mindoid

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When technology touches mind

rerf.in

An initiative of

Regent Education and Research Foundation

Group of Institutions

MINDROID

CONTENT

Dr. Dipankar Biswas
Editor

Dr. Himeli Chakrabarti
Editor

EDITORIAL

Welcome to the 1st edition of our magazine "Mindroid"! We are delighted and ecstatic to announce that it is ready to launch the first edition with all fresh hopes and colours. 'Mindroid' is published as an e-magazine, in keeping with the post-pandemic reality. The students and faculties of RERFGI showcased their creative abilities, through articles, poetry and photography in this magazine which is going to surely unfold the unravelled world of the most unforgettable and precious moments of the institute. This modest endeavour aims to unleash young minds, allowing them to explore the realms of imagination and experience to build a world of beauty in words. Our youthful writers' impassioned writings are unquestionably sufficient to pique the readers' interest and admiration. This keepsake is a sincere attempt to help our developing talents express their creativity and acquire the skill of being attentive because we believe that our success is determined by our ability to perceive, observe, and investigate. The journal also promotes the organization's spirit, which is fostered by collaborative activities, thoughts, and goals within the institutions.

The cover page is a clear demonstration of attachments between technology with human thoughts that were witnessed in the last two years during the pandemic situation. One of the magazine's most notable qualities is that it is multilingual, reflecting the institution's cosmopolitan nature. We are confident that the magazine will continue to be of great quality in the future. We'd like to take this opportunity to thank RERFGI trustee members, Principal Sir, Registrar Sir, GM Sir, all HODs, faculty members, and students for their dedication and hard work in producing this issue. We wish the magazine, all success.

MESSAGE FROM TRUSTEE

DR. NANDAN GUPTA
TRUSTEE MEMBER

It's really exciting that the Regent Education and Research Foundation Group of Institutions (RERFGI) is producing "Mindroid," their annual collegiate e-magazine. It gives me great pleasure to express my warmest congratulations to all of you and the editorial team of "Mindroid". College e-magazine is a platform that allows exposure and freedom to voice your views, and it always reflects the thoughts, ideas, dreams, creative writings, and goals of young brains. I applaud the team's efforts in compiling and unleashing the hidden ability, as well as making this magazine highly purposeful and meaningful.

RERFGI holds a particular place in my heart because it is the culmination of my ambitious quest to show my love for my country. My dream has always been to build a state-of-the-art engineering college in West Bengal, and I've been working hard to make that a reality. RERFGI is a non-profit trust established to promote high-quality technological and professional education, as well as to support research and training activities so that students who receive a degree are prepared to face not just professional obstacles, but also all of life's challenges. In this era of economic liberalisation, globalisation, and technical superpowers, our mission is to provide high-quality education in accordance with Swamiji's vision of universal education.

I appreciate the efforts of the Principal, Registrar, Staff and Students in bringing out this magazine successfully amidst all challenges of COVID 19 in the last two years. We at RERFGI believe in always giving our best to our stakeholders and instilling strong values in them such as ownership of oneself and the environment around us, commitment in everything we do, and complete involvement in all responsibilities entrusted to us, and always following the ethical path to achieve our objectives.

I wish the team the best of luck in all of their work, and may you discover new dimensions in the teaching and learning process, which will benefit all stakeholders and society as a whole. Let us all work together to develop young minds and contribute to the nation's development.

MESSAGE FROM TRUSTEE

DR. ASHOK BINAYKIA
TRUSTEE MEMBER

Mindroid is a podium that reflects of the quality education of every RERF students. It shows the endeavour of RERF life. It gives me immense pleasure to ensure that this magazine has successfully accomplished its objective. The reflection of the students' creativity and achievements is the epitome of the magazine. Students have put forth their ideas and thoughts that are too deep to be expressed and too strong to be suppressed.

I take the opportunity to thank all the contributors as their contribution is the reason that makes this magazine attractive with our readers.

MESSAGE FROM TRUSTEE

DR. RAKESH BINAYKIA

TRUSTEE MEMBER

It is a great pleasure for me to write about my own students and staffs. I believe that every student of RERF deserves a high quality of education. So, I have tried to open plentiful opportunities before them by providing quality education in the field of science and technology. "Mindroid" provides such a platform for the students as well as faculties to review their efforts and to analyse their achievements in RERF life. It is a juncture of great challenges and great prospects for us. The e-magazine tells the tales of RERF family members to express their thoughts.

I congratulate the team of students and the staffs for their tireless efforts that have come to fruition in the form of this magazine. I wish its all success and hope that this tradition that has been set by our current students will be carried out by their successors.

MR. SUBHANKAR GHOSH
REGISTRAR

REGISTRAR'S DESK

It gives me great gratification to know that "MINDROID", RERF Group of Institutions college magazine 2021-22 is standing by for publication. I congratulate the team of students and the faculty for their vigorous efforts that have come to execution in the form of this magazine. I wish it all success and hope that this practice that has been set by the current students will be carried through in all future endeavours. . I also broaden my special thanks to the Editorial Team for their proposal in bringing this e-Magazine into reality. I look forward to the active involvement of all the staff members of the institute, to contribute to the future and ongoing editions of the institute's e-Magazine and wish that this platform be more successful in the coming years.

DR. RAJORSHI BANDYOPADHYAY,
PRINCIPAL

PRINCIPAL'S DESK

Dear reader,

It gives me immense pleasure to learn that the college e-magazine "Mindroid" is ready for publishing for the academic year 2021-2022. This magazine provides an insight into the range and scope of the imagination and creativity of our students and faculty members.

I congratulate the editorial team on their devotion and hard work in achieving this aim through the medium of a magazine. This provides an all-around platform for students to express their talent and ingenuity at its best.

We want every student from the beginning to be a true asset to the country and a noble human being for the entire planet. We make particular efforts, such as implementing innovative teaching approaches, to bridge the gap between industry expectations (from new hires) and academic inputs by providing additional technical and soft skill development programs. We have a superb staff and state-of-the-art infrastructural facilities and laboratories to support our creative teaching approaches. In the future, we hope to continue providing outstanding technical education at an affordable cost.

With best wishes

MESSAGE FROM HOD

DR. NIBEDITA MUKHERJEA

HOD, BSH DEPARTMENT

I am delighted that the e-magazine MINDROID is being published by our institute 'RERF'. Hope, this e-magazine will be immensely beneficial both to the faculty members as well as to the students. It will not be out of place to share a few words about our Department in this august occasion.

The Department of Basic Sciences & Humanities with its highly qualified, experienced and dedicated faculty members and well-equipped laboratories imparts fundamental theoretical knowledge coupled with experimental verification of learnt knowledge, to the undergraduate Engineering students. First year curriculum plays a very important role in engineering domain by setting pro-techno platform for human resource development by way of teaching basic sciences and humanities subjects like Mathematics, Chemistry, Physics & Communication Skills in order to generate skilled manpower which in turn, will ensure optimum industrial productivity and improved quality of life of emerging technocrats.

The Department focuses on the student centric activities like GD, Debate and Communication skills, Soft Skill training, Classroom training, practical training, personal mentoring and Sports. The Department provides subject knowledge & skills through regular classes, guest lectures, seminars to lay the techno-savvy foundation .

MESSAGE FROM HOD

DR. DIPANKAR BISWAS

HOD, ECE DEPARTMENT

I welcome all of you to the Department of ECE, which was established in the year 2009. The department has a bunch of experienced and well-qualified faculty members, and well-equipped updated laboratories like Digital Signal Processing Laboratory, Communication, and Microwave Engineering Laboratory, VLSI Design Laboratory, Microprocessor Laboratory, Embedded System Design Laboratory, and Antenna Design/ Simulation Laboratory, etc.

For the students, Electronics and communication engineering is providing excellent career opportunities in different areas of technology. The devoted faculty members deploy a smart teaching process to make learning more attractive. Emphasis has been given to critical thinking and problem-solving abilities as these qualities accommodate the future with confidence. The students are encouraged to implement their acquired theoretical knowledge in the laboratories. The department organises different workshops, expert talks and additional training programs in collaboration with industries for the benefit of faculty and students. The students will be capable of visualising, planning and developing major projects after passing through such a robust academic curriculum. In the past years, graduate students from the ECE dept have been selected by some of the reputed software and hardware companies in the country. With the active cooperation of expert faculty members and the support of the RERFGI Management, Principal and Training and placement officer the students have been prepared to work in a global multicultural environment.

