been absorbed by a material. It can be caused by the absorption of energy from a variety of sources, including flames or electromagnetic radiation, such as fluorescence.
3. What is Elastic Scattering and Reflection Spectroscopy? Basically, it's the process of either reflecting or scattering radiations from a material.
4. What is Impedance Spectroscopy? It's all about figuring out how a medium can slow down the way energy moves around. For optical purposes, it's all about measuring the refraction index.
5. Inelastic scattering is when the wavelength of the radiation is changed due to the energy being exchanged between it and the material. This is seen in Raman and Compton spectroscopy.
6. Coherent or Resonance spectroscopy is a type of spectroscopy that utilizes radiative energy to combine two quantum states of a material into a cohesive interaction that is maintained by a radiating field. NMR spectroscopy is one of the most commonly used resonance methods [1-2].
7. In this chapter let's take a closer look at UV and its basic concepts.

### ELECTROMAGNETIC RADIATION AND SPECTROSCOPY

The electromagnetic spectrum is made up of all the radiations emitted by radio and television waves (radios), microwaves (microwaves), infrared (infrared), visible light (visible), ultraviolet (ultraviolet), X-rays (ultra-rays), gamma rays (gamma rays), cosmic rays (cosmic rays), etc. The wavelengths of these radiations are measured in micrometres or kilometers, and the order in which they increase in wavelength or decrease in frequency is called the electromagnetic spectrum shown in fig.1.

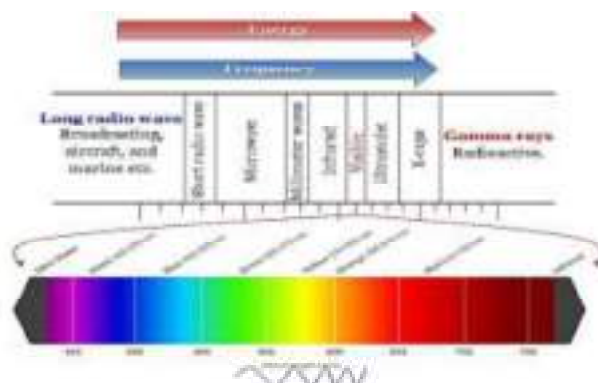


Fig. 1: Electromagnetic spectrum

### ORIGIN OF UV/VISIBLE SPECTRA

Let's figure out how the ultraviolet and visible spectra come about. It's because of the way electromagnetic radiations are absorbed in the ultraviolet and visible regions of the electromagnetic spectrum. When these radiations are absorbed, they cause a shift in the electronic energy levels in the molecule. During these transitions, the electrons in the ground state get excited and move up to a higher electronic state. The most common electronic transition in a molecule is from the highest occupied molecular orbit to the lowest unoccupied orbital (Fig. 2). The ultraviolet (UV) and visible (visible) spectrometer measures the degree of absorption of a sample as a result of the absorption of light at a wavelength ( $\lambda$ ) and the resulting plot between the absorbance and the wavelength ( $\lambda$ ). The significant characteristics of UV/visible absorption spectra are the  $\lambda_{\text{max}}$ , which is the maximum absorption intensity, and the absorption at this wavelength, which is represented by the maximum molar absorption. These parameters are characteristic of a specific molecule. The wavelength at which absorption occurs is determined by the difference in energy between ground electronic state (HOMO) and excited electronic state (LUMO). The lower the difference, the lower the value of the absorption maxima ( $\lambda_{\text{max}}$ ). Generally, the UV/visible spectrum is composed of a broad band of absorption, rather than a single sharp line, for each of these transitions [3-4].

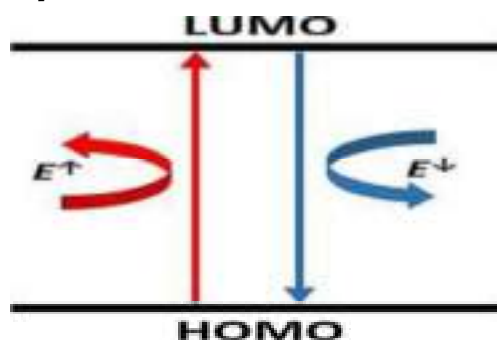


Fig. 2: Electronic transitions between two states

The band-like structure of ultraviolet/visible spectra is because the transitions happen over a bunch of different wavelengths, not just one. This is because each molecule's electronic energy level is made up of two separate energy levels, one for vibration and one for rotation. So, molecules can go through electronic transitions with both vibrational and rotation excitations happening simultaneously. This leads to a bunch of transitions that only differ from each other by a tiny amount of energy, giving you a bunch of lines that are too far apart to be resolved by a spectrophotometer, but instead give you a band-like structure surrounded by these closely separated lines which is shown in fig. 3 [5].

