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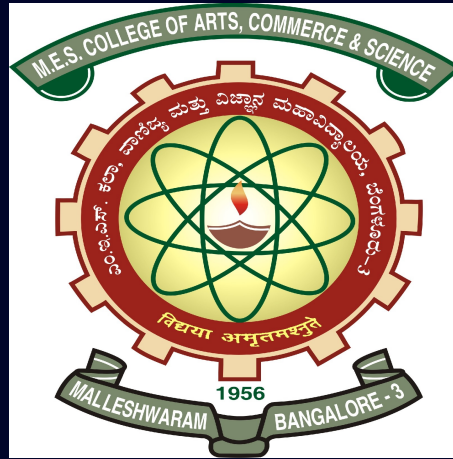
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# *MES BULLETIN OF APPLIED SCIENCES*



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(Working Papers)

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# Historic Significance of National Educational Policy 2019

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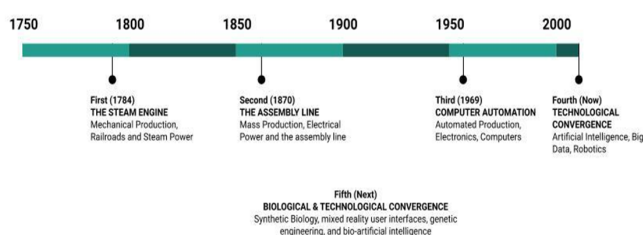
**Abstract:** India is aiming to be a USD 5 trillion economy by 2025 and the third largest economy in the world after USA and China. The Fourth Industrial revolution requires the country to step up its educational framework to ensure that the entire country is transformed into a Knowledge Economy to face challenges of the new world dynamics and maintain its position as a leader and ensure growth of the economy. Issues of Gross Enrolment Ratio (GER) in Higher Education and drop-out syndrome which severely impacts the STEM discipline that is the main engine of growth of the Indian economy and recommendations of the Higher Level Advisory Committee to bring about changes to drastically address this critical problem currently impacting us. Lack of Job-Ready Graduates and the impact on Industry and Unemployment and failure to encash the Demographic Dividend. Framework of recommendations of the National Education Policy and impact on Early and Higher Education. Merits and lacunae in the National Educational Policy and challenges in implementation of the various recommendations. Conclusions and the need of the hour to transform current educational system.

**Keywords:** National Educational Policy, Gross Enrolment Ratio.

## 1 Introduction

India is today the world's fifth-largest economy by nominal GDP and the third largest by purchasing power parity (PPP). It is the stated aim of the Honorable Prime Minister of India Shri Narendra Modi that India should be a \$5 Trillion economy by 2025 which will make it the Third Largest Economy in the World surpassing even Japan. The National Education Policy 2019 has clearly articulated that there needs to be an all-pervasive change in the current education system if India were to fulfill this aspirational goal. If we have to take our place beside USA and China as one of the world's three largest economies, we will need a knowledge society based on a robust education system and align ourselves to the Fourth Industrial revolution which is currently underway in the world. Quality Education will be a key part of the transition to the knowledge economy in the next decade and the National Education Policy attempts to address the challenges that need to be overcome to achieve this.

### INDUSTRIAL REVOLUTIONS



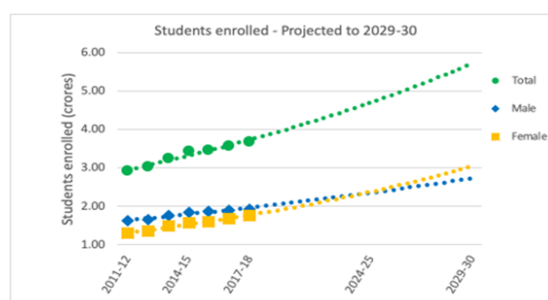
## Vision

The National Education Policy 2019 envisions an **India centred** education system that contributes directly to transforming our nation **sustainably** into an **equitable** and **vibrant** knowledge society, by providing **high quality** education to all.

## 1.1 Current Scenario and problem statement

Currently the population of India has crossed 138 crores and it ranks second in the world after China. The sex ratio in India currently is 71.7 crore men to 67.22 crore women. Hence India has 1000 females per 1070 males. In absolute terms, India has 48.70% female population compare to 51.80% male population. Literacy rate for adult male population is 80.95% whereas the Literacy rate for adult female population is 62.84%. Further 64.9% of the total population is between 15 years and 64 years old. The National Fertility and Health Survey-4 shows India's fertility rates have dramatically dropped to 2.18, below replacement rate, leading to demographic distress. Demographics are changing across the socio-religious spectrum and are strongly correlated with women's education and literacy. Higher education statistics published by All India Survey on Higher Education 2017-18 by the Ministry of Human Resources Development from 2011-12 to 2017-18 show an increasing trend. The total number of males enrolled increased by 30.3 lakh, 18.7 percent, in six years, while the number of women enrolled increased by 44.3 lakh, a whopping 34 percent rise. The compound annual growth rate (CAGR) for total enrollment is 3.87 percent, with males at 2.9 percent and females at 5 percent. The percentage of women rose from 44.6 percent in 2011-12 to 47.6 percent in 2017-18. More women are pursuing higher education now than ever before. Extrapolating the data out to 2030 indicates the number of women pursuing higher education might soon exceed men. The year 2024-25 could see a normalization between genders, and 2029-30 could see as much as 53 percent enrollment of women, a dramatic shift.

Year	2011-12	2013-14	2015-16	2017-18
Total	2,91,84,331	3,23,36,234	3,45,84,781	3,66,42,378
Male	1,61,73,473	1,74,95,394	1,85,94,723	1,92,04,675
Female	1,30,10,858	1,48,40,840	1,59,90,058	1,74,37,703
% Female	44.58	45.90	46.23	47.59



Gross Enrolment Ratio (GER) in Higher education in India is calculated for 18-23 years of age group. Total enrolment in higher education, regardless of age, expressed as a percentage to the eligible official population (18-23 years) in a given school year. The GER is widely used to show the general level of participation in and capacity of higher education. Data includes details on gender wise gross enrolment ratio in higher education for all categories, SC and ST. The total Gross Enrollment Ratio (GER) in age 18-23 is steadily increasing from 20.8 in 2011-12 to 25.8 in 2017-18. Male enrollment increased from GER of 22.1 to 26.3, a 19 percent increase. Female enrollment rose even faster, with a GER under 20 to 25.4, a significant jump of 30 percent. The GER between genders is normalizing, again indicating that more women are turning towards higher education to improve their livelihood. These trends show a silent revolution over the last decade, with significant implications on fertility rates and the economy. It would seem that as more women are turning towards higher education and correspondingly better employment opportunities, they are delaying childbirth and having fewer children. Higher education is one of the contributors to the levelling off population growth. With India's 29 states having diverse economic conditions, variance in state-wise GER is huge. The status of women has dramatically increased in India. The data from the AISHE and NFHS surveys indicate that the best investment India can make towards economic prosperity and societal progress is in higher education and employment prospects of women.

Year	2011-12	2013-14	2015-16	2017-18
All categories	20.8	23	24.5	25.8
Male	22.1	23.9	25.4	26.3
Female	19.4	22	23.5	25.4

At the time of Independence, policymakers did not focus on educating women. As a result, household income and India's GDP did not grow as much as it could have. Contrast this with China - with the establishment of the People's Republic of China in 1949, Chairman Mao famously said, "Women hold up half the sky", and instituted strict policies to educate women. The result is evident today in women's workforce participation, and contribution to China's GDP and outstanding rise as a Top 2 economy. With India's women pursuing higher education in larger numbers, they must be empowered to contribute to the nation's growth. It is opportune for India to leverage this economic multiplier to its GDP as it sets course to the \$10 trillion mark.

Table VII.3.1: Students enrolled in MTech and PhD courses

2017-18	IIT-D graduates	IIT-K graduates	IIT-Kgp graduates	BITS-Pilani graduates	Aggregate enrolment (overall)	Approximate graduates per year
BTech	694	505	1054	545	40,19,379	10,04,845
MTech	498	307	624	243	1,92,873	96,436
PhD	295	186	295	20	38,714	7,743

The High-Level Advisory Group was constituted by the Government of India to assess the global environment and make recommendations for boosting India's share and importance in global trade and mainstreaming new age policy making. The HLAG submitted its report in October 2019. As per this report, the current enrolment in Science, Technology, Engineering and Medicine (STEM) needs to be increased by three times if our

goal to be the third largest economy is to be realized. According to this report, in Key STEM disciplines, India lags behind other major economies in the number of Graduate and/or PhD students. Another problem is that despite producing the highest number graduates in STEM disciplines in the world (a function of India's large population), the shortage of skilled talent in the STEM sector in India has increased from 6% in 2014 to 12% in January 2018. This is, in large part, because the cream of Science and Engineering students go abroad to pursue higher education (Master's and PhDs), and eventually find employment in those countries. Further, because the focus, thus far, has been on engineering and medical studies, fields like pure sciences and research have not gotten their due attention. The number of students graduating in STEM disciplines from India's best institutes is miniscule in comparison to the aggregates as the table shows.

## 1.2 Recommendations

1. Departments at India's Tier 1 universities that undertake research in line with industry's and government's research priorities may be funded through a PPP model. This will help address the salary constraints that crowd out professors who would've been otherwise keen to teach at these institutes.
2. Identify at least 10 research institutions/universities and assign them to regions where high-value-added industries are concentrated to ensure that various industry segments are connected to relevant institutions.
3. Support extended to research through Corporate Social Responsibility (CSR) may be formalized under CSR rules.
4. Awarding fellowships in pure sciences disciplines may help incentivize students to make the jump from undergraduate to specialized, postgraduate education.



5. Launch a program that incentivizes the return of NRIs that have studied and worked abroad in key areas like biotechnology and artificial intelligence.
6. Establish an “intellectual resource committee” in all universities offering PhDs (starting with STEM) comprising individuals including founders, experts in relevant industries, friends of the universities, etc. The purpose of this committee would be to provide specialized mentorship, counselling and ensure an increase in rigour within PhD ecosystems in the country. Increase R&D spending GOI needs to spend at least 2-3% of GDP on Science and Research as against 0.69% at present to improve the quality of STEM postgraduates and facilitate research. Thus, the recommendations of the HLAG also point to the fact that the current scenario in higher education in India is not providing the impetus that India needs to realize its economic vision.

Table VII.3.2: All India Postgraduate Enrolment by Discipline (2013-2018, actual numbers)

Discipline\Year	2013-14	2014-15	2015-16	2016-17	2017-18
Engineering	2,58,966	2,89,207	2,61,065	2,16,317	1,92,873
Computer and Information Sciences	3,04,880	2,84,545	2,42,908	2,19,981	2,10,740
Chemistry	90,101	95,295	99,888	1,14,328	1,25,805
Biotechnology	14,985	14,511	14,778	16,651	18,894
Genetics	704	788	838	944	1,092
Mathematics	1,23,543	1,21,911	1,29,604	1,43,762	1,55,239
Statistics	6,645	7,608	8,309	9,464	9,280

Source: AISHE reports

Table VII.3.3: All India PhD Enrolment by Discipline (2013-2018, actual numbers)

Discipline\Year	2013-14	2014-15	2015-16	2016-17	2017-18
Engineering	22,888	27,467	30,587	32,856	38,714
Computer and Information Sciences	1,663	1,979	2,768	2,458	2,515
Chemistry	5,293	5,649	6,045	6,786	7,562
Biotechnology	1,878	2,002	2,711	2,176	2,333
Genetics	259	265	285	180	170
Mathematics	2,759	2,508	2,870	3,335	3,894
Statistics	420	398	451	549	588

Source: AISHE reports

In conclusion, it may be safely stated that the economic goals of the country can be achieved only by a complete overhaul of the current education system and concentrating on all sections of the society and provide higher education that in turn will help transform the economy significantly. When Ginni Rometty, the Chairman, President, and CEO of IBM, visited India in March 2019, her comments caused quite a stir. Had she committed to investing in India, or announced plans to open a new data centre? Neither. She had stated that Indians don’t have the skills required for employment at IBM, or in the IT industry as a whole. Her speech highlighted this as a global problem, pointing out that today’s job scenario has caused the value of certificates to drop while making certain skills exponentially more valuable. This is not the first time that such a statement about India has been made. In 2017, Deepak Parekh, the Chairman of HDFC, said that four-fifths of all Indian engineering graduates were unemployable. His conclusion was backed by the India Skills Report 2019, which found only 57 percent of final-year engineering graduates to be employable. These figures are corroborated by data compiled by the Centre for Monitoring Indian Economy (CMIE) think tank, which shows that India’s current unemployment rate stands at 7.2 percent. This means that over 31 million people in the country are actively looking for jobs. All of these comments serve as a harsh indictment of our education system, and the ways in which it has failed to fully unlock the potential of generations of students. Tools and technology to overhaul education India is needed since we are a nation brimming with talent. With the youngest, and largest, workforce of any country, and an economy that’s the envy of the world, the future is ours for the taking. But that shouldn’t

blind us to the very real problems we face. India's educational systems have always prioritized rote learning and theoretical knowledge over the real-world application of subject matter. An adherence to antiquated teaching methodologies and a refusal to adopt newly introduced techniques have only compounded these woes. In a country that sees millions of new graduates entering the workforce every year, the 'demographic dividend' on offer has yet to be harnessed. Instead, competition for every job vacancy is fierce, and national unemployment levels remain consistently high. In the face of such a situation, the need for a radical change in the way we do things becomes immediately apparent.

## **2 National Educational Policy and focus on inclusive education for women empowerment and underprivileged section of Indian society**

The National Education Policy 2019 provides a framework for the transformation and re-energization of the education system in order to respond to the requirements of fast-changing, knowledge-based societies while taking into account the diversity of the Indian people, their traditions, cultures, and languages. It seeks to ensure that human capital, the most vital form of capital that would fuel the necessary transformation, is secured and strengthened. Highest priority is accorded to the task of ensuring universal access to an education of high quality and breadth that would support India's continued ascent, progress, and leadership on the global stage – in terms of economic development, social justice and equality, environmental stewardship, scientific advancement and cultural preservation, and help develop and maximize our country's rich talents and resources for the good of the individual, the country, and the world. An education system built on the premises of quality and equity is considered central to sustainable development, achieving success in the emerging knowledge economy and society, for socio-economic mobility, and for building an equitable, just and humane society.