Finally, I would like to acknowledge the efforts of the teachers and the students in bringing out a college e-magazine “Mindroid”. My best wishes are always with them.

MESSAGE FROM HOD

MR. BIDYUT KUMAR GHOSH

HOD, EE DEPARTMENT

I am a firm believer that only knowledge can transform a human being to "being human". Undoubtedly, technical education plays a pivotal role to cope and combat with the challenges of this unprecedented world. To have a sustainable mankind across the world and to cultivate innovations and research to create an unmatchable and persistence ecosystem of holistic growth to excel others in this highly competitive arena.

Electrical Engineering Department of Regent Education & Research Foundation Group of Institutions, Barrackpore, since its inception (2011), has been highly successful in maintaining a learning environment and a flexible conducive ambience which thrives and strives for an incredible vision to accomplish and that's too within a stipulated time frame.

Our practice promotes creativity, innovation in teaching-learning practices of high standards. We embrace and admire a vast cultural diversity which enlightens us in all aspects of life. Nurturing a sense of eco friendliness in the atmosphere makes us democratic and participatory in nature otherwise it will be detrimental and fatal for all of us. Nevertheless, we equally emphasize on the development of core human values, mental well-being and physical well-being of our students.

Last but not least, we are student driven. The welfare of our students is always our top priority. Thus, we do modify our academic infra and invest on latest technological knowhow and on acquiring innovative skills from time to time as per the need of the industry. We have to navigate the young energetic minds for alteration through academic rigidity and absorb corporate soft skills & ethical values to get accommodated in the current professional scenario. I conclude with this sincere gratitude towards college authority for inception of the e-magazine, "MINDROID".

MESSAGE FROM HOD

MR. SUMAN KUMAR DEY

HOD, EEE DEPARTMENT

It is a matter of great pride and satisfaction for Electrical & Electronics Engineering Department of RERF Group of Institutions to bring out the e-magazine "MINDROID" released from the College. The College has made tremendous progress in all areas including academic, non-academics, capacity building relevant to staff and students. The College has achieved added milestone in getting NAAC accreditation and now in the process of getting recertification.

I am confident that this issue of the e-magazine will send a positive signal to the staff, students and the person who are interested in the Technical education and Technology based activities. A News Letter is like a mirror which reflects the clear picture of all sorts of activities undertaken by the entire Department and develops writing skills among students in particular and teaching faculty in general.

I congratulate the Editorial Board of "MINDROID" who have played wonderful role in accomplishing the task in Record time. I express my deep sense of gratitude to the college authority under whose inspiration this work has been undertaken and completed within the stipulated time. I also express my heartfelt Congratulations to staff members and Students for their fruitful effort.

MESSAGE FROM HOD

MR. SABYASACHI MUKHERJEE

HOD, ME DEPARTMENT

It is my privilege to welcome you to the Mechanical Engineering Department at Regent Education and Research Foundation. Our department comprises distinguished faculty members and highly efficient technical staff who are actively involved with the students in guiding and preparing them for a bright future. Although the Mechanical Engineering Department at RERF is young, our driving mission is to enrich the learners with necessary knowledge, skill and attitude so that they are well equipped to face with confidence as well as to fulfill the dynamic demands and the myriad challenges of twenty first century world which is marked by globalization, extraordinary expansion of knowledge and information and communication technology, innovation and rapidity. Our department strongly believes in facilitating the students by providing them with the best learning experiences and academic opportunities to learn, to grow and to flourish in life.

Mechanical engineering is one of the largest, most diverse, and oldest engineering specializations in the profession. Mechanical engineers, in general, employ the principles of energy, materials, and mechanics to design, develop, and build practically all forms of physical machines, devices, and systems. The profession's primary traits are its breath, flexibility, and originality. Mechanical Engineering is also one of the most versatile and useful engineering specialties. It comprises key components of production, electrical, civil, chemical, and even materials science and bio-engineering, in addition to physics and mathematics. From mobile phones and medicinal gadgets to aircraft and power plants, mechanical engineering influences practically every area of modern life. Mechanical engineers deal with economic issues as well as engineering issues, ranging from the cost of a single component to the economic impact of a manufacturing plant. Mechanical engineers work in sales, engineering management, and corporate management, among other fields.

MESSAGE FROM HOD

MR. SABYASACHI MUKHERJEE
HOD, ME DEPARTMENT

Continued ...

The Department of Mechanical Engineering at Regent Education and Research Foundation is one of the premier departments in our college that provides a unique academic and research environment. The Department got its approval in the year of 2014 and session started from 2015 with very few faculty members and resources. Today, the department has been contributing fundamentally towards achieving excellence in academics like teaching, Research, Workshops, lab-sessions, assignments, Industrial Trainings, Seminars, Internships, projects and many more. The department also features an extraordinary rich diversity of talented 12 number of permanent faculty members from various specializations like Manufacturing, Thermal Engineering., Fluid Mechanics, Design etc. It is currently running with Bachelor's Programs with an aim to keep pace with the rapidly evolving mechanical industry that demands unwavering passion and urge to innovate.

The mechanical engineering department has various laboratories such as Mechanical Workshop, Thermal Engineering, Fluid Mechanics, Strength of Material, Engineering Drawing, Metrology & Measurements, Dynamics of Machinery, AutoCAD etc. All the faculty members are actively engaged with the laboratories for making the academic knowledge of the budding engineers complete with a practical outlook and technology. Our goal is to create a perfect blend of intellectual and practical experiences for our students so that they can assist our community and meet a variety of problems. Our alumni are well-placed in prestigious companies as well as in post-secondary education at nationally recognized universities/ institutions.

MESSAGE FROM HOD

MR. YUVARAJ MONDAL

HOD, CE DEPARTMENT

Welcome to Department of Civil Engineering at Regent Education & Research Foundation Group of Institutions. Over the last decades, we have grown our expertise and competence in the core Civil Engineering curriculum and research field through various innovative projects. Our goal is to provide students with a balance of intellectual and practical experiences that enable them to serve a variety of societal needs. . Civil Engineers have a key role in shaping the future of society, being at the forefront of the knowledge and skills required to meet the big challenges facing the world today. Therefore, in our department students are nurtured to become the best professionals in Industry or become Entrepreneurs in their own innovative way. Our department offers science-based engineering curriculum. The primary focus of our curriculum is to impart technical know-how to students, promote their problem solving skills and innovation of new technologies. We are having hard-working students and at the same time young and dynamic faculties, whose expertises span the range of disciplines in civil engineering stream and a very healthy work-culture, are the basic elements that comprise the Department of Civil Engineering, the hub of the institute's academia. We hold firm belief in our ability to succeed and we encourage an attitude of self reliance, commitment and responsibility to the motherland that we are to serve. . Such is the psychology behind the young and dynamic civil department in effect; the Department of Civil believes in building career, enriching minds and provides a remarkable experience that lasts a life time. I am confident that the students of the department would justify the credibility of the department by showing a high level of professional competence in their respective field.

MESSAGE FROM HOD

MR. SUPROVAT BASU

HOD, MBA DEPARTMENT

The department of MBA was established with a view to committing to being one of the best MBA institutes in Eastern India. Since its inception, through its commitment to excellence and to raising its standard of education as a college of management, it has acquired more than a name for itself. The institute is committed to imparting the highest quality of education and exposure to help develop the next generation of business leaders with an international outlook and capability of adapting to change. By introducing new specialization areas like MIS, Operations, Finance, HR, Marketing etc. and adopting an innovative pedagogic approach the institute has been constantly working to develop professionals who are committed to their personal and professional endeavours and have the vision, courage and dedication to initiate and manage change. For carving an industry ready professional, the Institute has well-qualified and experienced faculties which are supplemented by visiting faculties and guest speakers from reputed management institutes and corporate.

MBA Department of RERF imparts management education with three broad objectives of quality management education -acquiring knowledge, development of skills, and competence. To achieve these objectives management course curriculum has been designed with the latest, reflecting contemporary developments in different specialization areas of management. Students are taught by a competent and committed faculty well experienced to teach these subjects. The course is delivered through a slew of modern teaching techniques such as Case Study Method, Lecture Method, Seminars, Field Visits, Group Projects, Role-Playing, Experiential Learning and Simulated Exercises to give the students an opportunity to learn by doing and personal involvement.