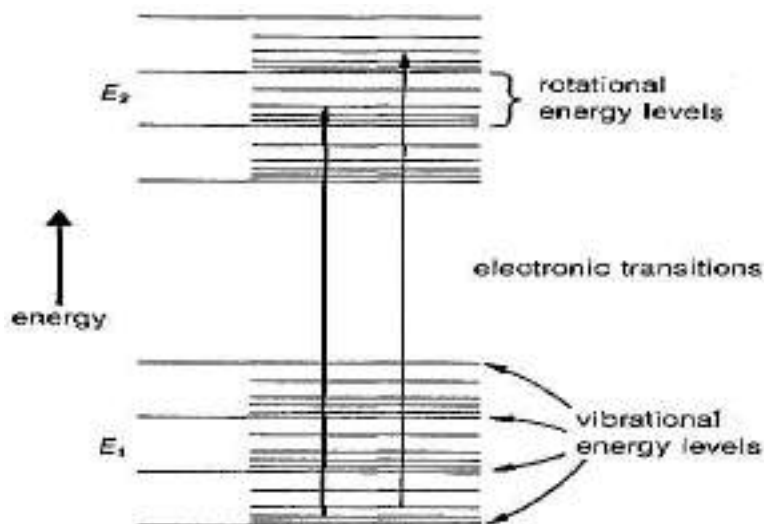


Fig. 3: Possible transitions with electronic energy levels

#### TYPES OF ELECTRONIC TRANSITIONS

In UV/visible spectroscopy molecule can undergoes electronic transitions involving  $\sigma$ ,  $\pi$  and non-bonding (n) electrons. Among these electrons four types of transitions are possible depending upon the structure of molecule (Fig. 4) [6-7].

1.  **$\sigma \rightarrow \sigma^*$  TRANSITION** - In this type of transition, the excitation of electron presents in  $\sigma$  molecular orbital to corresponding  $\sigma^*$  antibonding molecular orbital takes place by absorption of electromagnetic radiations in the UV range. Since energy difference between  $\sigma$  bonding molecular orbital and  $\sigma^*$  antibonding molecular orbital is very large, so these types of transitions require very high energy. As a result, absorption of the ultraviolet radiations of very short wavelength occurs.  $\sigma \rightarrow \sigma^*$  transitions generally occur in alkanes e. g., methane observed at 125 nm wavelength. These transitions are of less importance because of their high energy due to  $\sigma \rightarrow \sigma^*$  transitions.
2.  **$\pi \rightarrow \pi^*$  TRANSITION** - In this transition, the excitation of electron presents in  $\pi$  bonding molecular orbital to  $\pi^*$  antibonding molecular orbital takes place. Unsaturated group in a molecule shows this type of transitions. e.g., Alkenes, alkynes, azo compounds and carbonyl compounds.
3.  **$n \rightarrow \sigma^*$  TRANSITION** - In this type of transition, the excitation of electrons presents in nonbonding molecular orbital (n) to  $\sigma^*$  antibonding molecular orbital take place by absorption of electromagnetic radiations in the UV range. This type of transition requires lesser energy as compared to  $\sigma \rightarrow \sigma^*$  transition and thus it takes place at longer wavelength. e.g., Saturated compounds containing atoms having unshared pair of electrons such as oxygen atm, nitrogen, sulfur and halogens.
4.  **$n \rightarrow \pi^*$  TRANSITION** - In this type of transition, the excitation of electron presents in nonbonding molecular orbital (n) to  $\pi^*$  antibonding molecular orbital takes place. This

transition is of lowest energy and at the same time it is of low intensity as it is symmetry forbidden transition. e.g., carbonyl compounds exhibit this transition generally at 280 nm.