### **2.1 Key Features of NEP 2019 in brief**

#### **General**

- ◇ The Draft National Education Policy, 2019 is built on the foundational pillars of Access, Equity, Quality, Affordability and Accountability.
- ◇ The policy aims to universalize the pre-primary education by 2025 and provide foundational literacy/numeracy for all by 2025.
- ◇ It recommends renaming of Ministry of Human Resources Development as Ministry of Education.
- ◇ An autonomous body called the National Research Foundation (NRF) to be set up through an Act of Parliament.
- ◇ Rashtriya Shiksha Aayog or the National Education Commission - apex body - to be constituted. It will be chaired by the Prime Minister and will comprise eminent educationists, researchers, Union Ministers, representation of Chief Ministers of States, eminent professionals from various fields.
- ◇ Increase in public investment by the Central and State Governments to 20% of overall public expenditure over a 10-year period.
- ◇ Women's participation and education of girls to address the gender imbalance among school teachers and girls students, education of tribal, caste and religion-based groups to ensure

that children of these communities receive all the benefits earmarked for them, education of children of urban poor families in order to help students to navigate life in urban poor areas and education of children with special needs as well as transgender children with continued and renewed focus to mainstream children in neighborhood schools from foundational stage to Grade 12.

- ◇ Appropriate integration of technology into all levels of education - to support teacher preparation and development; improve teaching, learning and evaluation processes; enhance educational access to disadvantaged groups; and streamline educational planning, administration and management.

### **Early Education**

- \* Extension of Right to Education Act 2009 to cover children of ages 3 to 18. Free and compulsory education from pre-school to 12<sup>th</sup>.
- \* A major reconfiguration of curricular and pedagogical structure based on cognitive and socio-emotional developmental stages of children with Early Childhood Care and Education (ECCE) as an integral part of school education is proposed, with 5+3+3+4 design covering the children in the age group 3-18 years. Under this, Pre-Primary & Grades 1-2 is considered as foundational Stage; Grades 3-5 as Preparatory Stage; Grades 6-8 as Middle Stage and Grades 9-12 as Secondary Stage. This is an academic restructuring only; there will be no physical restructuring of schools.
- \* It aims at equitable & inclusive education for every child in the country, with a special focus on under-represented groups (URGs).
- \* Universal Access & Retention with 100% Gross Enrolment Ratio for all school education by 2030.
- \* In case of students being unable to attend school due to health issues, measures to ensure they return to school as soon as possible will include hiring health workers in schools, generating awareness among students, parents and the community-at-large, and connecting them to appropriate health services.
- \* Children learn languages, most quickly between 2-8 years, and multilingualism has great cognitive benefits for students. Therefore, a three-language formula has been proposed.
- \* It proposes the teaching of other classical languages and literature, including Tamil, Telugu, Kannada, Malayalam, Odia, Pali, Persian, and Prakrit in schools.
- \* A new independent State School Regulatory Authority (SSRA) to be created.
- \* Schools will be re-organized into school complexes. It also seeks to reduce the content load in the school education curriculum.
- \* There will be no hard separation of learning areas in terms of curricular, co-curricular or extracurricular areas and all subjects, including arts, music, crafts, sports, yoga, community service, etc. will be curricular. It promotes active pedagogy that will focus on the development of core capacities: and life skills, including 21<sup>st</sup> century skills.
- \* The Committee proposes for massive transformation in Teacher Education by shutting down sub-standard teacher education institutions and moving all teacher preparation/education programs into large multidisciplinary universities/colleges.
- \* The 4 year integrated stage-specific B.Ed. program will eventually be the minimum degree qualification for teachers. The practice of 'para-teachers' (unqualified, contract teachers) will be stopped across the country by 2022.
- \* Nutrition and learning are inextricably linked. The midday meal program will be expanded - both a nutritious breakfast and a midday meal will be provided to preprimary and primary

school students. Expenditure on the program will be linked to food costs and inflation to ensure the quality of the food served.

- \* There will be an increased focus on foundational literacy and numeracy in Grades 1-5, along with a robust system of adaptive assessment and availability of quality materials.
- \* A national repository of language and mathematics resources will be available on the National Teacher's Portal.
- \* Technological interventions to serve as aids to teachers will be piloted, and public and school libraries expanded to build a culture of reading and communication.
- \* All Grade 1 students will undergo a three-month long school preparation module.
- \* Teacher education will be redesigned to have a renewed emphasis on foundational literacy and numeracy.
- \* A National Tutors Program (comprising peer tutors) and a Remedial Instructional Aides Program (drawing instructors from the community) will be launched.
- \* A pupil-teacher ratio under 30:1 will be ensured at the level of each school.
- \* Social workers and counsellors will help ensure retention and mental health of all children, parental participation and mobilization of the local community and volunteers will be leveraged to ensure the policy goals related to foundational literacy and numeracy are met.
- \* Assessment will be transformed to support student development. All examinations (including Board examinations) will test core concepts and skills, along with higher order capacities. By 2025, assessment at middle school level and above will be through adaptive computerized testing. From 2020/2021 onwards, the autonomous National Testing Agency will administer aptitude tests and tests in various subjects, which can be taken on multiple occasions during the year.

## Higher Education

- \* It aims to consolidate 800 universities & 40,000 colleges into around 15,000 large, multidisciplinary institutions.
- \* The policy proposes three types of Higher Educational Institutions (HEIs): Research Universities, Teaching Universities and Autonomous degree-granting colleges.
- \* It aims to provide autonomy to all higher education institutions. Higher education institutions to be governed by Independent Boards with complete academic and administrative autonomy.
- \* In higher education, a restructuring of higher education institutions with three types of higher education institutions is proposed-
  - Type 1: Focused on world-class research and high-quality teaching.
  - Type 2: Focused on high-quality teaching across disciplines with significant contribution to research.
  - Type 3: High-quality teaching focused on undergraduate education.
- \* This will be driven by two Missions -Mission Nalanda & Mission Takshashila.
- \* There will be re-structuring of Undergraduate programs (e.g. BSc, BA, BCom, BVoc) of 3- or 4-years duration and having multiple exits and entry options.
- \* The four functions of Standard setting, Funding, Accreditation and Regulation to be separated and conducted by independent bodies: National Higher Education Regulatory Authority as the only regulator for all higher education including professional education.
- \* Creation of accreditation eco-system led by revamped NAAC; Professional Standard Setting Bodies for each area of professional education and UGC to transform to Higher Education

Grants Commission (HEGC).

- ★ The private and public institutions will be treated on par and education will remain a 'not for profit' activity.
- ★ Several new policy initiatives for promoting the internationalization of higher education, strengthening quality open and distance learning, technology integration at all levels of education, adult and lifelong learning and initiatives to enhance participation of underrepresented groups, and eliminate gender, social category and regional gaps in education outcomes are recommended. Open and distance learning will be expanded, thus playing a significant role in increasing the Gross Enrolment Ratio to 50%. Measures such as online digital repository, funding for research, improved student services, credit-based recognition of MOOCs, etc. will be taken to ensure it is at par with the highest quality in-class programs.
- ★ Promotion of Indian and Classical Languages and setting up three new National Institutes for Pali, Persian and Prakrit and an Indian Institute of Translation and Interpretation (IITI) has been recommended.
- ★ The path-breaking reforms recommended will bring about a paradigm shift by equipping our students, teachers and educational institutions with the right competencies and capabilities and also create an enabling and reinvigorated educational eco-system for a vibrant new India.

### **Professional Education**

- Professional education will be an integral part of the overall higher education system. The practice of setting up stand-alone technical universities, health science universities, legal and agricultural universities, or institutions in these or other fields, will be discontinued. All institutions offering either professional or general education must organically evolve into institutions offering both seamlessly by 2030.
- Agricultural education with allied disciplines will be revived.
- Legal education programs will be restructured.
- Healthcare education shall be re-envisioned such that the duration, structure and design of the educational programs is as much as is required for the roles that people play. There shall also be a much greater emphasis on preventive healthcare and community medicine in all of healthcare education.
- Engineering and technology programs will be revised to prepare professionals who are well prepared for both current and future practices and are able to exploit emerging science and technology while being responsive to changing socio-economic and environmental contexts.

## **2.2 Views in support of Draft National Education Policy**

1. The school education will cover children of 3-18 years, instead of the present 6-14 years under the RTE Act. It covers three years under early childhood care and education (ECCE) and four years under secondary education. ECCE would facilitate play and discovery-based learning for children of that age group.
2. Its emphasis on mother tongue-based education and oral language development are critical.
3. The policy focuses on online learning as an alternative to regular classroom interaction between teachers and students. It helps in achieving the twin objectives of cutting costs and increasing enrollment.
4. It aims to protect and promote our culture through the study of classical languages, mother tongues, and regional languages.

5. The teacher education system will be transformed, with rigorous preparation through a four-year integrated stage and subject-specific programs offered in multi-disciplinary institutions.
6. The draft talks about the better engagement of the private sector and provisioning for government funding for R&D work through a proposed national research fund.
7. Professional education will become an integral part of the higher education system.

### **2.3 Drawbacks in the Draft National Education Policy**

1. The draft policy is silent on the Institutions of Eminence and agencies like the Higher Education Funding Agency.
2. The policy does not address with sufficient clarity curricular, pedagogical and teacher education-related issues that plague the teaching and learning of early literacy in many Indian classrooms.
3. The policy proposes largely oral activities for the pre-primary grades, reading hours for Grades 1-3, with an additional hour for writing starting only in Grades 4 and 5. It contradicts evidence suggesting that young children be taught listening, speaking, reading and writing simultaneously and not sequentially.
4. It lacks discussion about what it takes to prepare teachers to successfully teach foundational literacy in a multilingual country. Instead, the document recommends recruiting volunteers and community members to support the acquisition of early literacy. Volunteers can be used but cannot be a primary mechanism to deliver foundational literacy to students.
5. It misdiagnoses the causes behind the severe learning crisis - namely poor school and teacher accountability. There is no fundamental reform proposed for revamping the accountability structures for schools. Instead, the NEP provides school management committees (SMCs). SMCs already mandated under the RTE Act are ineffectual.
6. With the democratization of knowledge and availability of technology for easy access to information, the draft should have focused more on how to teach and not only on what to teach.
7. The National Research Foundation (NRF) is tasked with “permeating the culture of research and innovation” and addressing societal challenges. But there is no mechanism, such as innovative curricula or extension units, for tier II or tier III institutions to work on local problems. It has no access or accountability to people or their representatives.
8. The Constitution puts education in the Concurrent List, giving authority and responsibility to both the States and the Centre. However, the draft had robbed the States by creating an excessively centralized structure of authority and vesting overarching powers with the PM-led Rashtriya Shiksha Aayog (RSA)
9. In promoting the study of regional languages, the importance of English is neglected. Those who are fluent in the English language live in households with three times higher income than those without any knowledge of English. By ignoring this, the Draft NEP19 has laid out a “language trap”, which will create social inequality and impede economic growth due to loss of the demographic dividend.
10. The report does not emphasize enough the role and importance of state governments in imparting education to the masses Challenges in implementation:
11. Draft NEP recommended doubling of public funding to 6% of the GDP and increasing overall public expenditure on education to 20% from the current 10%. This is desirable but does not appear to be feasible in the near future, given that most of the additional funding has to come from the States.
12. The report has appealed to philanthropists and companies to route their corporate social

- responsibility (CSR) funds to supplement government efforts, but it forgets that such funds will not be ideologically neutral.
13. Expanding coverage under the RTE Act to include pre-school children is extremely important, but should perhaps be introduced gradually, keeping in mind the quality of infrastructure and teacher vacancies. Amendment of the Act can perhaps wait for a while.
  14. The idea of setting up the Rashtriya Shiksha Aayog is crucial in order to integrate the approaches and programs of multiple departments. However, bringing medical or agricultural or legal education under one umbrella is likely to be met with stiff opposition.
  15. Language issues have to be handled sensitively in view of their emotional overtones, as witnessed recently.

### 3 Conclusion

Suggestions of the Draft National Education Policy will play a critical role in the transformation of the Indian education system. It is expected to help India in reaping its demographic dividend. However, the Draft National Education Policy has certain sore points that need to be relooked at for the benefit of teachers and students alike.

A change in current education system is needed, in order to ensure that the Gross Enrolment Ratio increases and also to ensure that the students exiting the Universities are job ready. We would need to adopt changes in three calibrated steps as under:

**Stage 1:** Introduction of new learning tools and products into the ecosystem, all of which serve to streamline and enhance the overall educational experience. Key among these are the incorporation of learning management systems (LMS), the integration of gamification as a learning tool, and the increasing applicability of augmented reality (AR) and virtual reality (VR) systems. LMSes serve as central, personalized databases through which students can access course material, upload assignments, and interact with professors and co-learners. By automating the administrative side of the learning process, both professors and students can focus solely on their academics. This ease of access and use is further complemented by gamification, wherein game mechanics and elements are integrated into non-game contexts. By presenting information in a fun and interactive manner, learners are more engaged in the lesson and therefore more likely to retain imparted concepts and information. The introduction of aspects such as scores, leader boards, and prizes further incentivizes students to fully commit to the topic, and ensures a fun, competitive element to their lessons. When combined with the ability of AR and VR, these tools are capable of transforming passive learning situations into interactive sessions and capture the imagination of all involved.

**Stage 2:** The government needs to ensure these new-age classroom resources and educational tools are implemented in a manner that prioritizes the practical application of theoretical knowledge. It is especially important that this mindset be inculcated at an early age, in order to instill a mindset that values curiosity over rigidity. As an example, many schools have taken the initiative of teaching coding to young children. But it's a rare few that have gone a step further and taught them to apply coding to find solutions to everyday problems and real-life situations. Only by taking that final step do these initiatives truly come to fruition.

**Stage 3:** Improving teaching methodologies is required and a coordinated approach is required

to change the teaching methods behind these new curriculums and tools. This is critical in light of the rapid advancement of technology – the internet offers virtually unlimited access to the sum of human knowledge, and artificial intelligence (AI) and machine learning (ML) systems are outperforming humans at increasingly complex cognitive tasks. If educators are to survive and thrive, they need to change with the times and prove their ability to contribute in this new environment. By embracing the possibilities offered by digital tools, educators also have a chance to transform classroom dynamics. Instead of a one-directional flow of information, from teacher to students, digital resources allow it to travel multi directionally: from teacher to student, student to teacher, and between students themselves. As India continues its transformation into a global superpower, the importance of a robust education system cannot be overstated. By integrating the many advantages offered by digital tools and ed-tech within the framework of the nation’s educational system, India has the chance to produce a generation of graduates ready to take on any job in the world.

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# A Review on Effect of Potassium-bi-sulphate as Food Preservative

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**Abstract:** Preservatives are chemical substance that are added to products to prevent their natural degradation. They prevent degeneration of enzymes and micro-organisms. Preservatives are classified into organic and inorganic preservatives bases on their chemical composition. Antimicrobial preservatives prevent the deterioration of food by certain microorganisms and the antioxidants prevent the oxidation of fat present in the food on exposure to air. An example for antimicrobial preservative is lactic acid butylated hydroxy anisole (BHA) which is commonly used synthetic antioxidant. There are also some non-synthetic preservatives such as citric and ascorbic acid which prevent degradation of fruits by targeting the enzymes responsible for it. There are several physical and chemical factors which effect the preservatives. Mostly it includes concentration, temperature, time of exposure etc. Some preservatives also show chemical reactivity towards food components. The lack of knowledge among the individuals of today's civilized society is posing a threat to their lives by using certain harmful preservatives. The most commonly used food preservatives in India are Benzoic acid and Sulphur dioxide. Sodium benzoate used as an alternative to benzoic acid as they both have almost same chemical properties. The present review gives the information about Potassium bi-sulphate which acts as a preservative and is a source for Sulphur dioxide which in-turn prevent the degradation of food. Also provided information about the several methods which are implemented to add preservatives into food substances and also effects of concentration, temperature, time of exposure on preservatives.