MESSAGE FROM HOD

MR. SUPROVAT BASU
HOD, MBA DEPARTMENT

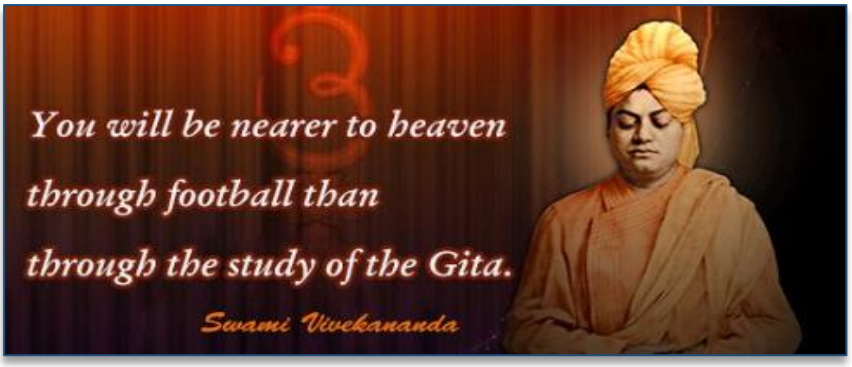
Continued ...

We strongly believe business today should be viewed in a global perspective. Accordingly, our future business leaders are provided multiple opportunities to develop these internationally applicable skills through interaction with highly distinguished faculty, study tours, industry visits, extensive corporate interaction, personality development & corporate communications programs. We believe in nurturing talents to turn into great performers in life and career. We do not believe in teaching bookish knowledge but in delivering academic excellence and real-life knowledge and reinforcing them with hands-on practices to develop the best professional and personal skills in you to make you successful in life and your career. Both the curriculum specializations and teaching methodologies are contemporary, dynamic, career and industry-focused to prepare you for the best of career opportunities. Reach out for the best, be a part of it, and let others follow and we are assuring you the best.

MESSAGE FROM HOD

MR. ARUP MALLICK
HOD, MCA DEPARTMENT

Master of Computer Application (MCA) is the two years master degree program approved by AICTE. The objective of our course is to train students with state of the art skills of technologies and imparting in-depth and thorough knowledge with application specific approach .Information Technology is growing rapidly. Increasing applications of computers in almost all areas of human endeavor has led to a vibrant industry with concurrent rapid change in technology. Students after passing MCA course, can either go the industry track with good skill sets of the modern trendy technologies or move to Academic domain with the good research interest or pursue any sort of higher studies. The MCA department in RERFGI helps students to be groomed up technologically for landing in professional world with practical knowhows. Extensive training of different technologies with their real life application and associated project works in RERFGI make the students confident enough to start their carrier with new dimension.



Physical Education is an integral part of the total education system. It helps in the attainment of the ultimate aim of education i.e. the achievement of holistic development. Games and Sports play a vital role in the student's life. A student should study hard to be successful in competitive examinations. But student should also play games and sports to enjoy the health and vigour of life. Along with bookish learning, a student should spend his time on games and sports also. Either study or work alone makes us exhaust. We remain no longer efficient to do any work. Team work is the key to success. In sports, one has the opportunity to collaborate with other team members to win. To succeed in education, a student needs to work hand in hand with teachers and fellow students. After college when working on a project, those with teamwork skills achieve their objectives effortlessly. In sports, there is leadership. Being a captain requires skills on how to become a good leader. In later life, even if he or she develops an interest in politics and end up being a top-notch leader. Being a leader at college helps a student gain interest and leadership skills. Many leaders have at one point in their education participated in college leadership. Most of the top positions in companies require someone with leadership skills. Regular practicing of events can find a different feel altogether.

Improve academic excellence: All the physical activities or sports require time and energy. Sports enhances the cognitive memory of the brain, helps and initiates in taking quick decisions, sharpens learning skill sets that also help students excel academically and in the outer sphere at large.

Reduce risk of obesity: All sorts of physical activities help in burning calories. Sports help control one's weight and reduce the risk of obesity and other related diseases.

Reduce stress: The most important benefit of sports is that it helps in reducing stress levels. Regular exercise is a natural way to feel relaxed, energetic and let go of stress. A lower amount of stress will thereby help in managing high blood sugar levels and even fight hypertension.

Sports remove our mental exhaustion. Education without sports is incomplete. The Sports Cell marks itself as one amongst the most efficacious Cell of Regent Education and Research Foundation Group of Institutions. It strives to excel at all levels and bring laurels to the colleges. With the help of college faculties, we are continuously improving in sports field. Considering the concept of "**SPORTS FOR ALL**" throughout the entire session we organized Inter-department tournaments for students as well as some sports activities for staff (teaching and non-teaching). It is one of the largest co-curricular activity programs that offer an extensive opportunity to all the students and staff. This venture shall enable the students and staff to have fun, learn new sports, enhance social interaction and tests one's physical capability.

These competitions also offer a break from the daily routine tasks and recreate or re-energetic them.

The following events have been organized for the inter-class sports tournaments for students:

- **CRICKET FOR BOYS**
- **VOLLEYBALL FOR BOYS**
- **ATHLETICS**
  - FOR BOY STUDENTS
  - 100 M RACE
  - SHOTPUT GAME
  - LONG JUMP
  - FOR GIRL STUDENT
  - 50 M RACE
  - SHOTPUT GAME
  - LONG JUMP
  - SPOON RACE

For Teaching and Non-teaching Staff

- **CRICKET**
- **BREAK A POT**
- **ATHLETICS**
  - 100 M RACE /50 M RACE
  - SHOTPUT GAME
  - LONG JUMP

From the beginning of the event on 15/03/2022 at morning session our college sports person of respective games (Men & Women) start their practice session and they work very hard for converting their sweat in winning trophies for the fame of our colleges. Approximately 850 candidates took part in different events. The events ended on 17/03/2022.

On 17/03/2022. The distribution of prizes was done in presence of Mr Subhankar Ghosh, Registrar RERFGOI and other dignitaries. The program was ended with a happy note.

SPORTS DO NOT BUILD CHARACTER.

THEY REVEAL IT.

IIC Cell Activities, 2022

Ministry of Education, Govt. of India has established an 'Innovation cell' with a purpose of systematically fostering the culture of Innovation in all Higher Education Institutions (HEIs) across the country.

Adhering to the Govt. policy, the Institution Innovation Council (IIC) Cell was formed here at Regent Education & Research Foundation in the third quarter of 2021, to encourage and develop a culture of start-up and entrepreneurship among the student's fraternity.

With the patronage of the trustee members, accompanied by the active support of the Principal and the Registrar, the IIC Cell of the Institute has achieved in flourishing an environment of origination and innovativeness in the Institute as a whole.

Under the able leadership of the President of the IIC Cell, together with the dynamic participation of all the IIC faculty members, the Cell has achieved two star grade from the Ministry within a very short time progression.

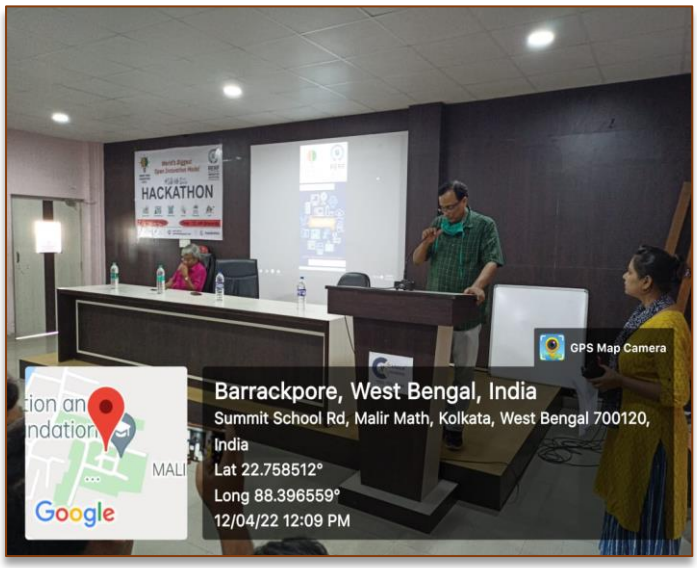
The IIC Cell organizes various workshops and seminars in the Institute where the students and faculty members participate devotedly and learn from the professionals who are expert in the domain of start-up and entrepreneurship. Due to pandemic, most of the workshops and seminars took place in the online mode in the last six months.