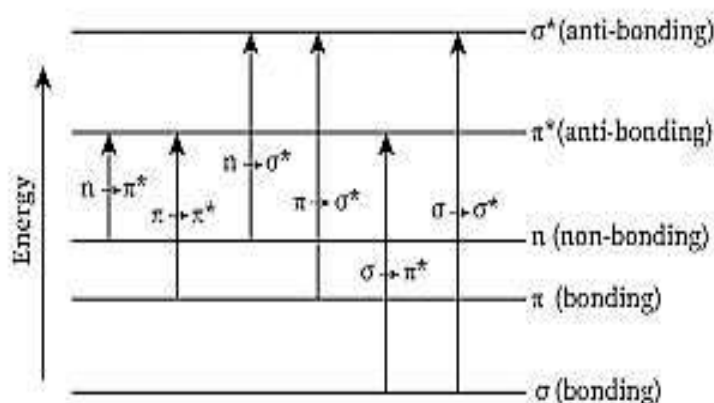


Fig. 4: All types of possible transitions between different electronic energy levels

#### SELECTION RULE

There are a few electronic transitions that are not observed in the UV-VIS spectroscopy, even though they are theoretically possible.

1. No electron spin quantum number changes are allowed during transitions. Singlet-triplets are not allowed.
2. Transitions between different-symmetrical orbitals are not allowed. Transition from  $n$  to  $\pi^*$  is forbidden because the symmetry of  $n$  and  $\pi^*$  do not match.

#### CHROMOPHORE

Chromophores are part of molecules or groups of molecules that absorb radiation. The type of chromophore is important because it determines the wavelength that's absorbed. When you absorb electromagnetic radiation, it causes electrons to jump from their ground state to their excited state. It depends on how much those electrons are attached to the nuclei, and that depends on what kind of group is in the molecule that's absorbing the radiation. The different chromophores are described below [8].

1. **ALKANES** - Alkanes consist of only single bonds and do not contain bonds with unsaturation or unshared pair of electrons. Thus, in this case, the only transition which is possible is  $\sigma \rightarrow \sigma^*$ . These two energy levels have a large energy difference due to which this transition takes place at high energy due to absorbance of ultraviolet radiations of very short wavelengths. Due to this, these transitions are of much less importance and generally take place at wavelength below 200 nm.
2. **ALKENES** - Alkenes are unsaturated compounds that consist of double bonds in their molecules. Thus, they consist of  $\pi$  electrons which makes  $\pi \rightarrow \pi^*$  transition possible.

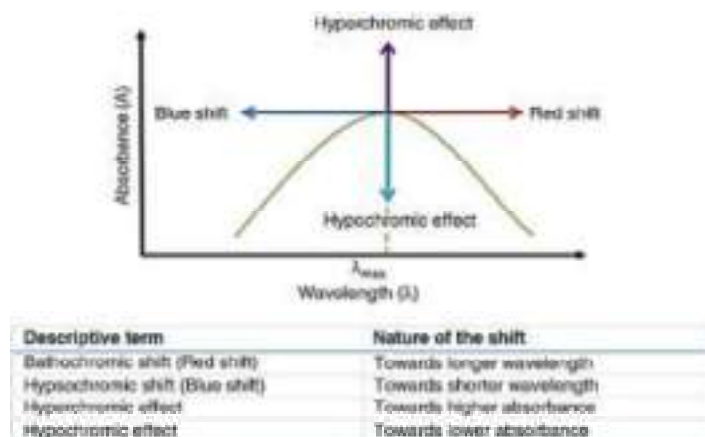
These transitions are also of high energy and their position depends upon the nature of substituent attached.

3. **ALKYNES** - Just like alkenes, alkynes also consist of  $\pi$  electrons which make  $\pi \rightarrow \pi^*$  transition possible in them. In UV region Alkynes absorb near about 175 nm.
4. **CARBONYL COMPOUNDS** - Carbonyl compounds consist of double bond between carbon and oxygen, so they consist of unsaturation i.e.,  $\pi$  electrons as well as nonbonding pair of electrons and thus they can undergo both  $\pi \rightarrow \pi^*$  and  $n \rightarrow \pi^*$  transitions. However,  $n \rightarrow \pi^*$  transition is symmetry forbidden and thus of low intensity and take place at 270 to 290 nm. The  $\pi \rightarrow \pi^*$  transitions are allowed and depending upon the structure of molecule transition take place in the range of 180 to 190 nm.
5. **ALCOHOLS, ETHERS, AMINES AND THIOLS** - All these compounds consist of nonbonding pair of electrons. In these cases, transitions of type  $n \rightarrow \sigma^*$  are significant. Due to the high energy, transition observed at short wavelength. In alcohols, ethers and amines this transition take place in the range of 175 to 200 nm, while in thiols this transition take place in the range of 200 to 220 nm.