**Keywords:** Antioxidants, Food additives, Preservatives, Potassium bi-sulphate.

## 1 Introduction

A preservative is a substance or a chemical that is added to product such as food, beverages, pharmaceutical drugs, and many other products to prevent decomposition by microbial growth or by undesirable chemical changes. In general, preservation is implemented in two modes, chemical and physical preservation entails processes such as refrigeration or drying [1].

Preservatives are classified into organic and inorganic preservatives bases on their chemical composition. Antimicrobial preservatives prevent the deterioration of food by certain microorganisms and the antioxidants prevent the oxidation of fat present in the food on exposure to air. An example for antimicrobial preservative is lactic acid butylated hydroxy anisole (BHA) which is commonly used synthetic antioxidant. There are also some non-synthetic preservatives such as citric and ascorbic acid which prevent degradation of fruits by targeting the enzymes

responsible for it. There are several physical and chemical factors which effect the preservatives. Mostly it includes concentration, temperature, time of exposure etc. Some preservatives also show chemical reactivity towards food components. The lack of knowledge among the individuals of today's civilized society is posing a threat to their lives by using certain harmful preservatives. The most commonly used food preservatives in India are Benzoic acid and Sulphur dioxide. Sodium benzoate used as an alternative to benzoic acid as they both have almost same chemical properties. Food preservatives are specific additives to prevent deterioration from enzymes, micro-organisms and exposure to oxygen. All chemical preservatives must be non-toxic and readily soluble, not impart off the flavors, exhibit anti-microbial properties over the pH range of the food, and be economical and practical [2].

**ORGANIC AND INORGANIC FOOD PRESERVATIVES:** Food preservative constitute a group of compounds of widely different molecular structures, they are organic and inorganic substances with the different functional and tendencies to form ions. Organic and inorganic acid preservatives may be added in the form of un-dissociated acid or a variety of salts. In food, the ionic composition is determined largely by concentration and pH [3].

**ANTI-MICROBIAL PRESERVATIVES:** Antimicrobial preservative prevent degradation by bacteria. This method is most traditional and ancient type of preserving ancient method such as pickling and adding honey prevent microorganism growth by modifying the pH level. The most commonly used antimicrobial preservative is lactic acid [4, 5]. Nitrates and nitrites are also antimicrobial [6, 7]. The detailed mechanism of these chemical compounds ranging from inhibiting growth of the bacteria to the inhibition of specific enzyme water-based home and personal care products used broad-spectrum preservatives, such as isothiazolinone and formaldehyde releasers, which may cause sensitization, allergic skin reaction and toxicity to aquatic life [8].

**ANTIOXIDANTS:** The oxidation process spoils most food, especially those with a high fat content. Fats quickly turn rancid when exposed to oxygen. Antioxidants prevents or inhibit the oxidation process. The most antioxidant additives are ascorbic acid (vitamin C) and ascorbates [9]. The term 'antioxidant' is mostly used for two entirely different group of substances; industrial chemicals that are added to products to prevent oxidation and naturally occurring compounds that are present in food and tissue [10].

Antioxidant dietary supplements have not been shown to improve health in humans or to be effective at preventing diseases [11]. Supplements of beta-carotene, vitamin A and vitamin E have no positive effect on mortality rate [12, 13], or cancer risk [14, 15]. Additionally, supplementation with selenium or vitamin E does reduce the risk of cardiovascular diseases [16, 17]. Synthetic phenolic compounds, like butylated hydroxytoluene (BHT), and butylated hydroxyanisole (BHA) are efficient chain-breaking antioxidants and widely used as food preservatives. Some naturally occurring phenolic compounds such as tocopherol, ascorbic acid, or caffeic acid are used as chain-breaking antioxidants but are typically less efficient compared with the synthetic ones, but that again depends on the type of food product [18].

**EXTRINSIC AND INTRINSIC PRESERVATIVES:** Food preservatives can be extrinsic (intentionally added) intrinsic (normal constituent of food) or developed produced during fermentation [19, 20].

**NON-SYNTHETIC COMPOUNDS FOR FOOD PRESERVATION:** Citric and ascorbic acids target enzymes that degrade fruits and vegetable, Eg. mono/polyphenol. Oxidase which turn surfaces of cut apples and potatoes brown. Ascorbic acid and tocopherol, which are vitamins, are common preservatives. Smoking entails exposing food to a variety of phenol, which are antioxidants. Natural preservatives include rosemary and oregano extract [21].

## 2 Factors Affecting Preservatives

Factors affecting preservatives include

1. Concentration of Inhibitors
2. Kind, number and age of microorganisms (older cells are more resistant)
3. Temperature
4. Time of exposure (if long enough some microbes can adapt and overcome inhibition)

Chemical and physical characteristics of food (water, activity, pH, solutes etc.) Some examples of inorganic preservatives are Sodium Chloride (NaCl), benzoate and bi-sulphates etc. Sodium Chloride lowers water activity and causes plasmolysis by withdrawing water from cells. The sodium salt of benzoate is used to improve solubility in foods sulphates and bi-sulphates have been used to prevent enzymatic and non-enzymatic browning in some fruits and vegetables [22]. Chemical food preservatives are widely used in the food industry and are invariably cheap ingredients that are effective against a wide range of spoilage organisms. Chemical food preservatives include components such as sodium benzoate, benzoic acid, nitrites, sulphates, sodium sorbate and potassium sorbate. Forced by public opinion the demands for natural or label-friendly alternatives has increased [23].

### **CHEMICAL REACTIVITY OF PRESERVATIVES TOWARDS FOOD COMPONENTS:**

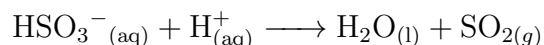
Chemical reaction between food preservatives and components of microbial cells, or with food components where these are implications with regard to anti-microbial action. Some food preservatives and particularly sorbic acid, Sulphur dioxide sulphates and nitrite ions are capable of more extensive reactivity with food components. Sulphur dioxide and sulphates species in a food decreases with time, and the shelf life may be limited by this reactivity [24].

**PRESERVATIVES AS FOOD ADDITIVES:** Every civilized society is using food preservatives but such practice can pose a threat to public health. Safe efficient preservatives development for perishable food items is a matter of intensive research. In urban slums of highly populated countries, the knowledge about contents of food tends to be extremely low, despite consumption of these imported foods [25].

## 3 Commonly used food preservatives in India

1. Benzoic acid or sodium benzoate: Benzoic acid and its salts are used as food preservatives. Benzoic acid inhibits the growth of mould, yeast. Benzoic acid or benzene-carbonic acid is a mono basic aromatic acid, moderately strong, white crystal in powder, very much soluble in alcohol, ether and benzene, but poorly soluble in water. Benzoic acid has the advantage that it doesn't effect the odour or taste of the food if it is in smaller quantities. It is the sodium salt of benzoic acid used as a white crystalline or amorphous powder.
2. Sulphur dioxide or potassium bi-sulphate: Potassium hydrogen sulphate or potassium bi-

sulphate is the chemical compound with the formula  $\text{KHSO}_3$ . It is used for the preservation of color less food materials such as fruit juice, squashes, apple etc. this is not used for the preservation of colored food materials because Sulphur dioxide produced from this chemical is a bleaching agent  $\text{KHSO}_3$  reaction with acid of the juice liberates Sulphur dioxide which is very effective in killing harmful microbes and thus preventing spoilage.



The advantage of this method is that no harmful chemical is left in the food.

Food preservatives are used primarily to prevent or relate microbial growth. The most typical food preservatives are sorbic-acid, benzoic acid, Sulphur dioxide etc, sample preparation depends mainly on the matrix. Preservative food additive can be anti-microbials which inhibit the growth of bacteria or fungi including mould. Food preservation may also include processes that inhibit visual deterioration such as the enzymatic browning. Many processes design to preserve food involve more than one food preservation method. Preserving fruit by turning it into jam, for example, involves boiling (to reduce the fruit moisture content and to kill bacteria etc.) sugaring (to prevent their regrowth) and sealing with an airtight jar (to prevent contamination) [26].

## 4 Future Prospective

Food-borne illness happens more often in our country. Public awareness of food preservatives is uneven. The increasing demand for ready to eat fresh food products had let to challenges for food distributors regarding the safety and quality of food. Increased amount of preservative in food materials can cause negative side effect. So there is a need to undergo research to check the good preservatives which will not cause harmful effect to the consumers.

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# Reuse and Recovery of Organic Compounds from Laboratory Waste

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**Abstract:** Preparation of meta-dinitrobenzene from Nitrobenzene is an elementary synthesis carried out in any organic preparation experiments in laboratories. The substrate nitrobenzene is a pale yellow coloured liquid with a characteristic almond like odour. Upon continuous vigorous agitation with nitration mixture at cooler temperatures, nitrobenzene solidifies as a yellow coloured solid called meta-dinitrobenzene that gets precipitated when added with a suitable quantity of ice cold water. As a result a lot of filtrate gets accumulated during the separation of pure product hence obtained. It is observed that large quantities of filtrate containing harmful organic residual effluents are discarded directly into the drains. This makes the treatment of waste water extremely dangerous. If left untreated it can prove to be deleterious to all the aquatic living forms, when it enters the water bodies. The objective of this study is to use the filtrate and recover as many organic compounds as possible before draining it out as waste. The recovered compounds can be reused within the laboratories or supplied as raw materials to other small scale manufacturers.

**Keywords:** Distillation, Filtrate, Meta-Dinitrobenzene, Nitrobenzene, Sulphuric Acid, Qualitative Analysis.

## 1 Introduction

Benzene is the smallest organic aromatic compound. Nitrobenzene is a significant derivative of benzene with a molecular formula  $C_6H_5NO_2$ . New Jersey Department of Health Right To Know [NJDOH RTH] Hazardous Substance List classifies Nitrobenzene as 1<sup>st</sup> degree Reactive, 2<sup>nd</sup> degree Flammable, Carcinogen and a Teratogen. However it is used in manufacture of perfumes, cosmetics, agro-chemicals, fertilizers, pesticides, dyes alongside its derivatives like meta-dinitrobenzene and aniline. Conventionally nitrobenzene is prepared by treating a charge of benzene with a nitrating mixture which is ideally a mix of concentrated sulphuric acid and concentrated nitric acid in the ratio 2:1 by volume. This is thereafter digested in the same vessel [1].

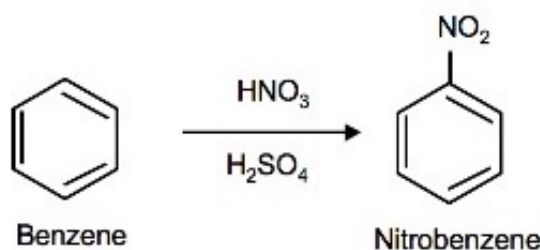


Figure 1: Preparation of Nitrobenzene from benzene



Nitrobenzene is subjected to another round of regulated nitration to form meta-dinitro benzene [1, 3 dinitrobenzene]. An aliquot of nitrobenzene on treatment with the nitrating mixture followed by vigorous agitation forms a solid meta-dinitrobenzene which is precipitated by adding ice cold water.

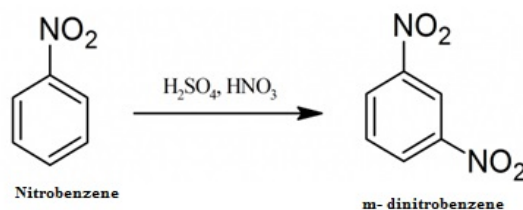


Figure 2: Preparation of m-dinitrobenzene from Nitrobenzene

The products obtained namely nitrobenzene and m-dinitrobenzene have substantial uses in the field of pharmaceuticals and chemical industries. The filtrate however is likely composed of unreacted nitrobenzene, remnants of concentrated acids like sulphuric acid and traces of nitric acid. These organic reactions produce large volumes of filtrates which are discarded untreated. Such a deed has grave impact on the natural environment and life in it.

Several strategies are being researched upon to combat the effect of these effluents. More recently, manufacture process of nitrobenzene and m-dinitrobenzene in industries are focussed on a continuous preparation that involves reuse of spent acid which remains at the end of nitration with fresh reactants to use up major portion of any unreacted nitric acid in the spent acid mixture [1].

This study aims to separate and carry out subsequent qualitative analysis of the three major components: water, sulphuric acid and nitrobenzene of filtrate or the spent obtained during nitration of benzene and nitrobenzene. The separated components can be reused as raw materials to carry out other chemical reactions or organic preparations. The study intends to reduce the wastage of expensive chemicals by using basic principles of chemistry. It reduces the possibility of those detrimental chemicals reaching the environment.

## 2 Methods

### 2.1 Preparation of m-dinitrobenzene form Nitrobenzene

1 ml of nitrobenzene was taken in a clean dry 100 ml beaker. 3 ml of concentrated nitric acid and 7 ml of concentrated sulphuric acid were added slowly into the beaker. The reaction mixture was vigorously stirred for 20 minutes using a glass rod by placing the beaker in a water bath till a solid was observed to be formed. The reaction mixture was tested for completion of reaction by dipping the glass rod in a test tube filled with ice cold water. If pale yellow solid is not precipitated, stirring was continued. Once yellow solid of m-dinitrobenzene precipitated, about 50 ml of ice cold water was added to cease the reaction and separate the product completely. The precipitate of m-dinitrobenzene was filtered and dried. The filtrate was separately collected for further analysis.

## 2.2 Distillation of Filtrate

Distillation is the process of separating the components from a liquid mixture by exploiting their relative volatile characteristics. Distillation results in complete separation forming nearly pure components or partial separation that increases the concentration of individual components in the mixture [2]. Components having low boiling point distil out first leaving behind components with higher boiling point. The different components of the spent vary in their boiling points. Water has a boiling point of 100 °C, Nitrobenzene has a boiling point of 210.9 °C and sulphuric acid has a boiling point of 337 °C. This was used to separate them to a large extent. Upon distillation, water evaporates first followed by yellow coloured nitrobenzene leaving behind sulphuric acid. The experimental setup was arranged as shown in Figure 3. Bunsen burner was turned on and kept below the round bottomed flask. On gradual heating the temperature remained constant at 95 °C - 100 °C until water boiled off which was collected in a beaker. Heating was further continued till temperature remained constant at 211 °C. At this temperature nitrobenzene boiled off and was collected in a separate beaker. Care was taken to avoid spilling of the spent from the round bottomed flask during heating.