Some of the prominent activities of the IIC Cell in the first half of 2022 are listed below:

Smart India Hackathon

An internal competition of Smart India Hackathon 2022 was held on 12th April, 2022 in physical mode. The primary objective of the competition was to:

- Nominate teams for Smart India Hackathon 2022.
- Project as a self-driven activity of IIC cell, Regent Education and Research Foundation Group of Institutions.
- Inspire students to involve in innovative projects and develop their engineering skills.



A total of 60 students from RERF attended this program. Two teams have participated in the competition. It was inaugurated with the speech of our honorable chief guest Dr. Rajorshi Bandyopadhyay, Principal, Regent Education & Research Foundation Group of Institutions at around 12 noon and continued for one and a half hours. Professor Ranjit Sur, retired Professor, ISI, Kolkata also joined the event and shared his thoughts. The whole program was conducted by the President of the IIC Cell, Prof. Suparna Panchanan.

Celebration of National Technology Day, Observance with World Telecommunication and Information Society Day

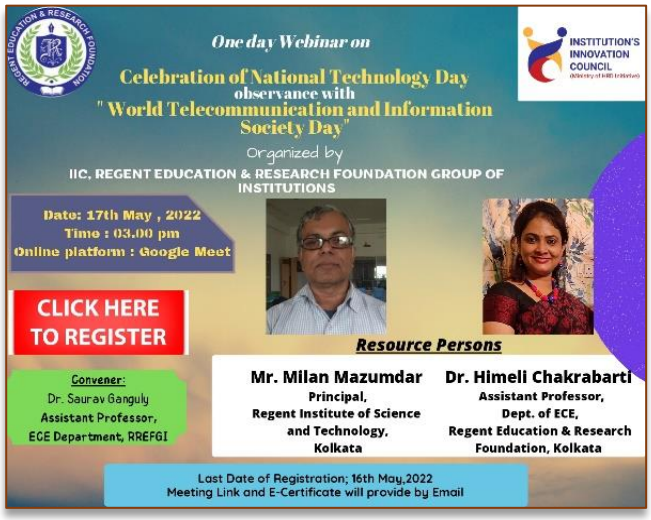
Students and teachers celebrated the National Technology Day, observance with World Telecommunication and Information Society Day, on 17th May 2022, in

the form of a webinar, where lectures were delivered by two eminent speakers of the domain.

The speakers were:

- Mr. Milan Mazumdar, Principal, Regent Institute of Science and Technology, Kolkata.
- Dr. Himeli Chakrabarti, Assistant Professor, Dept. of ECE, Regent Education & Research Foundation, Kolkata.

17th May is celebrated as World Telecommunication and Information Society Day internationally...



The event started in 1969, and the day was celebrated as the World Telecommunication Day to commemorate creation of International Telecommunication Union (ITU) on May 17, 1865.
World Information Society Day was an international day proclaimed to be on 17th May by a United Nations General Assembly resolution, following the 2005 World Summit on the Information Society in Tunis.
In November 2006, the ITU Plenipotentiary Conference in Antalya, Turkey, decided to celebrate both events on 17th May as World Telecommunication and Information Society Day.

The main objective of the day is to raise global awareness of social changes brought about by the Telecommunication revolution and the Internet and new technologies. It also aims to help reduce the digital divide.

Mr. Milan Mazumdar introduced a wonderful presentation on the theme of WT&IS Day 2022, “Digital Technologies for Older Persons and Healthy Ageing”, while Dr. Himeli Chakrabarti presented a marvelous chronological

development on the inventions and discoveries of telecommunication technology over the last 150 years.
Both the students and teacher fraternity were delighted by the new knowledge they accrued from the webinar. The total participants were nearly 100.

Self-Driven Activity of IIC Cell 4.0 of RERFGI Forming a Sustainable Start-up from an Innovative Idea

The IIC Cell 4.0 of Regent Education & Research Foundation conducted a one-day webinar on the theme of innovation on 27.5.22, Friday.
The speakers of the theme were:

- Biprashekhar Chakraborty, PhD (Cofounder of Gaanpeon & Nectarzing), Kolkata
- Mr. Kanad Bhattacharjee (Public speaker, Motivational Expert, Corporate Trainer and Start-up Enthusiast)

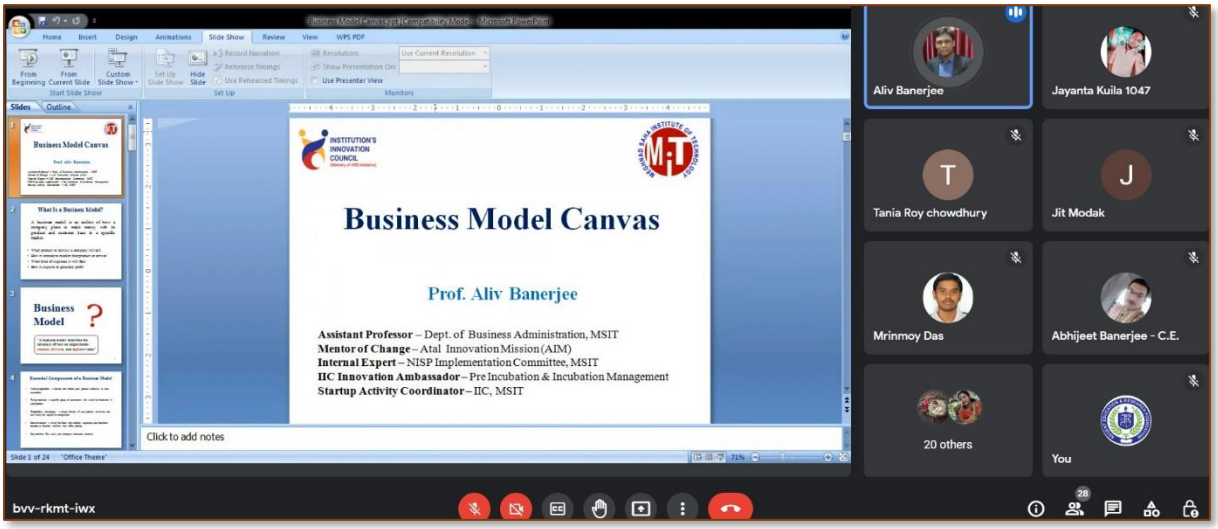
Both the speakers shared their wonderful journey from a small commencement to an enterprise. Although they are from complete academic background, it was interesting to hear how they took up a challenge in the domain of fine arts and steadily endeavored towards a big project.
The participants were extremely thrilled on hearing their expedition. It was really interesting to note that from a miniscule beginning, how they moved to success.
A total of 100 students and teachers participated in the webinar session.

IIC-Driven Activity of IIC Cell 4.0 of RERFGI on Session/ Workshop on Business Model Canvas (BMC)

The IIC Cell 4.0 of Regent Education & Research Foundation conducted a one-day webinar on the theme of innovation on 11.6.22, Friday.
The speaker of the theme was:

- Mr. Aliv Banerjee

(Assistant Professor, Dept. of Management Studies, Meghnad Saha Institute of Technology, Kolkata)



Mr. Banerjee shared his experience and knowledge as how to initiate a start-up as an entrepreneur.
The participants were extremely exhilarated on hearing his voyage. It was really interesting to note that from a miniscule beginning, how he moved to success.
A total of 60 students and teachers participated in the webinar session.

The IIC Cell of the Institute, with its vibrant activities is enthusiastic and dedicated in achieving its aim and keep inspiring and support the students and the academic community in accomplishment of start-up, innovation and entrepreneurship to adhere a positive impact on the society and build the nation as a whole.

NSS Annual Report for the Year 2022

The **National Service Scheme** of **Regent Education and Research Foundation Group of Institutions, Barrackpore** has been functioning well with so many activities furnishing development to the volunteers as well as the community. The Programme Officer, NSS Unit RERF, Mr. Swadhin Chakrabarty and other faculties did their best with the support of the Principal Dr. Rajorshi Bandopadhyay and other faculties in the college. In the regular activities so many community development programmes, webinars, awareness programmes, observation of national festivals etc. were successfully conducted with the support and participation of the volunteers.

ভাষা আন্দোলন দিবস (International Mother Language Day)

Date: 21-02-2022

International Mother Language Day is observed across the world on 21 February to highlight the significance of linguistic diversity and multiculturalism. The day focuses on how languages hold strategic importance for people and can advance the process of education and development. The theme of the International Mother Language Day, "Using technology for multilingual learning: Challenges and opportunities", will discuss the potential role of technology to advance multilingual education and support the development of quality teaching and learning for all.