#### AUXOCHROMES

The presence of some groups with chromophores as substituents may change the absorption characteristics of chromophores. They increase the intensity of absorption and maybe change the wavelength of absorption. We can say that, chromophores are responsible for absorption of radiations and auxochromes increase the intensity of absorption. Some common examples are  $-\text{CH}_3$ ,  $-\text{OH}$ ,  $-\text{NH}_2$  and halogens etc. The effect of these substituents can be further divided into following categories [10].

1. **RED SHIFT OR BATHOCHROMIC SHIFT** - Auxochrome can cause absorption maxima to shift towards longer wavelengths, which is called red shift. This can also happen when there's a change in the polarity of the solvent, which can lead to a red shift.
2. **BLUE SHIFT OR HYPSOCHROMIC SHIFT** - Auxochrome may cause the absorption maxima to change to a shorter wavelength (hypsochromic shift, or blue shift).
3. **HYPERCHROMIC EFFECT** - Hyperchromic effect is a term used to describe an increase in the rate of absorption caused by the addition of a substituent to a chromophore.
4. **HYPOCHROMIC EFFECT** - Due to the presence of substituent with chromophore decrease in absorption intensity is called hypochromic effect.



### EFFECT OF SOLVENTS ON UV/VISIBLE SPECTROSCOPY

The solvent used for dissolving the compound under study has a significant effect on the UV / visible spectra of the compound. Often, the fine structure of the absorption bands is blurred due to interactions between the solvent and the solute molecules. This effect is magnified when using polar solvents. The fine structure of the UV/ visible spectra is best seen in the vapor phase. The position and intensity of the absorption maximum depends on the solvent polarity, but this shift depends on the nature of the compound, i.e., whether the compound is a polar or a non-polar. If the compound is non-polar, the change in the solvent polarity will not cause a significant shift in its absorption spectra, as the interaction between the solvent and solute are minimal. For polar compounds, the effect on the absorption spectrum is practically the same in polar solvents like alcohol and non-polar solvents like hexane. This effect depends on the type of transition occurring within the molecule [9].

In the case of  $n \rightarrow \pi^*$  transition with increase in solvent polarity blue shift is observed. The shift towards shorter wavelength is mainly due to greater stabilization of more polar ground state, then excited state through dipole-dipole interactions, formation of hydrogen bonds or solvation with polar solvent. As a result of which energy difference between ground and excited state is increases and absorption shifts towards shorter wavelength.

In the case of  $\pi \rightarrow \pi^*$  transitions with increase in solvent polarity bathochromic shift is observed. As in this case excited state which is more polar is stabilized with increase in the solvent polarity which decreases the energy difference between ground and excited state resulting in bathochromic shift.

The  $n \rightarrow \sigma^*$  transitions are very sensitive to hydrogen bonding with solvents. For example, alcohols and amines etc. have non-bonding electrons on the hetero atom and thus form hydrogen bonding with solvent molecules. As a result of this, ground state gets more stabilized as compared to excited state resulting in blue shift in absorption maxima.

### EFFECT OF CONJUGATION ON UV/VISIBLE ABSORBANCE

Bathochromic shifts are always caused by conjugation. The more conjugation a molecule undergoes, the more bathochromic shift it undergoes. The conjugation not only increases

the absorption wavelength, but also the absorption intensity. When there is conjugation, the electronic energy levels are close together, resulting in lower energy or longer wavelength transitions. For example, ethylene absorbs at 174 nm, while 1,3-butadiene absorbs at 217 nm with two double bonds, whereas 1,3,5-hexatriene with three conjugated double bonds absorbs at 258 nm [10-11].