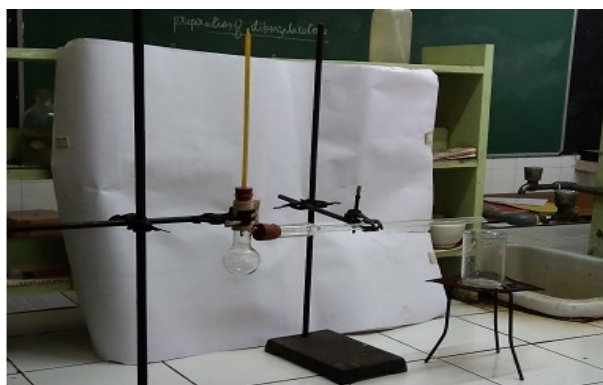
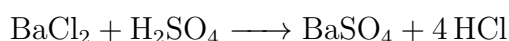


Figure 3: Distillation setup for separating the components of spent

## 3 Qualitative Analysis of Distillates

### 3.1 Qualitative Test for Sulphuric acid

1. **Litmus Test:** Blue litmus paper was dipped in sulphuric acid. Blue litmus turns red proving that it is an acid.
2. **Barium chloride Test:** Barium chloride when added to sulphuric acid, a white precipitate of Barium Sulphate was formed insoluble in excess hydrochloric acid.



### 3.2 Qualitative Test for Nitrobenzene

1. **Janovsky Reaction [3]:** 10 ml of dry distilled acetone was added to the sample of nitrobenzene in a beaker. 2 g of dry sodium hydroxide was added and the reaction mixture was heated for 5 minutes gently in a hot water bath. The mixture did not turn pink confirming the presence of mono nitro compound [4].
2. **Preparation of dinitrobenzene derivative:** Approximately 1 ml of nitrobenzene separated from the spent was taken in a clean dry 100 ml beaker. 3 ml of concentrated nitric acid and 7 ml of concentrated sulphuric acid were added slowly into the beaker. The reaction mixture

was vigorously stirred for 20 minutes using a glass rod. 50 ml of ice cold water was added. A pale yellow precipitate of a dinitro derivative was formed confirming the presence of nitrobenzene.

#### 4 Conclusion and Future prospective

Waste management is a crucial area of research in recent times. It focuses on reducing the harmful effects of waste on human and environmental health [5]. An effective way to achieve this is by reducing, reusing and recycling the waste generated to a large extent even before disposing it at domiciliary and industrial levels. One such simple yet efficient strategy is detailed in this study which can be employed in all institutions associated with organic preparations. Basic, fundamental and simple scientific techniques can be used to treat the waste generated and recover as many organic compounds from it which can otherwise prove to be deleterious to aquatic life and environmental equilibrium. The reuse of these organic compounds contributes to the preservation of water quality and reduction of water pollution. This study emphasizes the importance of minimization strategies to waste production to achieve substantial environmental improvements.

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# Flow Through Pipes and Applications

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**Abstract:** We live in a thin layer of air that blankets the surface of earth. The local and global movement of air determine our weather. The availability of water has been associated historically with the flourishing of many civilisations. To utilise the water resources optimally we need to predict the flow rates of water in rivers during different seasons. One such branches of science that deals with the study of motion of fluids and forces associated with it is Fluid Dynamics. This article emphasises on the branch of fluid dynamics flow through pipes and mathematics involved in it.

**Keywords:** Hagen Poiseuille flow, Fluid dynamics, Flow rate, Applications of Hagen Poiseuille flow

**AMS Subject Classification:** 76B99.

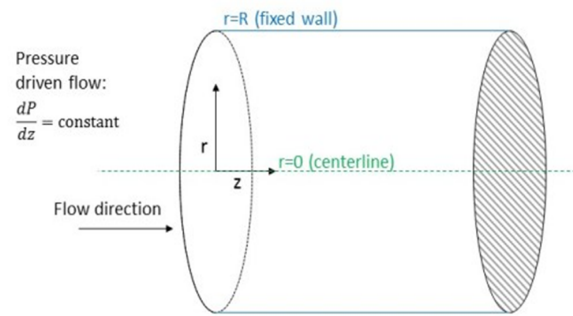
## 1 Introduction



How easy it is to open the tap and we get water from an overhead tank, but it is not that easy for any fluid when it enters the pipe. The fluid flowing through the pipe is influenced by the roughness, position diameter of the pipe, velocity and viscosity of the fluid and other factors resulting in different types of flow. We shall learn about one such flow that is *HAGEN POISUELLE FLOW* problem. The steady laminar flow of an incompressible viscous fluid in a long, straight, circular, rigid pipe of uniform cross section due to constant pressure gradient in the absence of body forces is called as **Hagen Poiseuille flow**.

## 2 Mathematical formulation and solution

Mathematics involved in the study of Hagen Poiseuille flow problem helps in deriving equations to determine the average velocity, maximum velocity, mass flow rate of fluid as follows



Let  $z$  be the axis of the pipe along which the flow takes place and  $r$  is the radial distance. The velocity of the flow is given by

$$\vec{q} = q_z(r, \theta, z)\hat{k} ; q_r = 0 ; q_\theta = 0 \tag{1}$$

So there is no flow in the radial direction and axial direction ( $\theta$  direction).

In other words, the flow is only in the axial direction. From the continuity equation we have  $\nabla \cdot \vec{q} = 0$  i.e.  $\frac{\partial q_z}{\partial z} = 0$ . Thus  $q_z$  is independent of  $z$ .

Also, the flow is considered to be axi-symmetric i.e.  $\frac{\partial q_z}{\partial \theta} = 0$ . Thus  $q_z$  is independent of  $\theta$ .

Substituting these results, equation (1) reduces to

$$\vec{q} = q_z(r)\hat{k} \tag{2}$$

The Navier-Stoke's equation is given by

$$\rho \left( \frac{\partial \vec{q}}{\partial t} + (\vec{q} \cdot \nabla)\vec{q} \right) = \nabla p + \rho g + \mu \nabla^2 \vec{q} \tag{3}$$

Since the flow is steady we have  $\frac{\partial \vec{q}}{\partial t} = 0$

Consider  $(\vec{q} \cdot \nabla)\vec{q} = \left( q_z \frac{\partial}{\partial z} \right) q_z(r)\hat{k} = 0$ .

Since the body forces are absent we have  $\vec{g} = 0$ .

Consider

$$\begin{aligned} \nabla^2 \vec{q} &= \left( \frac{\partial^2}{\partial r^2} + \frac{1}{r} \frac{\partial}{\partial r} + \frac{1}{r^2} \frac{\partial^2}{\partial \theta^2} + \frac{\partial^2}{\partial z^2} \right) q_z(r)\hat{k} \\ &= \left( \frac{d^2 q_z}{dr^2} + \frac{1}{r} \frac{dq_z}{dr} \right) \hat{k} \end{aligned}$$

Substituting the above results, equation (3) becomes

$$0 = -\nabla p + \mu \left( \frac{d^2 q_z}{dr^2} + \frac{1}{r} \frac{dq_z}{dr} \right) \hat{k} \tag{4}$$

Equation (4) in component can be written as

$$\frac{\partial p}{\partial r} = 0 \quad (5)$$

$$\frac{1}{r} \frac{\partial p}{\partial \theta} = 0 \quad (6)$$

$$\frac{\partial p}{\partial z} = \mu \left( \frac{d^2 q_z}{dr^2} + \frac{1}{z} \frac{dq_z}{dr} \right) \quad (7)$$

By equations (5) and (6), we can see that  $p$  is independent of  $r$  and  $\theta$ . Thus equation (7) becomes

$$\frac{dp}{dz} = \mu \left( \frac{d^2 q_z}{dr^2} + \frac{1}{z} \frac{dq_z}{dr} \right) \quad (8)$$

Since the flow is due to constant pressure gradient, we have  $\frac{dp}{dz} < 0$ . Thus equation (8) reduces to

$$P = \mu \left( \frac{d^2 q_z}{dr^2} + \frac{1}{z} \frac{dq_z}{dr} \right)$$

$$\frac{d}{dr} \left( r \frac{dq_z}{dr} \right) = \frac{P}{\mu} r$$

Integrating the above equation with respect to  $r$ , we obtain

$$\frac{dq_z}{dr} = \frac{Pr}{2\mu} + \frac{A}{r}$$

Integrating the above equation again with respect to  $r$ , we get

$$q_z = \frac{Pr^2}{4\mu} + A \log r + B \quad (9)$$

where  $A$  and  $B$  are constants to be determined.

From equation (9) it is clear that the velocity becomes infinite along the axis of the pipe (i.e.  $r = 0$ ) which is physically unrealistic or unacceptable. To have finite velocity along the axis of the pipe we must have  $A = 0$ . Thus equation (9) reduces to

$$q_z = \frac{Pr^2}{4\mu} + B \quad (10)$$

## 2.1 Boundary conditions

Since the boundary of pipe is rigid and not rotating the no slip condition suggests that  $q_z = 0$  at  $r = a$  where  $a$  is the radius of the pipe. Thus equation (10) becomes  $B = -\frac{Pa^2}{4\mu}$ .

Now equation (10) reduces to

$$q_z = -\frac{Pa^2}{4\mu} \left( 1 - \frac{r^2}{a^2} \right) \quad (11)$$

Equation (11) is the velocity distribution for Hagen-Poiseuille flow and is in the form of parabolic revolution.

## 2.2 Maximum velocity

Differentiating equation (11) with respect to  $r$  and equating it to zero we get,  $r = 0$ .

$$\text{Also } \frac{d^2 q_z}{dr^2} = \frac{p}{2\mu} < 0.$$

The maximum velocity is obtained at  $r = 0$ , which is given by  $q_{z_{max}} = -\frac{Pa^2}{4\mu}$

## 2.3 Average velocity

The average velocity is denoted by  $\vec{q}_z$  is defined as the ratio of the total flow over a cross section to the area of cross section.

$$\text{The area of cross section} = \int_0^{2\pi} \int_0^a r dr d\theta = a^2\pi$$

$$\begin{aligned} \text{The flow over a cross section} &= \int \vec{q} \cdot \hat{n} ds \\ &= \int_0^{2\pi} d\theta \int_0^a -\frac{Pa^2}{4\mu} \left(1 - \frac{r^2}{a^2}\right) r dr \\ &= -\frac{Pa^2}{8\mu} \end{aligned}$$

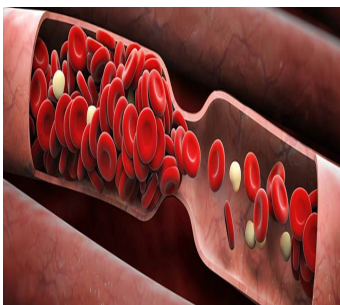
$$\text{Also, } q_{z_{max}} = 2(\vec{q}_z)$$

## 2.4 Mass flow rate

The mass flow rate denoted by  $M$ , is defined as the amount of fluid that passes through any cross section of the channel per unit width and per unit time.

$$M = \rho \int_0^{2\pi} \int_0^a q_z r dr d\theta = -\frac{\pi \rho p a^4}{8\mu}$$

## 3 Applications of Hagen Poiseuille flow



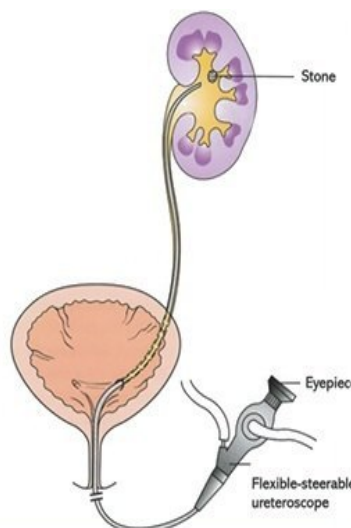
Poiseuille flow equation is used to study the narrowing of blood vessel and increase in blood viscosity caused by smoking and high blood cholesterol levels.

A piping network may be used to represent the circulatory system which results in closed loop piping network consisting pipes of various lengths and diameters. Methods for piping network analysis may be used to determine mean pressure changes across vascular circuits.

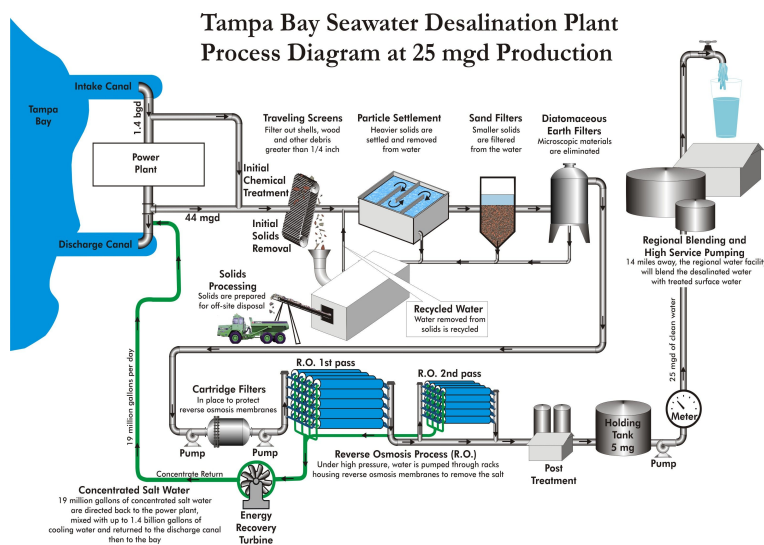


Physical exercises trigger the contract mechanism to enlarge the diameter of the blood vessels. The piping network theory and Poiseuille equation may be used to analyze the effect of physical exercises on distribution of blood flow in vascular systems. The cardiovascular system consists of two major circulatory systems—pulmonary and systemic circulation and heart. This represents a pump piping system operation. The operation of cardiovascular system is determined by the characteristics of heart and blood vessels. We can investigate how physical activities modify these characteristics and thereby affect the operating point of the system. The flow rate may be used to calculate the work done by heart.

Flexible ureteroscopy has become an effective modality for treatment of upper urinary tract stones. Hagen Poiseuille equation is used as a tool to determine the renal pelvic pressure during this process.







During the process of desalination of water the desalination model uses Hagen-Poiseuille equation to calculate the velocity components. The Poiseuille flow model simulates the permeate flux of water in cross flow filtration tubular membrane.

The formation of biofilms are influenced by flow velocity, mass transform, drag and diffusion potentials of a system which can be studied through Hagen Poiseuille equation and can be controlled by reducing the turbulence in the flow.



These are some of the applications of a single flow problem there are many more influential factors acting on fluid flow leading to variety of flow problems. Mathematics is a tool to analyze such flow problems and make them available for the welfare of humanity.

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# Is Artificial Intelligence Necessary????