My greetings on International. Linguistic diversity has always been one of the foundational pillars of our civilization. More than just a means of communication, our mother languages connect us with our heritage and define our socio-

cultural identity. At RERF, this year, the programme was inaugurated by Dr. Rajorshi Bandopadhay (Principal, RERF) and Dr.Sudip Chatterjee, (Chairman, Cultural Committee, RERF). The programme was given name "*কলতান*". A beautiful Cultural Program organized by Srijita Goswami (EEE department 4th Syear student) in collaboration with Ms. Asmita Guha Chowdhury (Convenor of Cultural Committee, RERF). A special talk was given by Dr. Sudip Chatterjee, (Chairman, Cultural Committee, RERF) and Dr. Rajorshi Bandopadhyay (Principal, RERF). Around 40 students of which 10 volunteers participated in the program.

International Women's Day

Date: 08-03-2022

Imagine a gender equal world. A world free of bias, stereotypes and discrimination. A world that is diverse, equitable, and inclusive. A world where difference is valued and celebrated. It is a day when women are recognized for their achievements without regard to divisions, whether national, ethnic, linguistic, cultural, economic or political.

Since those early years, International Women's Day has assumed a new global dimension for women in developed and developing countries alike. The growing international women's movement, which has been strengthened by four global United Nations women's conferences, has helped make the commemoration a rallying point to build support for women's rights and participation in the political and economic arenas.

International Women's Day is a time to reflect on progress made, to call for change and to celebrate acts of courage and determination by ordinary women, who have played an extraordinary role in the history of their countries and communities.

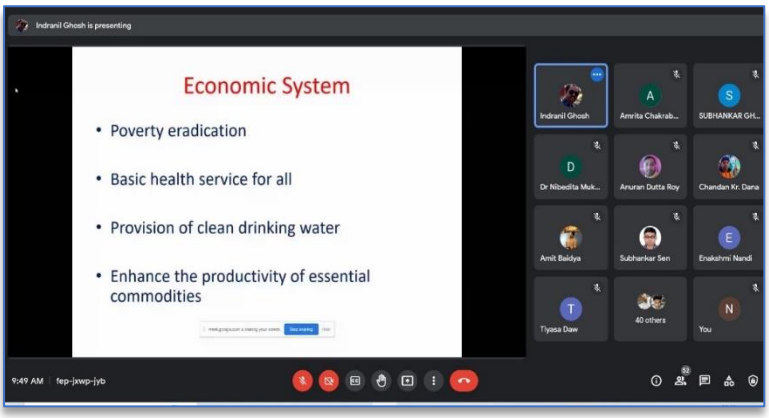
This is our motto. Together we can forge women's equality. This year, in RERFGOI, characters' play was played by our students and volunteers on 8th March 2022 in association with Women Cell and Cultural Committee. The programme was inaugurated by Dr. Rajorshi Bandopadhay (Principal, RERF). A beautiful cultural program organized by Srijita Goswami (EEE department 4th year student) in collaboration with Ms. Asmita Guha Chowdhury (Convenor of Cultural Committee, RERF). There was an excellent musical instrumental performance by Dr. Sudip Chatterjee, (Chairman, Cultural Committee, RERF). A special talk was given by Dr. Nibedita Mukherjea (Chairman, Women cell RERF) on Gender awareness and social security. The event was beautifully arranged and everyone thoroughly enjoyed it. Around 50 participated of which 10 are NSS volunteers.

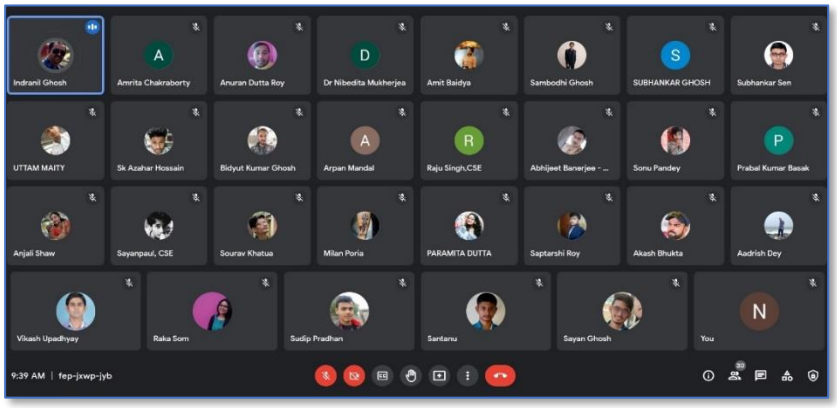
World Environment Day

Date: 05-06-2022

5th June, World Environment Day. It is the United Nations' principal vehicle for encouraging awareness and action for the protection of the environment. First held in 1973, it has been a platform for raising awareness on environmental issues such as marine pollution, overpopulation, global warming, sustainable development and wildlife crime. World Environment Day is a global platform

for public outreach, with participation from over countries annually. Each year, the program has provided a theme and forum for businesses, non-government organizations, communities, governments and celebrities to advocate environmental causes. It means greenery, spreading awareness and encouraging action to protect our environment. This year, NSS unit of RERFGOI in collaboration with BSH department conducted a webinar on 'Sustainable Development and Environment'. Talk was done by Dr. Indranil Ghosh (Associate Professor, Netaji Subhas Engineering College). The webinar was conducted in google meet platform at 9:30 a.m morning and inaugurated by Mr. Subhankar Ghosh (Registrar, RERF) and Mr. Swadhin Chakrabarty (Programme officer, NSS Unit, RERF). Key speaker delivered an extremely enriching speech on this topic. The programme was ended with vote of thanks by Dr. Nibedita Mukherjea (HOD, BSH; RERF). Around 10 NSS volunteers and 60 students participated in the programme.





প্রথম তিন মিনিট এবং তারপর

অভীক ঘোষ দস্তিদার
সহকারী অধ্যাপক, বেসিক সাইন্স এন্ড হিউম্যানিটিজ বিভাগ

১. ভূমিকা (Introduction)

১৯২০ সালের ২০ শে এপ্রিল একটি রৌদ্রোজ্জ্বল দিনে এক আসামান্য বিতর্ক সভার আয়োজন করা হয়েছিল। আয়োজক ন্যাশনাল একাডেমি অফ সায়েন্সেস আর বিষয়বস্তু ছিল ছায়াপথের প্রকৃতি। আকাশগঙ্গাই (Milkyway) কি একমাত্র "দ্বীপ মহাবিশ্ব" (island universe) নাকি এর বাইরেও অন্য ছায়াপথ আছে? এই ছিল বিতর্ক সভার মূল উপপাদ্য। মাউন্ট উইলসন অবজারভেটরি থেকে হারলো শ্যাপলি (harlow shapley) এবং পিটসবার্গের অ্যালেগেনি অবজারভেটরি থেকে হেবার কার্টিস (Heber Curtis) এই বিতর্কসভার মূল বক্তা ছিলেন। সেদিন এর সভায় এই প্রশ্নের কোনো নিস্পত্তি হয় নি। ১৯২৪ সালে এর উত্তর খুঁজে পেয়েছিলেন এডুইন হাবল (Edwin Hubble)।

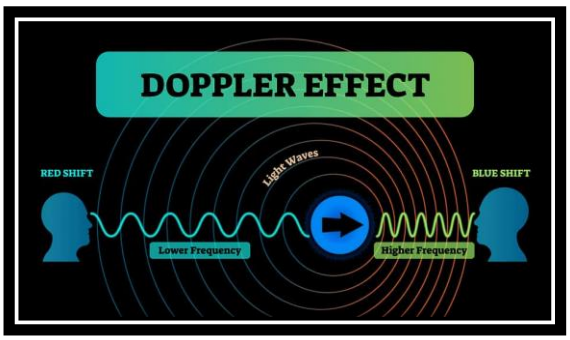
কল্পনা করুন যে, কোনো এক অন্ধকার রাতে, আপনি খোলা মাঠে বিভিন্ন দূরত্বে একটি ফ্ল্যাশলাইট (flashlight) রাখলেন। প্রতিক্ষেত্রে সেই আলোর আপেক্ষিক ঔজ্জ্বল্য (specific intensity) পরিমাপ করে, আপনি বুঝতে পারবেন আলোটি কত দূরে আছে। কারণ আলোর ঔজ্জ্বল্য দূরত্বের বর্গের সাথে ব্যস্তানুপাতে (inversely) পরিবর্তিত হয়। হাবল ১০০ ইঞ্চি উইলসন টেলিস্কোপের সাহায্যে বিভিন্ন নীহারিকার (nebula) ঔজ্জ্বল্য পরিমাপ করেন। এবং সেই ঔজ্বল্যের মান থেকে বস্তুগুলির দূরত্ব নির্ণয় করেন। এই অনুসন্ধান দশক ব্যাপী এক বিরাট বিতর্কের উত্তর দিল। আকাশগঙ্গাই এই মহাবিশ্বের একমাত্র ছায়াপথ নয়। অসংখ্য ছায়াপথ এক বিশাল মহাশূণ্যের ভিতর ছাড়িয়ে রয়েছে।