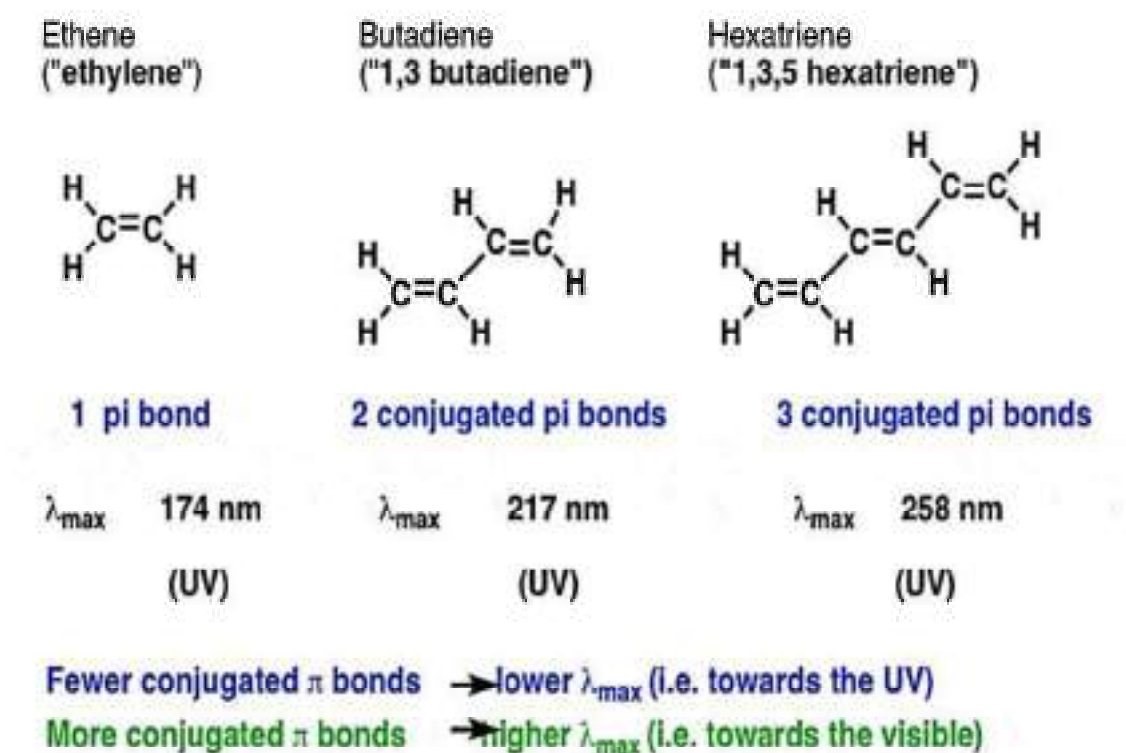


Fig. 5: Effect of Conjugation on absorption maxima

Another example of effect of conjugation on absorption maxima is  $\alpha$ ,  $\beta$ -unsaturated aldehydes. Normal isolated alkene absorbs near to 170 nm due to  $\pi$  to  $\pi^*$  transitions, while isolated carbonyl group absorbs near to 290 nm due to  $n$  to  $\pi^*$  transitions. Combination of alkene and carbonyl group that gave a conjugated  $\alpha$ ,  $\beta$ -unsaturated aldehydes in which alkene group absorbs in the region of 210-230 nm while carbonyl group absorbs in the region of 310-330 nm (Fig. 6).