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**Abstract:** *“The real risk with AI isn’t malice but competence. A super intelligent AI will be extremely good at accomplishing its goals and if those goals aren’t aligned with ours, we’re in trouble”- Stephen Hawking [1].*

*If we are using mobile phones then we are knowingly or unknowingly we are adopted to artificial intelligence in our daily life. We can see few computerized technology all over world, where it replaced human efforts with the artificial intelligence. Mostly this technology will be adopted soon to make work more accurate in very short time and to perform advance tasks. Artificial intelligence become necessary to each and every person everywhere. We need to adopt to this technology where the future depends. It is important for everyone to know about Artificial intelligence as everyone depends on this. The adoption of this technology is costlier and need modernized equipments to develop artificial intelligence. There are people who encourage AI and there are people who discourage AI, but it is sure that the future will be AI.*

*In this paper I will discuss about what exactly is artificial intelligence, what things we need to know to adopt artificial intelligence, why we should adopt artificial intelligence, disadvantages of using artificial intelligence, does it effect humans?*

**Keywords:** *Artificial intelligence, accurate, reliable.*

## 1 Introduction

The field of AI research was born at a workshop at Dartmouth College in 1956, where the term “ARTIFICIAL INTELLIGENCE” was coined by John McCarthy. Artificial intelligence was founded as an academic discipline in 1955 and in the years since has experienced several waves of optimism, followed by disappointment and the loss of funding, followed by new approaches, success and renewed funding [2].

Basically artificial intelligence refers to the development of computers to work as the human brain works. It may come into light in future days (2021). It may replace almost all work done by humans. It may have boon as well as bane. There are many debates going on regarding the artificial intelligence. There is a high chance that in future many countries may use artificial intelligence. In today’s life we can see Siri, Alexa which are based on artificial intelligence giving the output in less time. Coming to the adoption of artificial intelligence, as we are modernizing we need new things and we need to do our works instantly without going through troubles that may be one of the reason why we need to adopt artificial intelligence in our daily life. Artificial intelligence is the advance technology where many research is going on to adopt this technology.

## 2 What is Artificial Intelligence?

Computer Science defines AI research as the study of intelligent agents: Any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals. A more elaborate definition characterizes AI as “A system’s ability to correctly interpret external data, to learn from such data and to use those learnings to achieve specific goals and tasks through flexible adaptation [2].”

When most of the people hear the term artificial intelligence, they usually think of robots. Artificial intelligence is based on the principle that human intelligence can be defined in a way that a machine can easily mimic it and execute tasks, from the most simple to those that are even more complex. The goals of artificial intelligence include learning, reasoning and perception [3].

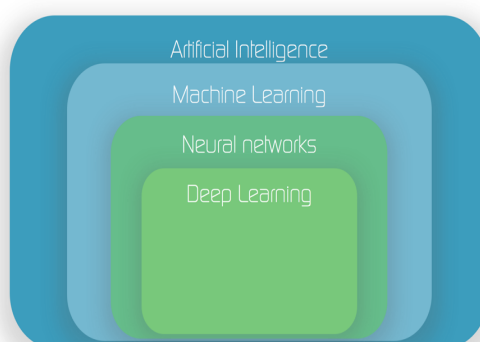
### Types of Artificial intelligence

Theoretical AI says that intelligence has three types, namely

1. **Artificial Narrow Intelligence (ANI):** Artificial Narrow intelligence is also referred to as Artificial Intelligence or Weak Artificial Intelligence. This type of artificial intelligence focus primarily on one single task and with limited range of abilities [4]. The best example of Artificial Narrow Intelligence is Voice search, Alexa, Siri which performs single tasks at a time.
2. **Artificial General Intelligence (AGI):** As the name suggests, it is general-purpose. Its smartness or efficiency could be applied to do various tasks. It is comparatively like the human brain. Unlike ANI, it can learn and improve itself to perform various tasks [5]. An individual cannot always program these machines, in this case Artificial General Intelligence will be productive.
3. **Artificial Super Intelligence (ASI):** Artificial Super Intelligence that will match and then surpass the human mind [3]. It is an aspect of intelligence which is more powerful than a human’s intelligence. It can think abstractions which are impossible for humans to think. The human brain is made of neurons and is constrained to some billion neurons [5].

## 3 Things need to know to adopt Artificial Intelligence

These are the three things which are the main applications of artificial intelligence. These Three things helps to perform or make us to understand the concept of Artificial Intelligence.



- 1. Machine Learning:** Machine learning is itself a type of artificial intelligence that allows software applications to become more accurate in predicting outcomes without being explicitly programmed [6]. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves.  
Machine learning is the ability for a computer to output or does something that it wasn't programmed to do. While machine learning emphasizes making predictions about the future, artificial intelligence typically concentrates on programming computers to make decisions. If you use an intelligent program that involves human-like behaviour, it can be artificial intelligence. However, if the parameters are not automatically learned (or derived) from data, it's not machine learning [6]. Combining machine learning with AI and cognitive technologies can make it even more effective in processing large volumes of information.
- 2. Neural Networks:** The basic idea behind a neural network is to simulate lots of densely interconnected brain cells. The system will learn things, recognize patterns, and make decisions like a human. The system doesn't need to be programmed explicitly. The system will learn all by itself - just like a brain [6]. The main function of Neural networks is these machines should perform like a Human brain without any explicit code or instruction given to them.
- 3. Deep Learning:** DL is a newer area of ML that that uses multi-layered artificial neural networks to deliver high accuracy in tasks such as object detection, speech recognition, language translation and other recent breakthroughs that you hear in the news. Beauty and strength of DL is they can automatically learn/extract/translate the features from data sets such as images, video or text, without introducing traditional hand-coded code or rules [7]. It also approximates many brain development theories of the human brain.

## 4 Why we should adopt artificial intelligence???

The applications for artificial intelligence are endless. This technology can be applied to many different sectors and industries. Artificial intelligence is extending its frontier in technology and knowledge. Wherever we see people are discussing about machines with intelligence which improve our lives [8]. There are many reasons why we need to adopt artificial intelligence which includes many features like reliability, time, flexibility, ability, memory etc. Here we discuss the main reasons to adopt AI.

- **Reduces Errors:** As we humans make mistakes one or the other time, but here machines are more accurate and the information they give is more accurate without any mistakes as made by humans. It plays a vital role in maintaining accuracy with any kind of data [9].
- **Daily Applications:** Everyday we are using artificial intelligence everywhere. We have Siri, Alexa, Maps, Gaming apps, Camera (where we have location, AI effects) etc. We have already been adopted to this technology [9].
- **Takes risks instead of humans:** We can use artificial intelligence in various hazardous situations like wars, diffusing bombs, going to space, mining, deep oceans or in any natural disasters [9].
- **Available 24/7:** As machines never get tired or fatigue. It is available to us at all time .This is one of the biggest advantage where the time to complete largest tasks can be done quickly.
- **Medical Applications:** It is most important to use artificial intelligence in medical field. It can be reliable, as it cannot be infected with virus [10]. It can do surgeries as it is more accurate and chances of death rate may be minimized. A recent example: As we know in

China, the people are infected with Corona virus, here we can use artificial intelligence to cure the patients or in research, to find vaccine for that virus.

- Digital Assistance: Siri, Alexa, Avatars, self driving cars-these are examples of digital assistance where user can interact with chat bots like these and get the desired information, which is accurate and it consumes less time.

Above are the some of the important criteria or advantages why we need to adopt artificial intelligence.

### **Disadvantages of Artificial Intelligence:**

Every technology have pros and cons, here we discuss about the disadvantage of artificial intelligence

- Very costly: The cost of producing and maintaining of artificial intelligence is very costly and difficult. Only rich countries can use this technology and maintain artificial intelligence with day to day activities.
- Unemployment: As the work or information given by artificial intelligence is more accurate and reliable, there is a high chance that people who are not skilled, will be replaced by artificial intelligence which performs the same tasks as the normal individual do [9].
- Making Humans Lazy: As every information is available easily and in less time, everyone depends on artificial intelligence thus becoming lazy to find out those information by themselves [9].
- No replication of Humans: Whatever the tasks artificial intelligence can do but it doesn't have emotions and moral values. They don't know what is ethical and what is legal and because of this they don't have their own judgement making skills [11]. Thus in many situations it may cannot perform accurately and may result in wrong decisions, which is threat to humans.
- Less Creativity: As artificial intelligence only performs what has been programmed to that, it cannot be more creative as humans are. Humans need to specify the work to be done, how to handle situations etc. In this case, it cannot replace skilled individual.

As discussed above the disadvantages of artificial intelligence, it may not be equal to human as it is programmed by skilled humans. Whatever the artificial intelligence do it has been monitored by humans and do what humans specify them to do.

## **5 Does it affect Humans?**

Coming to the threat to humans, its obviously yes! There will be threat to humans as it is been programmed by humans. Some of its functions can be changed by hackers or others who don't have idea about artificial intelligence. In some situations due to its inability it may not take proper decision which may harm humans.

In some cases it lead to unemployment, where humans become unemployed as many works will be taken by artificial intelligence. If the functionality of artificial intelligence is changed, it seriously affects humans and there is chance of destruction of humans in the world.

So it is necessary to handle and program the artificial intelligence well in a way it should be useful to humans and should be monitored by a skilled individual. It should mainly be protected from Hackers or Crackers, they might change the functionality and use for their needs and finally affecting humans.

## 6 Conclusion

Whatever may be the pros and cons of the technology we have to use this wisely and for our development rather than thinking in negative aspect. It is left to us to make use of artificial intelligence in a good way and developing the technology.

Artificial intelligence will change the technology throughout if we make proper use of it. I hope this paper helped you to choose whether you need to adopt the technology or not. As per my point of view, it is necessary to adopt artificial intelligence as it is inhuman, we can use in some fields where it becomes difficult for humans .

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# Preliminary Phytochemical screening of sub genus *Euphorbia* L. from Andhra Pradesh

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**Abstract:** Preliminary phytochemical screening is the key step for finding the chemical constituents which leads to the isolation of lead compounds of medicinal importance. The sub genus *Euphorbia* L., contains succulent arborescent trees with milky latex, belonging to the family Euphorbiaceae. All vegetative parts like root, stem, leaves and latex are of much medicinally active and are employed in many traditional systems of medicines. The main focus of this study is to identify and understand the bioactive chemical constituents of root and stem extracts by subjecting the powder to soxhlet extraction in different solvent systems. The yield of each extract was calculated and it was found to be more in methanolic and aqueous extract. The phytochemical screening showed the presence of alkaloids, phenolics, glycosides, tannins, flavonoids etc. which contribute several pharmaceutical applications to humans.

**Keywords:** Phytochemical screening, sub genus *Euphorbia* L., Andhra Pradesh.

## 1 Introduction

Plants have a wide range of scientific and economic value. They are considerably valuable in agriculture, food, cosmetics, medical and pharmaceutical industries. Over the past few decades there have been much interest in plant and other natural materials as a source of new medicines. Plants are essential source of bioactive compounds which can be used to cure or treat diseases. Numerous plant species recorded to have active phytochemical compounds which are known as plant secondary metabolites [1]. Secondary metabolites act as plant's natural system of defense and repair. Phytochemicals or plant secondary metabolites are not essential nutrients and are not required by the human body for sustaining life but have important properties to prevent or to fight some common diseases [2]. Among the different secondary metabolites, alkaloids, flavonoids, tannins, carotenoids, and phenolic compounds are found to be most beneficial to humans [3].

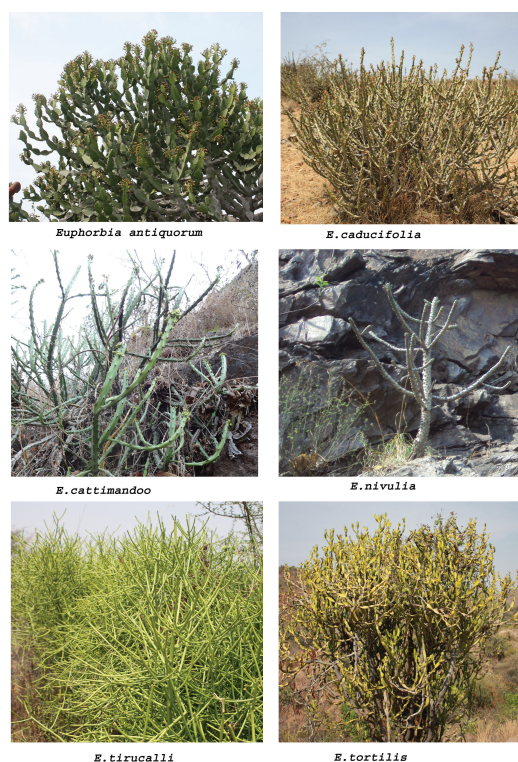
The genus *Euphorbia* occupied a distinct position in the Euphorbiaceae family, which contains more 2100 species and labeled as one of the most diverse groups of flowering plants on earth. Many of the species are known as "spurges". They all produce mostly white latex which they exude when cut, and this sap is often toxic. There are many herbaceous spurges, especially in temperate zones worldwide, but the genus is best known for its many succulent species, some of which appear very similar to cacti. Succulent *Euphorbias* are most diverse in southern and eastern Africa and Madagascar, but also occur in tropical Asia and America. In India the genus represented 84 spp [4]. In Andhra Pradesh the subgenus represented 7 species.



## 2 Materials and Methods

### 2.1 Plant collection

Plants studied in this report were collected in 2010-2015 from different areas of Andhra Pradesh and identified with the help of regional flora (Figure 1) The voucher specimens were deposited at SKU herbarium and BSID Hyderabad, herbarium. Aerial parts of the plants were air-dried at room temperature in the shade and were used for solvent extraction.



**Figure 1: Habit of *Euphorbia* spp.**

### 2.2 Preparation of crude extracts

For qualitative detection about 100 g of the each powdered test material was loaded on to Soxhlet and fractionated sequentially in 200 ml of petroleum ether, methanol and water successively over 6-8 hrs or the extraction was continued until the liquid was clear. The extracts obtained were filtered and concentrated under reduced pressure, below 40 °C to dryness and the residue used for the tests.

### 2.3 Detection of alkaloids

The n-hexane, ethyl acetate, methanol and water extracts were tested for the presence of alkaloids. A portion of the n-hexane extract was concentrated and the residue was digested with 1.5 ml of 2% hydrochloric acid. The resulting acidic solution was divided into three portions. Of respectively, while the third served as blank. The formation of affiant turbidity or precipitation on the above reagents indicates the presence of alkaloids.

A portion of the methanol extract was digested with 1.5 ml of 2% hydrochloric acid, filtered, neutralized with 10% ammonium hydroxide and extracted with n-hexane. The n-hexane soluble portion was tested for alkaloids.

A portion of water extract basified with 10% of ammonium hydroxide and extracted with n-hexane. The n-hexane solution was extracted with 10% hydrochloric acid and the acidic aqueous solution was tested for alkaloids as in the ether extract.

These two portions were tested for alkaloids by adding Mayer's reagent and Wagner's reagent.

**Anthocyanins and anthocyanidins** 1 ml of ethyl acetate, methanol and water extracts were tested for the presence of anthocyanins and anthocyanidins. Red colour in acidic aqueous solutions of Ethyl acetate, methanol and water extracts at pH 3-4 indicates the presence of anthocyanins and the change of colour with modification (pH 8-9) indicates the presence of anthocyanidins.