২. আইনস্টাইনের স্থির মহাবিশ্ব থেকে হাবলের সূত্র (From a static Universe of Einstein to Hubble's law)

১৯১৭ সালে আলবার্ট আইনস্টাইন, তার আপেক্ষিকতা তত্ত্বের (Theory of relativity) উপর ভিত্তি করে একটি স্থির মহাবিশ্বের কল্পনা করেন। অর্থাৎ এমন একটি ব্রম্ভান্ড যা সময়ের সাথে পরিবর্তিত হয় না। এই তত্ত্বে আইনস্টাইন, একটি মহাজাগতিক ধ্রুবক (cosmological constant) এর ব্যবহার করেন যা মহাকর্ষের আকর্ষণ বলের উল্টো দিকে কাজ করে এবং এই ব্রম্ভান্ডর স্থিতাবস্থা বজায় রাখে।

১৯১৭ সালেই ডাচ বিজ্ঞানী উইলেম ডি সিটার (Willem de Sitter) অঙ্ক কষে দেখালেন যে যদি মহাবিশ্বের ভর না থাকতো তাহলে এই মহাজাগতিক ধ্রুবক এর প্রভাবে অতি দ্রুত প্রসারিত হতো। ১৯২২ সালে, রাশিয়ান বিজ্ঞানী আলেকজান্ডার ফ্রিডম্যান (Alexander Friedmann) প্রস্তাব দিলেন যে মহাজাগতিক ধ্রুবক ছাড়াও একটি মহাবিশ্বও প্রসারিত কিংবা সংকুচিত হতে পারে এবং এটি মহাবিশ্বে কতটা পদার্থ রয়েছে তার উপর নির্ভর করে। তাহলে কি করে বোঝা সম্ভব যে মহাজাগতিক বস্তুগুলি পরস্পর থেকে দূরে সরে যাচ্ছে নাকি কাছাকাছি চলে আসছে?

একটি ট্রেনের হর্নের তীক্ষ্ণতা ক্রমাগত বৃদ্ধি পায় যত ট্রেনটি কাছে আসে এবং ট্রেনটি যত দূরে সরে যায় তাতো তীক্ষ্ণতা হ্রাস পায়। গতিবেগের সাথে তীক্ষ্ণতার এই পরিবর্তন ঘটে শব্দের কম্পাঙ্ক (frequency) বা তরঙ্গদৈর্ঘ্যর (wavelength) পরিবর্তনের জন্য। এই ঘটনাটি ডপলার এফেক্ট (Doppler effect) নামে পরিচিত।



এই আপাত পরিবর্তনটি নক্ষত্র বা ছায়াপথ দ্বারা নির্গত দৃশ্যমান আলোর জন্যও লক্ষ্য করা যায়। যদি একটি নক্ষত্র পৃথিবীর দিকে অগ্রসর হয়, তবে এটি স্থির আলোর উৎসের তুলনায় কম তরঙ্গদৈর্ঘ্যের আলো নির্গত করে। অর্থাৎ তরঙ্গদৈর্ঘ্যটি বর্ণালীর নীল প্রান্তের দিকে সরে যায়, একে ব্লুসিফ্ট (Blueshift) বলা হয়। উল্টোভাবে চিন্তা করলে, আমাদের থেকে দূরে সরে যাওয়া

একটি নক্ষত্রের আলো দীর্ঘতর তরঙ্গদৈর্ঘ্যের দিকে সরে যাচ্ছে বলে মনে হবে। যেহেতু এটি বর্ণালীর লাল প্রান্তের দিক, জ্যোতির্বিজ্ঞানীরা একে রেডশিফট (Redshift) বলেন। ১৯২৯ সালে, এডউইন হাবল, ক্যালিফোর্নিয়ার পাসাডেনায় কার্নেগি অবজারভেটরিতে কাজ করার সময়, বহু দূরবর্তী ছায়াপথের রেডশিফ্ট (redshift) পরিমাপ করেন। এই রেডশিফ্ট প্রমান করে যে নক্ষত্র তথা ছায়াপথগুলি ক্রমাগত একে অন্যের থেকে দূরে সরে যাচ্ছে। অন্যভাবে বললে মহাবিশ্ব ক্রমাগত প্রসারিত হচ্ছে। এডউইন হাবল দেখতে পান যে ছায়াপথগুলির দূরে সরে যাওয়ার বেগ সবসময় তাদের দূরত্বের সমানুপাতিক। অর্থাৎ যে ছায়াপথটি আমাদের থেকে যত দূরে অবস্থিত, সেটি আমাদের থেকে ততো দ্রুত দূরে সরে যাচ্ছে। বেগ এবং দূরত্ব, এই দুটির অনুপাত 'হাবল ধ্রুবক' (Hubble constant) নামে বিখ্যাত এবং এই ধ্রুবকটি মহাবিশ্বের সম্প্রসারণের হারকে নির্ধারিত করে। আধুনিক গবেষণা দাবি করছে যে এই হাবল ধ্রুবকটিও আদতে ধ্রুবক নয়; এর মান ক্রমাগত বৃদ্ধি পাচ্ছে বা অন্য ভাবে বললে, মহাবিশ্বের প্রসারণের হার বৃদ্ধি পাচ্ছে।

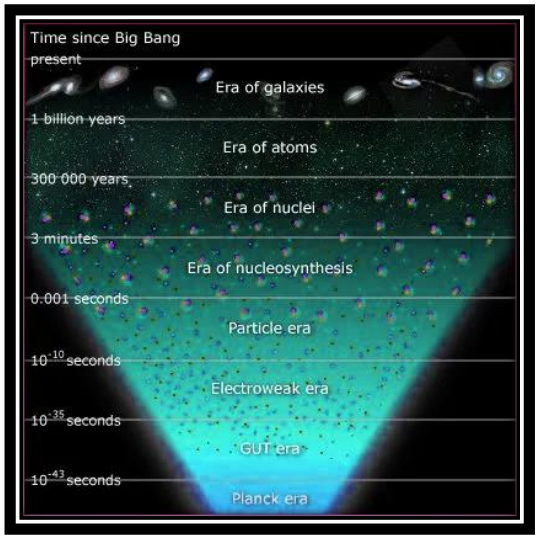
৩. একটি মহাবিস্ফোরণ (Bigbang)

মহাবিশ্বের প্রসারণকে যদি একটি ছায়াছবি বা সিনেমা হিসাবে কল্পনা করা যায় এবং সেই সিনেমাটি যদি উল্টোদিকে (rewind) চালানো হয়, তাহলে একটি মুহূর্ত আসবে যখন এই ব্রহ্মাণ্ডর সমস্ত ভর একটি বিন্দুতে কেন্দ্রীভূত ছিল। এই বিন্দুটিকে সিঙ্গুলারিটি (singularity) বলা হয়। এই বিন্দুটির ঘনত্ব (density) ছিল অসীম এবং তাপমাত্রা (temperature) ছিল অকল্পনীয় মাত্রায় বেশি। এটিই সৃষ্টির আদিমতম মুহূর্ত। কোনো এক অজানা কারণবশতঃ, আনুমানিক ১৩.৮ বিলিয়ন (১ বিলিয়ন = ১০০ কোটি) বছর আগে এক মহাবিস্ফোরণের (Bigbang) ফলে এই কেন্দ্রীভূত সমস্ত ভর একে অন্যের থেকে দূরে সরে যেতে শুরু করে। এবং জন্ম হয় এই মহাবিশ্বের।