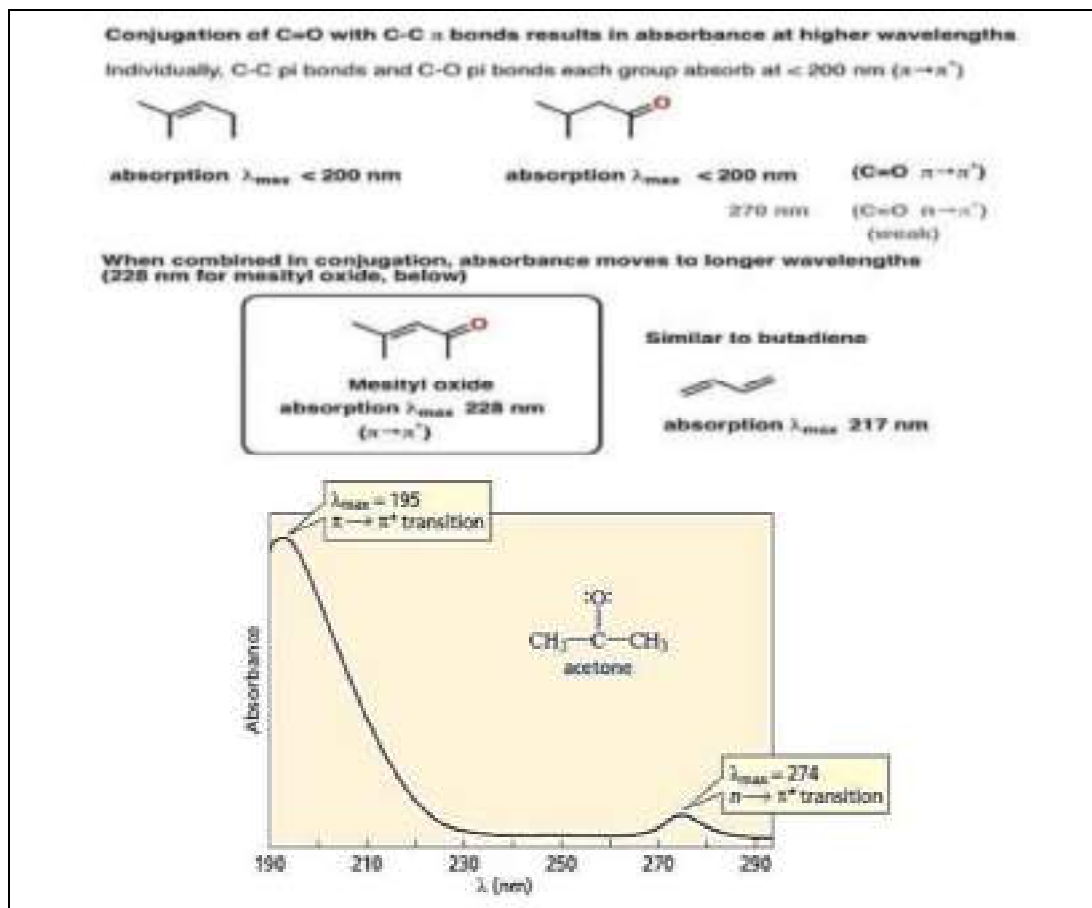


Fig. 6: Effect of conjugation on absorption maxima

The  $\beta$ -carotene (Fig. 7) which consists of eleven conjugated double bonds absorbs in a visible region at 450 nm and thus appears orange in colour.

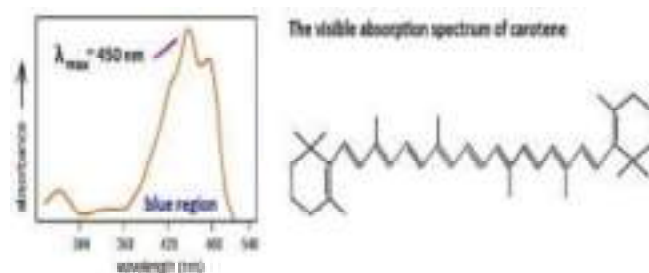


Fig. 7: The visible absorption spectrum of carotene.

**LET'S TAKE A QUICK LOOK AT THE BASICS OF UV-VIS SPECTROSCOPY**

1. UV/visible spectra arise due to transition of electrons from ground state to excited state due to absorption of electromagnetic radiations in UV/visible region.
2. Electronic transitions can take place from  $\sigma$  to  $\sigma^*$  or  $\pi$  to  $\pi^*$  or  $n$  to  $\pi^*$  or  $n$  to  $\sigma^*$  depending upon the nature of molecule.
3. Transition from  $\sigma$  to  $\sigma^*$  requires a highest energy and take place at a shorter wavelength, while synopsis transition from  $n$  to  $\pi^*$  requires a least energy and hence take place at longer wavelength.
4. The part of molecule or group of atoms which is responsible for absorption is called chromophore.
5. Electronic transitions can take place from  $\sigma$  to  $\sigma^*$  or  $\pi$  to  $\pi^*$  or  $n$  to  $\pi^*$  or  $n$  to  $\sigma^*$  depending upon the nature of molecule.
6. The group attached to chromophore that can change the absorption characteristics of chromophore is called auxochromes.
7. The absorption maxima also depend upon the choice of solvent and depending upon the nature of compounds both hypsochromic or bathochromic shifts may be observed with change in solvent polarity.
8. The presence of conjugation always results in a decrease in energy levels between two electronic energy levels and thus gave bathochromic shift. Larger conjugation more will be bathochromic shift.

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