**Anthracene glycosides** 1 ml each of ethyl acetate, methanol and water extracts were tested for the presence of anthracene glycosides (Peyer,1931). Ethereal solutions of, Ethyl acetate methanol and water extracts were treated with 2.5% ammonium hydroxide. Formation of red colour indicates the presence of anthracene glycosides.

**Anthraquinones** Fresh plant material was tested for the presence of anthraquinones. The plant material was extracted with 0.5% of potassium hydroxide. To the alkaline extract 1 ml of hydrogen peroxide, 1 ml of acetic acid and 1 ml of benzene were added. The mixture of red colour in the ammonia layer indicates the presence of anthraquinones.

**Aucubins and Iridoids** Fresh plant material was tested for the presence of Aucubins and Iridoids. The plant material was chopped and treated with 5 ml of 1% aqueous hydrochloric acid. After 3-6 hours, the extract was treated with 1 ml of Trim-Hill reagent (10 ml of acetic acid, 1 ml of 0.2% copper sulphate in water and 0.5 ml of concentrated hydrochloric acid) and heated on a water bath. The appearance of blue color indicates the presence of aucubins (diterpenoids) while green color indicates the presence of iridoids (monoterpenoids).

**Carotenoids** n-hexane extract was tested for the presence of carotenoids. Half volume of the n-hexane solution was evaporated and the residue dissolved in antimony chloride followed by the addition of concentrated sulphuric acid. The development of a blue/green color indicated the presence of carotenoids.

**Coumarins** n-hexane, ethyl acetate, methanol and water extracts were tested for the presence of coumarins. The ethereal solutions of three extracts were evaporated and dissolved in water separately. UV fluorescence (at 254 nm) of the aqueous solution and the increase in intensity after the addition of 10% ammonium hydroxide, indicates the presence of coumarins.

**Emodins** n-hexane extract was tested for the presence of emodins by Borntrager's reaction [5]. When the alkaline aqueous solution was red in colour, a portion of ethereal solution was evaporated and the residue dissolved in benzene followed by the addition of 25% ammonium hydroxide. The development of red colour indicates the presence of emodins.

**Fatty acids** 2 ml of n-hexane extract was tested for the presence of fatty acids. A portion of the n-hexane solution was evaporated on a piece of filter paper. Formation of transparent spot indicates the presence of fixed oils.

**Flavonoids** n-Hexane, ethyl acetate, methanol and water extracts were tested for presence of flavonoids by Shinoda's reaction [6]. Ethereal solutions of the four extracts were evaporated and the residue was dissolved in 50% methanol separately on a sand bath. On addition of magnesium powder and concentrated hydrochloric acid, the development of yellow/red colour indicates the presence of flavonoids.

Reagent 1	Reagent 2	Reagent 3	Reagent 4	Flavonoid type
5% NaCl	Con. H <sub>2</sub> SO <sub>4</sub>	Mg+ HCl hot	Sodium amalgum	
Pale yellow	Pale yellow	No change in colour	No change in colour	<b>Dihydrochalcones</b>
Yellow	Intense yellow to red	Red	Red	<b>Flavones</b>
Yellow to brown	Intense yellow	Yellow to pale red	Yellow to pale red	<b>Flavonols</b>
Yellow	Yellow	No change in colour	Red	<b>Flavonones</b>

**Gallic-tannins and Catecholic Compounds** Ethyl acetate, methanol and water were tested for the presence of Gallic-tannins and Catecholic Compounds. 1 ml of each extract was diluted with 1 ml of water and added 2-3 drops of dilute ferric chloride solution. Formation of blue black solution indicates the presence of gallic-tannins, while a green black colour indicates the presence of catecholic compounds.

**Test for glycosides** To 1 ml of each extract a few drops of glacial acetic acid and ferricchloride and 3-4 drops of concentration sulphuric acid were added. The appearance of blue-green colour indicates the presence of glycosides.

**Lignans** Methanol extract was tested for the presence of lignans. 5 ml of the extract was treated with 1 ml of concentrated hydrochloric acid and 2% furfuraldehyde. The development of red colour indicates the presence of lignans.

**Phenols** 1 ml of methanol extract was dissolved in alcohol or water and treated with a few ml of neutral ferric chloride solution. Any change in colour indicates the presence of phenols.

## 2.4 Detection of proteins

The extract was filtered through Whatmann No.1 filter paper and the filtrate was subjected to test for proteins.

**Biuret test** To 2 ml of test solution add 2 ml of 10% sodium hydroxide. Mix well. Add 2 drops of 0.1% copper sulphate solution. Pink colour in ethanol layer indicated the presence of proteins.

**Xanthoproteic test** To 5 ml of test solution, add 1 ml concentrated nitric acid. Boil the contents. After cooling add excess 40% sodium hydroxide. On adding acid, yellow colour is noticed. When sodium hydroxide added deep orange colour develops.

**Polyoses** Water extract was tested for presence of polyoses. 2 ml of the extract was evaporated and the residue was treated with 2-3 drops of concentrated sulphuric acid followed by 3-4 drops of alcoholic thymol. The development of red colour indicates the presence of polyoses.

**Polyuronoids** Water extract was tested for the presence of polyuronoids. 2 ml of the extract was admixed with 10 ml of alcohol or acetone followed by the addition of 4-5 drops of haematoxylin. The mixture was filtered and the precipitate was washed with alcohol. A violet precipitate indicates the presence of polyuronoids.

**Reducing compounds** Methanol and water extracts were tested for the presence of reducing compounds. 0.5 ml of water extract was diluted followed by the addition of 5-8 drops of Fehling's reagent and the mixture was heated. The development of the brick red color precipitation indicates the presence of reducing compounds.

**Saponins** Water extract was tested for the presence of saponins 0.5 ml of water extract was mixed with 10 ml of distilled water and agitated in a graduated cylinder for 15 minutes. Formation of persistent foam indicates presence of saponins.

**Steroids and triterpenoids** n-hexane, ethyl acetate, methanol and water extracts were tested for the presence of steroids and triterpenoids by Libermann-Burchard test. The solutions of the four extracts were evaporated and the residue dissolved in 1 ml each of acetic anhydride, chloroform and concentrated HCl separately. Formation of green color indicates the presence of steroids, while red-violet indicates the presence of triterpenoids.

**Volatile Oils** n-hexane extract was tested for the presence of volatile oils. 2 ml of ether extract was evaporated on a porcelain tile. Aromatic smell of residue indicates the presence of volatile oils.

### 3 Results and Discussion

Phytochemical process was carried out among the seven species of Euphorbia extracted of the four different solvents i.e n-hexane, Ethyl acetate, Methanol and Aqueous were processed to determine the Phytochemical constituents. The presence of the compounds was recorded by the plus '+' sign for strong reaction and 'T' sign for a weak reaction.

The preliminary phytochemical screening conducted on the stem bark and root extracts of test species revealed the presence of alkaloids, Anthraquinones, anthocyanins, Anthocyanidins coumarins phenols, flavonoids, tannins, glycosides etc as shown in Table 1. Presence of phyto constituents varied upon different solvent systems. The n-hexane extract showed the presence of Alkaloids, aucubins, coumarins, glycosides, Iridoids, steroids etc. Ethyl acetate gave positive results for Reducing compounds, flavones, anthracene glycosides, anthocyanins, gallic tannins etc. Methanolic extracts gave positive result for the presence of Alkaloids, Anthraquinones, Anthocyanidins, Anthracene glycosides, proteins, Polyoses, Phenols, Steroids, Reducing compounds, glycosides etc. The aqueous extract confirms the presence of Alkaloids, Anthraquinones, Anthocyanins, Anthracene glycosides, Coumarins, Flavonoids, Flavonols, Glycosides, Gallic- tannins, Iridoids, Reducing compounds, Proteins etc.

Screening of seven medicinal plants was analysis to maximum classes of phyto-constituents is present. The medicinal plants have highest therapeutic efficiency by pharmaceutical field. The seven medicinal plants extract to indicate the more positive result of methanolic and aqueous plant extract. The plants extract were to determine the presence of phyto-constituents. The medicinal plants have been used to treatment of so many disease and their medicinal roles of these plants have such a secondary product and identified the bioactive compounds. This paper

reveals that above seven medicinal plants gives a basis of its use in medicine and develop to further drugs in pharmaceutical area and also contains different biologically active constituents, and secondary product are valuable of further analysis.

## 4 Conclusion

Several studies confirmed the presence of these phytochemicals contribute medicinal properties to plants. Therefore, extracts from this plant could be seen as a good source for useful drugs. Preliminary qualitative test is useful in the detection of bioactive principles and subsequently may lead to drug discovery and development. Phytochemical studies revealed that the stem bark extract is rich in many active phytoconstituents which impart physiological response. However, a detailed analysis of the plant material is required in order to explore the hidden therapeutic potency of this plant. Also, many phytochemical methods should be adopted to isolate, purify, and characterize the active constituents present in this plant which could later become promising for drug development.

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## A Review on Isolation and Characterization of *Acetobacter Aceti* from Sugarcane

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**Abstract:** *Acetic acid bacteria are airborne and are ubiquitous in nature. They are actively present in environments where ethanol is being formed as a product of the fermentation of sugars. They can be isolated from the nectar of flowers and from damaged fruits. The present review is to investigate the efficiency of acetic acid bacteria to produce good quality vinegar from fruit peels and to isolate the Acetobacter acetimore naturally. Whatever, as we know that acetic acid bacteria play very important role in production of vinegar for acetic acid fermentation. To overcome the disadvantages or side effects from vinegar. In the present review methods for isolation of Acetobacter from sugarcane juice, honey, flowers using GYC media.*

**Keywords:** *Acetic acid bacteria, Honey, Sugarcane, Yeast extract.*

### 1 Introduction

Acetic acid bacteria are a large group of obligate aerobic gram-negative bacteria with the ability to oxidize ethanol to acetic acid [1].



*Acetobacter aceti* microscopic view

They are widely distributed in natural habitats and classified into the family *Acetobacteraceae*. Members of this family are useful in industrial production of vinegar [2]. Acetic acid bacteria (AAB) can use substrates such as glucose, ethanol, lactate or glycerol as energy sources. However, most of these compounds are not completely oxidized into CO<sub>2</sub>, and water and several metabolites, especially acetic acid, are accumulated in the growth medium. AAB are commonly found in nature because of their high resistance to acidity and the variety of substrates that they can use [3]. These bacteria have been isolated from alcoholic beverages, vinegar, fruits, flowers, honey, sugarcane, fruit juice, soil and water [4, 5]. Among the most important acetic acid bacteria, the strains of genus *Acetobacter* are mainly involved in vinegar

[6, 7].

The aim of this study is to characterization of the isolated strains from novel food and agricultural resources that could grow at high temperatures and tolerate against high concentrations of ethanol and produce high levels of acetic acid.

## 2 Literature Review

Tharinee et al. in 2015 referred Isolation of acetic acid bacteria from various kinds of fruits and fermented fruit juices [8]. They collected thirty varieties of fruits: apple, black grape, cantaloupe, cherry, Chinese pear, dragon fruit, green grape, guava, lorgan, longkong, lychee, mango, mangosteen, mulberry musckmelon, papaya, peach, persimmon, pineapple, pisang mas, plum, plum mango, rakumplam, rambutan, red grape, rose apple, santol, strawberry, sugarcane and watermelon and 4 fermented juices of kaffir lime, Indian gooseberry, pineapple and star fruit. Ninety-nine isolates of acetic acid bacteria were obtained from 18 varieties of fruits and 4 fermented juices using sterile distilled water supplemented with 4.00% ethanol (v/v) as an enrichment medium. Eighty-nine isolates were identified to be in the genus *Acetobacter* and 10 isolates were in the genus *Gluconobacter*. Fifty- nine isolates were *Acetobacter acetias* determined by biochemical tests. Nineteen isolates; P1, P4, P6, P8, P12, K4, K5, K6, K7, S8 and S11 gave the widest yellow zone on bromocresol green ethanol agar. They were selected for acetic acid production and compared with *Acetobacter aceti* TISTR354 in ethanol-yeast extract medium supplemented with 6.00% (v/v) ethanol. It was found that P1, P4, P6, P12 and *Acetobacter aceti* TISTR354 gave the highest yield of acid 4.06%, 3.70%, 3.89%, 4.00% and 4.03% respectively. All the isolates were tested for their tolerance to ethanol and acetic acid. It was suggested that their fruits should be ripe fruits which are appropriate for enrichment technique. It was found that they were able to grow at 4% and 6% ethanol. Moreover, isolates P1, P4, P6, P12, K6, K7, K8, S1, S2, S11 were able to grow at 10.00% ethanol.

The study conducted by Kowser et al., with various samples which are inoculated in sterilized GYC standard media then incubated at 30 °C for 48 hours [9]. Successive subculture was performed to screen out the strains. In Gram's staining, the morphology of the isolated bacteria exhibited pink, small rod shaped single, pair and chain in arrangement, in the hanging drops technique, all the isolates revealed motile. Biochemical tests were performed by fermentation of five basic sugars by producing both acid and gas bubbles in Durham tube. All of the isolates were Indole, Voges-Proskauer (VP) and Oxidase negative, Methyl Red (MR) and Catalase positive. The growth rate of isolated strain was optimized by weighing dry cell and turbidity at 600 nm at different concentrations of dextrose (1%, 5% and 10%). 10% dextrose solution showed rapid growth and higher cell mass than 5% and 1% solution respectively. Acidity of the media gradually increased from 0.102% to 2.18% from day 0 to day 7 and pH of the media decreased from 6.8 to 5.5 during the period. They were successful in doing enrichment of *Acetobacter aceti*, which was essential for vinegar production.

Zahoor et al., in 2006 made a study conducted by to isolate vinegar culture (*Acetobacter aceti*) from sugarcane juice, rotten apples, flowers, wine, canal water and vinegar as a primary source for *Acetobacter* by continuous sub-culturing on standard medium glucose, yeast extract and calcium carbonate (GYC) [10]. GYC Agar described by Swings in 1992 detects the presence of acid-producing microorganisms and is regarded as "standard growth medium". The

culture was identified on the basis of colony characteristics and morphology. It was finally confirmed by different biochemical or enzymatic tests and further specified by nutritional and temperature requirements for the growth. The isolated strain was later used for the production of vinegar through fermentation. Among canal water, crushed apples, sugar cane juice, alcohol, vinegar and flowers, the alcohol and vinegar were found to be the most suitable sources for isolation of *Acetobacter spp.* The colonies of purified culture were found to be pale to off-white, circular, raised, convex, smooth and not 3 mm in diameter with morphology of Gram-ve, ellipsoidal, rods, squat bacilli, roundish, single, in pairs and in chains. The isolated and identified spp. Gave excellent results for the production of vinegar and this vinegar was more acceptable rather than commercially available fermented vinegar. At industrial level good quality vinegar can be produced by using pure culture of *Acetobacter aceti* for acetic acid fermentation.