মহাবিশ্বের সম্প্রসারণকে প্রায়ই একটি বিস্ফোরিত বোমার সাথে তুলনা করা হয়। এটা আদতে কিন্তু তা নয়। প্রতিটি বোমার একটি কেন্দ্র থাকে যেখান থেকে বোমা বিস্ফোরিত হয়, এবং বোমার টুকরোগুলি সেই কেন্দ্র বিন্দু থেকে দূরে সরে যায়। স্পেস বা স্থান বা জায়গাটি একটি পটভূমি হিসাবে স্থির থাকে। অন্যদিকে, মহাবিশ্বের সম্প্রসারণ হল স্পেস বা স্থানের একটি সম্প্রসারণ, যা তার সাথে সবকিছু (ভর এবং শক্তি) বহন করে। এই চমকপ্রদ ধারণাটি (hypothesis) প্রথম বৈজ্ঞানিক গবেষণাপত্রের আকারে ১৯৩১ সালে প্রকাশিত হয়েছিল যার লেখক ছিলেন বেলজিয়ান জ্যোতির্বিজ্ঞানী এবং ক্যাথলিক পুরোহিত জর্জেস লেমাইত্রে (Georges Lemaître)।

৪. প্রথম তিন মিনিট (First three minutes)

কিন্তু কেমন ছিল এই আদিমতম মুহূর্তগুলো। আজকের পদার্থবিজ্ঞান তার একটা মোটামুটি ধারণা দিতে পারে। মহাবিশ্বের যে চেহারা আজ আমরা জানি, সেরকম পরিস্থিতি তৈরী হতে এখনকার হিসাবে প্রায় ৭ দিন সময় লেগেছিলো। তার মধ্যে প্রথম তিন মিনিটে সবথেকে বেশি গুরুত্বপূর্ণ ঘটনাগুলি ঘটেছিলো। আমরা এই প্রথম তিন মিনিটকে সাতটি গুরুত্বপূর্ণ যুগে ভাগ করতে পারি। প্রতিটি যুগের আলাদা তাপমাত্রা এবং ঘনত্ব ছিল।



মহাবিস্ফোরণের পরপরই, প্রথম যে সময়টি অস্তিত্বে এসেছিল তা হল প্ল্যাঙ্ক যুগ (Planck Epoch)। এই সময়কালে, মহাবিশ্বের তাপমাত্রা ছিল $১০^{৩২}$ কেলভিন, এই অলকল্পনীয় তাপমাত্রায় প্রকৃতির চারটি মৌলিক বল (primary force) যথাক্রমে মহাকর্ষীয় বল (Gravitational force), তড়িৎ-চৌম্বকীয় বল (Electromagnetic force), দুর্বল বল (weak force) এবং শক্তিশালী বল (strong force) একসঙ্গে একটি একত্রীভূত বল (super force) হিসাবে বিদ্যমান ছিল। এই যুগটি সর্বমোট $১০^{-৪৩}$ সেকেন্ড স্থায়ী হয়েছিল।

GUT বা "গ্র্যান্ড ইউনিফাইড থিওরি" যুগ (Grand Unified Theory epoch) শুরু হয়েছিল, যখন মহাবিশ্বের বয়স ছিল মাত্র $১০^{-৪৩}$ সেকেন্ড এবং এটি বিগ ব্যাংয়ের $১০^{-৩৬}$ সেকেন্ড পর্যন্ত অব্যাহত ছিল। প্ল্যাঙ্ক যুগের পর, মহাকর্ষ বল স্ট্যান্ডার্ড মডেলের

(Standard model) অন্য তিনটি মৌলিক বল থেকে আলাদা হয়ে যায়। তাই এখন, (GUT যুগে), তড়িৎ-চৌম্বকীয় বল (Electromagnetic force), দুর্বল বল (weak force) এবং শক্তিশালী বল (strong force) একটিমাত্র বল হিসাবে কাজ করতো। অধিকন্তু, এই যুগের শেষের দিকে, ব্রহ্মাণ্ডর তাপমাত্রা $১০^{৩২}$ কেলভিন থেকে $১০^{২৯}$ কেলভিন -এ নেমে এসেছিল।

বিগ ব্যাং-এর পর ইলেক্ট্রোউইক যুগটি (Electroweak epoch) তৃতীয় স্থানে এসেছিলো। এই যুগে, শক্তিশালী বল (strong force) পৃথক হয়ে যায়; এইভাবে দুর্বল এবং তড়িৎ চৌম্বকীয় বল একটি একক বল হিসাবে আত্মপ্রকাশ করে। এইসময় ($১০^{-৩৩}$ সেকেন্ড সময়ে), হঠাৎ একটি মহাজাগতিক স্ফীতি (cosmological inflation) শুরু হয় এবং মহাবিশ্ব দ্রুতগতিতে প্রসারিত হয়ে একটি প্রোটনের আকার থেকে একটি মুষ্টির সমান আকারে বড় হয়েছিল। এই প্রসারণ আলোর চেয়ে দ্রুত গতিতে ঘটেছিলো। যাইহোক, এই ব্যাপক সম্প্রসারণের পিছনের সঠিক পদার্থবিদ্যার সূত্রগুলি আজও স্পষ্টভাবে জানা নেই। মহাজাগতিক স্ফীতি খুব দ্রুত শেষ হয়, এবং পরবর্তীকালে, মহাবিশ্ব স্বাভাবিকভাবে প্রসারিত হতে শুরু করে। মহাবিশ্বের বয়স যখন $১০^{-৩২}$ সেকেন্ড, তাপমাত্রা ১০০ ট্রিলিয়ন ট্রিলিয়ন কেলভিন ($১০^{২৬}$ কেলভিন)এ নেমে আসে এবং W এবং Z বোসনের মতো মৌলিক কণার জন্ম হয়।

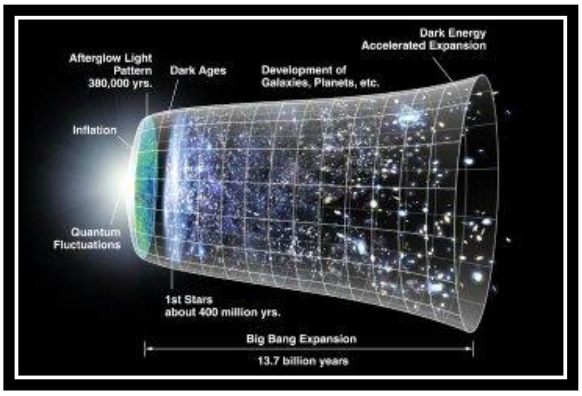
বিগ ব্যাং এর $১০^{-১২}$ সেকেন্ড পরে ইলেক্ট্রোউইক যুগ শেষ হয় এবং তারপর কোয়ার্ক যুগ (Quark epoch) শুরু হয়। ততক্ষণে, মহাবিশ্ব যথেষ্ট ঠান্ডা হয়েছে এবং হিগস ক্ষেত্রও (Higgs field) ধ্বনাত্বক মান লাভ করেছে। ফলত, ইলেক্ট্রোম্যাগনেটিক বল এবং দুর্বল বল পরস্পর থেকে বিচ্ছিন্ন হয়ে যায়। এবং, চারটি মৌলিক বলই তাদের সতন্ত্র পরিচয় লাভ করে। ফলস্বরূপ, সমস্ত মৌলিক কণাগুলোই হিগস ক্ষেত্রের সাথে যোগাযোগ করতে পারে এবং নিজস্ব ভর অর্জন করতে সক্ষম হয়। এই সময় কোয়ার্ক (Quark) এবং গ্লুওন (Gluon) কণাগুলি একটি মিশ্রনের (primordial soup) ন্যায় সর্বত্র বিরাজমান ছিল। কিন্তু তখনও তাপমাত্রা এতোখানিও কমেনি যে কোয়ার্কগুলি পরস্পরের সাথে সংযুক্ত হয়ে প্রোটন বা নিউট্রনের মতো হ্যাড্রন তৈরি করতে পারে। প্রসঙ্গত বলে রাখা যায়, পদার্থবিদ্যার আদর্শ মডেলে, কোয়ার্ক হল প্রাথমিক কণাগুলির মধ্যে একটি। একটি হ্যাড্রন তৈরী করতে দুই বা ততোধিক কোয়ার্কের প্রয়োজন হয় যারা গ্লুওনের সাহায্যে নিজেদের মধ্যে সংযুক্ত হয়।

কোয়ার্ক যুগ শেষ হওয়ার পরপরই এবং বিগ ব্যাং এর ১ মাইক্রোসেকেন্ড পর হ্যাড্রন যুগ শুরু হয়। এই সময়ের মধ্যে, তাপমাত্রা আরও কমে যায় এবং পূর্ববর্তী যুগের কোয়ার্কগুলি একত্রিত হয়ে হ্যাড্রন তৈরি করতে সক্ষম হয়। এই সময়ের শেষের দিকে কেবল প্রোটন এবং নিউট্রনের মতো হালকা স্থিতিশীল হ্যাড্রন তৈরী হয়। বিগ ব্যাং এর ১ সেকেন্ড পরে হ্যাড্রন যুগ শেষ হয়।