Potential acetic acid bacteria were investigated from different readily available sources. Seven different samples (sugarcane bagasse, sugarcane juice, sugarcane juice processing water, soil, rotten apples, rotten redgrapes and rotten white grapes) were collected from local market. After processing and enrichment, samples were inoculated on Glucose Yeast Calcium carbonate (GYC) agar plates and incubated at 30 °C for four days. Nineteen different bacterial colonies were selected and isolated on the basis of clear zone formation on GYC medium. The bacterial isolates were identified on the basis of their morphological, biochemical and physiological characterization. Among nineteen isolates, one was identified as *Acetobacter aceti*, one as *Acetobacter Pasteurianus*, one as *Acetobacter Orleansis*, two were identified as *Acetobacter fibrinogenesis* and the remaining fourteen isolates were identified as *Gluconobacterspp.* As potential acetic acid producers, only the *Acetobacter* isolates were further assessed for their acid production capability under different temperature and pH using 'Potency Index' as a potency determining parameter. Temperature 30 °C and pH 5.5 were found to be the optimum temperature and pH respectively for maximum acetic acid production by most of the species. *Acetobacter Pasteurianus* with the highest P.I. value of 3.78 was the most potent acetic acid producer among these isolates [11].

### 3 Future prospectives

Acetic Acid Bacteria are most commonly known for their role in vinegar production. It is necessary to develop pure vinegar cultures for vinegar production so that the use of synthetic vinegar may be avoided as it is prohibited in most countries. Keeping in view all of these points. The present work is conducting to isolate a pure culture of *Acetobacter aceti* and the maintenance of this culture. This strain could be a potential strain for production of vinegar type with a new and desirable taste.

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# Insights into Physics Teaching and Learning

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**Abstract:** *Learning physics comes with its share of complexities and challenges, specially at the graduate level. These include understanding physical quantities, comprehending concepts, using mathematical procedures, interpreting equations, using multiple representations and of course, solving problems. These are often intertwined and hence learning by understanding to develop association between elements of knowledge known as 'schema' is vital. In this paper, an overview of each of the above aspects will be presented through examples and the way forward to develop coherent understanding of physics.*

**Keywords:** *Aspects of learning physics, Conceptual understanding, Problem-solving.*

## 1 Introduction

Research in physics education has gained prominence as a domain for physics instructors world over. In the context of science education at the graduate level, there is an 'impedance mismatch' between teaching and learning. In spite of the notion that the teacher that they have articulated and explained a concept during a class, the comprehension on part of the students remains wanting. A paradigm shift from consideration of 'teaching as an art' to 'teaching scientifically as an art' would probably bridge the gap between physics teaching and learning. Physics teachers are required to know how students learn and difficulties therein. It is imperative to know the complexities and challenges in teaching-learning processes. This paper provides insights into identifying aspects of physics teaching and learning that ought to be addressed for effectiveness of processes.

## 2 Discussion

### 2.1 Understanding physical quantities

Content learning comprises of defining numerous physical quantities in different branches of physics. Ex. Force, electric field, internal energy, refractive index and many others. Students must realise the relation between the three features illustrated in Figure 1. Further they are required to associate the quantities that lead to a derived physical quantity through a precise understanding of the meaning of the symbols that could be used in a situation (as in ' $C$ ' for couple per unit twist) as well as physical constants (as in ' $c$ ' for speed of light).

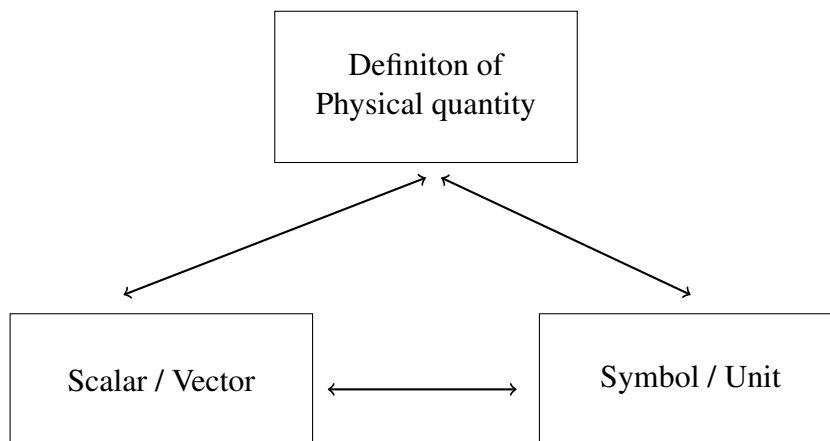


Figure 1: Features of a physical quantity

## 2.2 Comprehending concepts

Concepts are the gateways through which we understand physical phenomena. Concepts encompass qualitative and quantitative concepts in math and physics contexts as well. Physics education researchers have developed concept surveys to understand students’ misconceptions/alternate conceptions [1]-[11].

Examples of students’ misconceptions are:

1. When students are asked to mention which of the two exerts a greater force in a situation of collision of a truck and a car, they fail to use Newton’s III law, though they are familiar with the statement of the law.

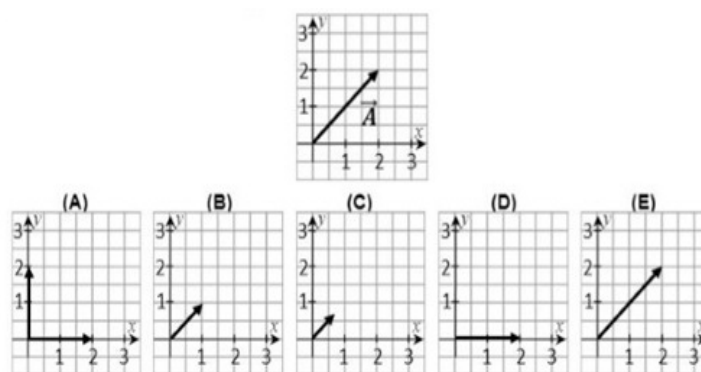
Misconception in this context is that greater the mass larger the force!!



<i>Force</i>	$F = F$
<i>Impulse</i>	$F_t = F_t$
<i>Change in momentum</i>	$m_{\Delta v} = m\Delta v$
<i>Acceleration</i>	$m_a = ma$

2. In Test of Understanding of Vectors (TUV) developed by Barniol and Zavala [12], test item 2 is based on the concept of unit vector in the direction of a vector. Following is the test item 2 in TUV.

The figure below shows  $\vec{A}$ . Choose the option that shows the unit vector in the direction of  $\vec{A}$ .



In an investigation on graduate students' understanding of basic vector concepts, we found that a mere 12% of test respondents chose the correct option C on a total of 74. Students chose the graphical representation of a vector that has one unit magnitude on the  $x$  axis and one unit on the  $+y$  axis among options when asked to choose the unit vector of a vector in a given direction - option B!

Concepts are certainly stumbling blocks for students. A structured way of teaching concepts in addition to providing the association between the concepts would enable students to understand in an effective way.

- Emphasis should be on on conceptual understanding through ample real-world phenomena.
- Abstract concepts could be explained through visual representations and use of simulation.

### 2.3 Using mathematical procedures

Mathematics is the 'language' of physics. Students learn most of the math knowledge required in physics in math classes: integration, differentiation, vector algebra, vector calculus, exponentials, trigonometry, manipulations and so on. The questions that are pertinent in this context are:

1. Do physics teachers know what math knowledge students bring into physics classes?
2. How do we ensure that effective transfer or blending of maths in physics learning is an easy progression ?

Research on how students transfer or blend math knowledge has been the focus in physics learning and specifically in problem-solving [13]-[19]. It is vital that physics teachers ensure that students are well equipped with the skill-sets required for content learning and solving problems.

The possible methods could be the following.

- A rigorous review of the mathematics elements used in physics in every topic is essential.
- Providing scaffolding to help students internalise the process.
- Testing students' problem solving skills in altered contexts.

### 2.4 Interpreting equations

Interpreting a math equation comprises of knowing the precise relation between the symbols [20] and translating into other representation. For discussion in this context, an example of an equation in mathematics is  $y = -kx$ , hence  $k = -\frac{y}{x}$ . This implies  $k$  is negative.

Interpreting a physics equation comprises of knowing:

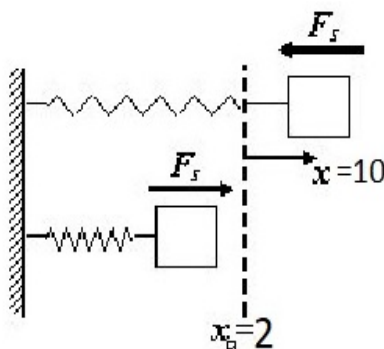
- the context of reference
- precise relation between the symbols which are used to represent physics quantities
- unit for the physical quantity that is being represented in terms of a relation inference about the negative sign if any
- translating into other representation

Ex. The equation for linear restoring force is commonly written as  $F = -kx$  hence  $k = -\frac{F}{x}$

Students need to be trained to ask questions such as:

- Can  $k$  be negative?
- What does negative sign denote?
- What is the unit for  $k$ ?
- What do the symbols  $F$  and  $x$  ?

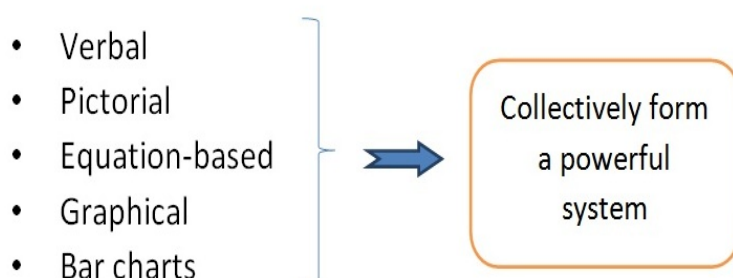
It is known that in the equation mentioned,  $x$  is the displacement of the physical system from the equilibrium position executing linear simple harmonic motion. However, in this context,  $x$  is used for both position coordinate and displacement! When we write  $x$ , the assumption is that the equilibrium coordinate is 0! The change in two position coordinates that gives the displacement is not clearly visible in the form of the equation. Hence writing  $F = -k(x - x_0)$  will include the equilibrium coordinate and clearly the form of the equation illustrates the displacement as change in position coordinates. Students should be able to write the displacement for the illustration shown below.



Students should be taught to interpret equations in a general context first and subsequently a specific case.

## 2.5 Using multiple representations

Physicists use a range of representations for both quantitative and qualitative understanding that are listed. A bulk of research work in Physics education is focussed on how students understand representations in different formats [21]-[25]. Why do we use multiple representations?



All representations are partial in nature and each representation provides access to certain parts of disciplinary knowledge. There are two facets of representations according to Mike de Cock [21].

- Representational fluency involves the ability to translate and switch between representations accurately
- Representational flexibility involves making appropriate representational choices

Making sense out of a representation and switching between representations termed as representational fluency is central to physics problem solving. For instance in the physics problem, students' representational fluency is tested in translating the component format of a vector to  $ijk$  format of the vector.

**Problem:** A force  $\vec{F} = 2\hat{i} + 5\hat{j}$  acts on a particle which is displaced from a point  $(0, 0)$  to another point  $(2, 2)$ . What is the work done by the force?

Students need to be trained on interpreting a representation and further develop abilities of switching between representations accurately.

## 2.6 Solving problems

It is often inferred that the goal of content learning in physics is to be successful in problem-solving. Problem-solving skills have neither been developed through adequate training nor adequately tested in the end-semester examination. Students are generally tested on plug & chug-type that are included as end-of-chapter problems. With the convenience of using calculators it must be an easy job.

### Why then do students not perform as expected?

The following analysis could lead us to the answer. In Physics content learning, each sub-unit has a minimum of 3-4 equations and 4 units in a semester of BSc course has about 40 equations or more! So, the student is tested on recalling an equation from memory which was done at the Pre-University level. Moreover, recalling would be adequately tested through the questions that require short/long answers. In the context of problem-solving, recalling dozens of equations is definitely a burden to the students.

### What problem-types would enhance student reasoning abilities?

A possible structure of the problems and expected learning gains are the following.

- A problem with the relevant equation/s will be given in the problem-statement and students would be required to do some analysis of the equation/s with calculation.
- Strategy would enhance their reasoning abilities and of course would comprise of the computation part.

## 3 Conclusion

Learning physics is undoubtedly difficult for students at the graduate level. Teaching by adopting research-based scientific methods provide significant insights into formulating effective teaching-learning processes. Structured teaching-methods aligned along learning gains/course

outcomes need to be practised to enhance students' learning experiences. A measured and appropriate intervention of technology in classroom teaching would provide new opportunities for learning and enable students to transfer learning elements in altered contexts.

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# Communication Skills of Vigenere Ciphers and Knapsack Cryptosystem

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**Abstract:** *Cryptography is the art and science of making communications unintelligible to others except the intended people. In this paper we look into encoding and decoding messages using Vigenere ciphers as well as public key cryptosystem like knapsack.*

**Keywords:** *Cryptography, Cipher text, Public and private key, Vigenere Cipher, Knapsack Cryptosystem, Enciphering algorithm, Deciphering algorithm.*

**AMS Subject Classification:** 11T71.

## 1 Introduction

Cryptography is a popular practical means known to protect the information while transmitting it through both public and commercial communications networks. The word Cryptography is originated from the Greek words *Kryptos* meaning “hidden” and *graphein* meaning “to write” [1, 2]. Privacy of the ever increasing quantity of digital data, widespread use of electronic funds transfer, secure electronic banking, making and breaking of secret codes in diplomatic and military circles and many more have lead to increase development and new inventions in the field of cryptology.

A few basic terms in cryptography are *ciphers* which are nothing but codes or the information that needs to be concealed; data which can be read and easily understood is called *plain text*. The plain text is transformed into a secret form called *cipher text* with the help of cipher. This process of converting plain text into cipher text is called *encrypting* or *enciphering*. The reverse process is called *decrypting* or *deciphering* which is transforming a cipher text back to its original plain text [3].

$$\text{Plain text} \xrightarrow{\text{Encryption}} \text{Cipher text} \xrightarrow{\text{Decryption}} \text{Plain text}$$

There are two types of ciphers namely monoalphabetic cipher (where each letter in the plain text is replaced by the same cipher text) and polyalphabetic cipher (where a letter in plain text has more than one cipher text equivalents).

Encryption and decryption use a string of secret characters referred to as *key*, which can either be public or private. A few popular/conventional cryptosystems are Affine, Ceasar, Hill and exponentiation, in which there is only one key called enciphering key. This key will not be known to public and the deciphering key must be found from the enciphering key. An example for public key cryptosystem are RSA and knapsack, where in the enciphering key is made public but only the authorized receiver knows the deciphering key. All the mentioned cryptosystems are based on modular arithmetic [4, 5].

## 1.1 Vigenere Ciphers

The Vigenere ciphers, named after the French Cryptographer Blaise de Vigenere, is one of the most famous examples of polyalphabetic cipher to be published. These ciphers were developed by G.B. Bellaso as early as in 1553.

### Encoding messages using Vignere Ciphers

- Choose a key of length  $n$  say,  $a_1 a_2 \dots a_n$  which is known to both the receiver and the sender.
- Replace the alphabets in the key by its ordinal number, starting from  $A = 0$  to  $Z = 25$ , and name it as  $K_i$ .
- Replace the letters in the plain text by its ordinal number and name it as  $P_i$ .
- Group the numbers into blocks each of length  $n$ .
- Use  $C_i \equiv P_i + K_i \pmod{26}$  and convert the resulting ordinal numbers to its plain text. Thus the message has been enciphered.

### Decoding messages using Vigenere Ciphers

- Convert the received cipher text to its ordinal number and name them as  $C_i$ .
- Group the ordinal numbers into blocks of same length as the key.
- Use  $P_i \equiv C_i - K_i \pmod{26}$  and convert the resulting ordinal numbers to its plain text. Thus the message has been deciphered.

## 1.2 Knapsack Cryptosystem

R. C. Merkle and M. E. Hellman devised a public key cryptosystem based on The Knapsack problem, a well known problem in combinatorics in 1978. The main principal in this cryptosystem is the requirement of a super increasing sequence of integers say  $a_1, a_2, a_3, \dots, a_n$  such that  $a_i > a_1 + a_2 + \dots + a_{i-1} \forall i = 1, 2, \dots, n$  [4, 6].

### Algorithm for the knapsack problem with super increasing weights

Let  $S = a_1 x_1 + a_2 x_2 + \dots + a_n x_n$  be a sequence with super increasing weights. A solution exists which can determined using [7, 8]

$$x_n = \begin{cases} 1 & \text{if } S \geq a_n \\ 0 & \text{otherwise} \end{cases} \quad \text{and} \quad x_i = \begin{cases} 1 & \text{if } S - \sum_{j=i+1}^n a_j x_j \geq a_i \\ 0 & \text{otherwise} \end{cases} \quad \text{for } (1 \leq i \leq n-1) \quad (1)$$

### Encoding in Knapsack Cryptosystem

- Choose a superincreasing sequence  $a_1, a_2, \dots, a_n$ .
- Select a modulus  $m$  such that  $m > 2a_n$  and a positive integer  $w$  with  $0 < w < m$  such that  $\gcd(w, m) = 1$ .
- Form a sequence of integers  $b_1, b_2, \dots, b_n$  defined by  $b_i \equiv w a_i \pmod{m}$  for  $i = 1, 2, \dots, n$  and  $0 \leq b_i < m$ .
- Convert the plain text into string of binary numbers using the table

Letter	Binary equivalent	Letter	Binary equivalent	Letter	Binary equivalent
A	00000	B	00001	C	00010
D	00011	E	00100	F	00101
G	00110	H	00111	I	01000
J	01001	K	01011	L	01011
M	01100	N	01101	O	01110
P	01111	Q	10000	R	10001
S	10010	T	10011	U	10100
V	10101	W	10110	X	10111
Y	11000	Z	11001		

Table 1: Binary equivalent of alphabets

- Depending on the value of  $n$ , split the binary numbers into  $n$  blocks (add 1s to complete the block). The elements in the block are named  $(x_1x_2 \dots x_n)$ .
- Now transform each numeric plain text block into  $S = b_1x_1 + b_2x_2 + \dots + b_nx_n$ . The code has now been encrypted and the encrypting sequence  $b_1, b_2, \dots, b_n$  is public.

**Decoding in Knapsack Cryptosystem**

- The values of  $w$  and  $m$  should be known to decode the message.
- Compute  $S' \equiv w^{-1}S(\text{mod } m)$  where  $w^{-1}$  satisfies  $w w^{-1} \equiv 1(\text{mod } m)$ .
- The sequence  $S'$  obtained is a superincreasing sequence, which is solved to obtain the binary values values of  $x_1, x_2, \dots, x_n$ .
- Group the blocks into bits of length of  $S$  and substitute their corresponding alphabets using Table 1. Thus the message has be been decoded.

## 2 Examples and Dicussion

**Example 1:** Encipher the message *HAVE A NICE TRIP* using a Vigenere cipher with the key-word *MATH*.

So we have

M	A	T	H
12	00	19	07

Since the length of the keyword is 4, group the plain text into blocks of length 4 and adding the corresponding ordinal numbers using  $C_i \equiv P_i + K_i(\text{mod } 26)$ , we obtain

H	A	V	E	A	N	I	C	E	T	R	I	P
07	00	21	04	00	13	08	02	04	19	17	08	15
12	00	19	07	12	00	19	07	12	00	19	07	12
19	00	14	77	12	13	01	09	16	19	10	15	01
T	A	O	L	M	N	B	J	Q	T	K	P	B

Thus the message has been enciphered as *TAOL M NBJQ TKPB*.

**Example 2:** Encipher the message *SEND MORE MONEY* using a Vigenere cipher with the keyword *CIPHER*.

So we have

C	I	P	H	E	R
02	08	15	07	04	17

Since the length of the keyword is 6, group the plain text into blocks of length 6 and adding the corresponding ordinal numbers using  $C_i \equiv P_i + K_i \pmod{26}$ , we obtain

S	E	N	D	M	O	R	E	M	O	N	E	Y
18	04	13	09	12	14	17	04	12	14	13	04	24
02	08	15	07	04	17	02	08	15	07	04	17	02
20	12	02	10	16	05	19	12	01	21	17	21	00
U	M	C	K	Q	F	T	M	B	V	R	V	A

Thus the message has been enciphered as *UMCK QFTM BVRVA*.

**Example 3:** The ciphertext *BS FMX KFSGR JAPWL* is known to have resulted from a Vignere cipher whose keyword is *YES*. Decipher the message.

Given keyword is

Y	E	S
24	04	18

Since the length of the keyword is 3, group the cipher text into blocks of length 3 and subtracting the corresponding ordinal numbers using  $P_i \equiv C_i - K_i \pmod{26}$ , we obtain

B	S	F	M	X	K	F	S	G	R	J	A	P	W	L
01	18	05	12	23	10	05	18	06	17	09	00	15	22	11
24	04	18	24	04	18	24	04	18	24	04	18	24	04	18
03	14	13	14	19	18	07	14	14	19	05	08	17	18	19
D	O	N	O	T	S	H	O	O	T	F	I	R	S	T

Thus the message has been deciphered as *DO NOT SHOOT FIRST*.

**Example 4:** Decipher the message *TETS FHBZ IETSFH* generated from a Vignere cipher using the keyword is *MATH*.

Given

M	A	T	H
12	00	19	07

Since the length of the keyword is 4, group the ciphered text into blocks of length 4 and subtracting the corresponding ordinal numbers using  $P_i \equiv C_i - K_i \pmod{26}$ , we obtain

T	E	T	S	F	H	B	Z	I	E	T	S	F	H
19	04	19	18	05	07	01	25	08	04	19	18	05	07
12	00	19	07	12	00	19	07	12	00	19	07	12	00
07	04	00	11	19	07	08	18	22	04	00	11	19	07
H	E	A	L	T	H	I	S	W	E	A	L	T	H

Thus the message has been deciphered as *HEALTH IS WEALTH*.

**Example 5:** Decipher the message *XIYL IOGA IABA* generated from a Vignere cipher using the keyword is *MATH*.

Following the same procedure as the previous problem, we obtain

X	I	Y	L	I	O	G	A	I	A	B	A
23	08	24	11	08	14	06	00	08	00	01	00
12	00	19	07	12	00	19	07	12	00	19	07
11	08	05	04	22	14	13	19	22	00	08	19
L	I	F	E	W	O	N	T	W	A	I	T

Thus the message has been deciphered as *LIFE WONT WAIT*.

**Example 6:** Encipher the message *SELL ALL* with a super increasing sequence 3, 6, 12, 24 and  $m = 53, w = 23$ .

The given sequence is  $\{3, 6, 12, 24\}$  i.e.  $n = 4$  and clearly  $m > 2a_4$  and  $\gcd(m, w) = 1$ . Constructing the enciphering sequence using  $b_i \equiv w a_i \pmod{m}$  for  $i = 1, 2, \dots, n$  we end up with  $\{16, 32, 11, 22\}$ . Using Table 1, the binary equivalent of each letter of the message will be

S	E	L	L	A	L	L
10010	00100	01010	01010	00000	01010	01010

Since  $n = 4$ , group the binary numbers into 9 blocks each of length 4, which results in

1001 0001 0001 0100 1010 0000 0010 1001 0101

Computing  $S_1 = 16(1) + 32(0) + 11(0) + 22(1) = 38, S_2 = 16(0) + 32(0) + 11(0) + 22(1) = 22, S_3 = 22, S_4 = 32, S_5 = 27, S_6 = 0, S_7 = 11, S_8 = 38, S_9 = 54$ .

Thus the enciphered message is 38 22 22 32 27 00 11 38 54.

**Example 7:** Encipher the message *EUREKA* with a super increasing sequence 2, 3, 7, 13, 29 and  $m = 63, w = 25$ .

The given sequence is  $\{2, 3, 7, 13, 29\}$  i.e.  $n = 5$  and clearly  $m > 2a_5$  and  $\gcd(m, w) = 1$ . Constructing the enciphering sequence we end up with  $\{50, 12, 49, 10, 32\}$ . Using Table 1, the binary equivalent of each letter of the message will be

E	U	R	E	K	A
00100	10100	10001	00100	01010	00000

Since  $n = 5$ , group the binary numbers into 6 blocks each of length 5, which results in

00100 10100 10001 00100 01010 00000

Computing  $S_1 = 50(0) + 12(0) + 49(1) + 10(0) + 32(0) = 49, S_2 = 50(1) + 12(0) + 49(1) + 10(0) + 32(0) = 99, S_3 = 82, S_4 = 49, S_5 = 32, S_6 = 00$ .

Thus the enciphered message is 49 99 82 49 32 00.

**Example 8:** Decrypt the knapsack ciphertext 54, 47, 47, 57, 97, 81, 97, 57, 50, 31 which was generated with the enciphering sequence 7, 31, 50, 47 and  $m = 65, w = 12$ .

The enciphering sequence is  $\{7, 31, 50, 47\}$  i.e.  $n = 4$ . Also  $m > 2a_4$  and  $\gcd(m, w) = 1$ . Computing  $w^{-1}$ , we get  $w^{-1} \equiv 38 \pmod{65}$ . Given  $S = \{54, 47, 47, 57, 97, 81, 97, 57, 50, 31\}$ . Computing  $S'$  we obtain a superincreasing sequence  $\{37, 31, 31, 21, 46, 23, 46, 21, 16, 8\}$ . Solving each term in  $S'$  with linear combination of elements of enciphering sequence and  $x_1, x_2, x_3, x_4$  using (1), we obtain the solutions as  $(1, 0, 0, 1), (0, 0, 0, 1), (0, 0, 0, 1), (1, 0, 1, 0)$ ,

$(0, 0, 1, 1), (0, 1, 1, 0), (0, 0, 1, 1), (1, 0, 1, 0), (0, 0, 1, 0), (0, 1, 0, 0)$ . Combine all the binary values of the cipher texts and group them into blocks of length 5. Using Table 1, convert the binary code values to their corresponding alphabets and we have

10010	00100	01101	00011	01100	01110	10001	00100
S	E	N	D	M	O	R	E

Thus the code has been decrypted as *SEND MORE*.

**Example 9:** Decrypt the knapsack ciphertext 104, 47, 47, 81, 104, 47, 104, 54, 57, 31 which was generated with the enciphering sequence 7, 31, 50, 47 and  $m = 65, w = 12$ .

Let  $S = \{54, 47, 47, 57, 97, 81, 97, 57, 50, 31\}$ . Computing  $S'$  we obtain a superincreasing sequence  $\{52, 31, 31, 23, 52, 31, 52, 37, 21, 8\}$  where  $w^{-1} \equiv 38(\text{mod } 65)$ . Solving each term in  $S'$  with linear combination of elements of enciphering sequence  $\{7, 31, 50, 47\}$  and  $x_1, x_2, x_3, x_4$  using (1), we obtain the solutions as  $(1, 0, 1, 1), (0, 0, 0, 1), (0, 0, 0, 1), (0, 1, 1, 0), (1, 0, 1, 1), (0, 0, 0, 1), (1, 0, 1, 1), (1, 0, 0, 1), (1, 0, 1, 0), (0, 1, 0, 0)$ . Combine all the binary values of the cipher texts and group them into blocks of length 5. Using Table 1, convert the binary code values to their corresponding alphabets and we have

10110	00100	01011	01011	00011	01110	01101	00100
W	E	L	L	D	O	N	E

Thus the code has been decrypted as *WELL DONE*.

**Example 10:** Decrypt the knapsack ciphertext 33, 33, 38, 48, 33, 32, 49, 16, 33 which was generated with the enciphering sequence 16, 32, 11, 22 and  $m = 53, w = 23$ .

The given enciphering sequence is  $\{16, 32, 11, 22\}$  i.e.  $n = 4$ . Also  $m > 2a_4$  and  $\text{gcd}(m, w) = 1$ . Solving the linear congruence  $23 \cdot w^{-1} \equiv 1(\text{mod } 53)$ , we get  $w^{-1} \equiv 30(\text{mod } 53)$ . Consider the linear combination of elements of enciphering sequence and  $x_1, x_2, x_3, x_4$ . Let  $S_n = \{33, 33, 38, 48, 33, 32, 49, 16, 33\}$ . Solving for each ciphertext,  $S_n$ , we obtain the following solutions  $(0, 0, 1, 1), (0, 0, 1, 1), (1, 0, 0, 1), (1, 1, 0, 0), (0, 0, 1, 1), (0, 1, 0, 0), (1, 0, 1, 1), (1, 0, 0, 0), (0, 0, 1, 1)$ . Combine all the binary values of the cipher texts and group them into blocks of length 5. Using Table 1, convert the binary code values to their corresponding alphabets and we have

00110	01110	01110	00011	01001	01110	00001
G	O	O	D	J	O	B

Thus the code has been decrypted as *GOOD JOB*.

### 3 Conclusion

- Recent developments in computer technology and sophisticated techniques in cryptography have brought about enormous changes in information security, transfer of secured messages over public networks etc.

- The advantage of using a Vignere cipher is that a ciphertext can be decoded only if, the used keyword is known by, both the sender and reciever. The enchipered message might contain different cipher texts for the same plain text, making it difficult to decrypt the message just by looking at it.
- The disadvantage of using Vignere cipher is once the length of the keyword is known or determined, the coded message is nothing but a string of mono alphabetic ciphers and decoding will be quite simple.
- Unlike RSA cryptosystem, this knapsack cyrptosystem proposed by R.C. Merkle and M.E. Hellman is not a signature system as it does not satisfy the property  $E(D(M)) = M$ , proposed by W. Diffie and M.E. Hellman, where  $E$  is the enciphering key,  $D$  is deciphering key for every message  $M$ .

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