জন্মের ১ সেকেন্ড পরে মহাবিশ্বের তাপমাত্রা লেপটন নামক আরেকটি প্রাথমিক কণা তৈরির জন্য যথেষ্ট অনুকূল হয়ে ওঠে। লেপটন এক ধরনের প্রাকৃতিক মৌলিক কণা এবং এটি কোনো উপাদান কণার সমন্বয়ে গঠিত হয় না। ইলেকট্রন হল লেপটনের একটি বহুল প্রচলিত উদাহরণ। এই সময়ের মধ্যে ক্রমাগত লেপটন এবং অ্যান্টি-লেপটন তৈরি হতে শুরু করে এবং এই উৎপাদন ১০ সেকেন্ড ধরে চলতে থাকে। এই যুগটি লেপটন যুগ (lepton epoch) নামে পরিচিত। যাইহোক, মহাবিশ্ব এই সময়ে অস্বচ্ছ (opaque) ছিল কারণ ফোটনগুলি সহজেই এই মুক্ত ইলেকট্রন দ্বারা বিক্ষিপ্ত হচ্ছিলো।

এই মুহূর্ত পর্যন্ত, মহাবিশ্বের সমগ্র ভরই মূলত প্রোটন, নিউট্রন, ইলেকট্রন এবং ফোটন রূপে বিদ্যমান ছিল। যাদের মধ্যে ফোটন কণাগুলির সংখ্যা ছিল অন্যান্য কণাদের তুলনায় বহুগুন বেশি। এইসময়, চারটি মৌলিক বলই তাদের বর্তমান রূপ লাভ করেছিল। ফলস্বরূপ নিউক্লিওসিন্থেসিস (Nucleosynthesis) বা জটিল নিউক্লিয়াসের জন্মপ্রক্রিয়া শুরু করার উপযুক্ত পরিস্থিতি তৈরী হয়েছিল। এটি এমন একটি প্রক্রিয়া যার মাধ্যমে আমাদের মহাবিশ্বে বেশিরভাগ ভারী উপাদান তৈরি হয়। মহাবিশ্বের ২ মিনিট বয়সে, তাপমাত্রা ১.২ বিলিয়ন ডিগ্রি কেলভিনের নিচে নেমে যায়। এই তাপমাত্রায়, ফোটনের গড় শক্তি ছিল ১.৮×১০^{-১৪} জুল, যা কিনা একটি ডিউটেরিয়াম (deuterium) নিউক্লিয়াসের বাইন্ডিং শক্তির (binding energy) সমতুল্য। একটি ডিউটেরিয়াম নিউক্লিয়াসে একটি প্রোটন এবং একটি নিউট্রন থাকে যা শক্তিশালী পারমাণবিক বল দ্বারা সংযুক্ত থাকে। মহা বিস্ফোরণের দুই মিনিট পরে, প্রোটন এবং নিউট্রনের সংমিশ্রণে ডিউটেরিয়াম তৈরি হয়েছিল। মহাবিস্ফোরণের পর প্রথমবারের মতো মহাবিশ্বে একটি প্রোটনের চেয়ে বেশি জটিল নিউক্লিয়াস জন্ম হল। যদিও তখনও মহাবিশ্বের বেশিরভাগ প্রোটন, হাইড্রোজেন নিউক্লিয়াস হিসাবে বিচ্ছিন্ন অবস্থায় রয়ে যায় এবং অবশেষে, মহাবিস্ফোরণের ৩ মিনিট পরে, মহাবিশ্বের

তাপমাত্রা ১ বিলিয়ন ডিগ্রি কেলভিনের নিচে নেমে আসে। এই তাপমাত্রায়, ফোটনের গড় শক্তি ছিল ১.৫ x $১০^{-১৪}$ জুল, যা হিলিয়াম (helium) নিউক্লিয়াসের বাইন্ডিং শক্তির সমতুল্য। সুতরাং, ৩ মিনিট বয়সে, ডিউটেরিয়াম, প্রোটন এবং নিউট্রন বিভিন্ন প্রক্রিয়ার মাধ্যমে সংযোজিত (nuclear fusion) হয়ে হিলিয়াম নিউক্লিয়াস গঠন করে। যখন এই ঘটনাগুলি ঘটেছিলো, ততক্ষনে এই মহাবিশ্ব ক্রমাগত প্রসারিত এবং আরও ঠান্ডা হচ্ছিলো।



২০ মিনিটের মধ্যে, মহাবিশ্ব আর পারমাণবিক সংযোজন (nuclear fusion) জন্য আর যথেষ্ট গরম ছিলোনা, কিন্তু এই তাপমাত্রাও একটি পরমাণুর অস্তিত্বের জন্য কিংবা ফোটনের বহুদূর ভ্রমণের জন্য যথেষ্ট বেশি ছিল । তাই এই মুহূর্তের ব্রম্ভান্ডকে একটি অস্বচ্ছ প্লাজমা (plasma) রূপে কল্পনা করা যায়। এরপর রিকম্বিনেশন যুগ (recombination epoch) শুরু হয় প্রায় ১৮,০০০ বছরে এসে। এই সময়ে এসে ইলেকট্রন হিলিয়াম নিউক্লিয়াসের সাথে মিলিত হয়ে He^{+} আয়ন গঠন করতে শুরু করে। প্রায় ৪৭,০০০ বছরে, মহাবিশ্ব শীতল হওয়ার সাথে সাথে এর আচরণ বিকিরণের পরিবর্তে ভরের দ্বারা প্রভাবিত হতে শুরু করে।

প্রায় ১০০,০০০ বছর পর, প্রথমে নিরপেক্ষ হিলিয়াম পরমাণু (neutral Helium atom) গঠনের পর, প্রথম অণু হিসাবে হিলিয়াম হাইড্রাইড (Helium Hydrite) তৈরী হল । তারও অনেক পরে, হাইড্রোজেন এবং হিলিয়াম হাইড্রাইড বিক্রিয়া করে আণবিক হাইড্রোজেন (H_2) তৈরি করে যা প্রথম যেকোনো নক্ষত্রের জন্য প্রয়োজনীয় জ্বালানী (fuel)। প্রায় ৩৭০,০০০ বছরে এসে, নিরপেক্ষ হাইড্রোজেন (neutral hydrogen) পরমাণুগুলি গঠন প্রক্রিয়া শেষ হয়, এবং ফলস্বরূপ মহাবিশ্বও প্রথমবারের মতো স্বচ্ছ (transparent) হয়ে ওঠে। নবগঠিত পরমাণুগুলি – প্রধানত হাইড্রোজেন, হিলিয়াম এবং স্বল্প পরিমাণ লিথিয়াম (lithium) - নিজেদের মধ্যে বিক্রিয়া করে প্রচুর ফোটন (photon decoupling) কণার জন্ম দেয়। এই ফোটনগুলি আজও মহাজাগতিক মাইক্রোওয়েভ পটভূমি (Cosmic Microwave Background) হিসাবে সনাক্ত করা যায়। এটি বর্তমানে মহাবিশ্বের আমাদের প্রাচীনতম প্রত্যক্ষ পর্যবেক্ষণ।

৫. কৃষ্ণ যুগ এবং প্রথম নক্ষত্র (The dark era and the first star)

৩৭০,০০০ বছর থেকে প্রায় ১ বিলিয়ন বছর সময়কাল পর্যন্ত মহাবিশ্ব স্বচ্ছ ছিল কিন্তু তখন হাইড্রোজেনের মেঘ একত্রিত হয়ে কোনো নক্ষত্র বা ছায়াপথ তৈরি করতে পারে নি। তাই আলোর কোনও নতুন উৎস ছিল না। কিন্তু এই ব্রম্ভান্ড তখন হালকা কমলা রঙের কসমিক মাইক্রোওয়েভ ব্যাকগ্রাউন্ড দ্বারা পরিপূর্ণ ছিল। মহাবিশ্বের প্রসারণের সাথে সাথে এই ফোটনগুলির তরঙ্গদৈর্ঘ্য ধীরে ধীরে বৃদ্ধি পেতে থাকে এবং দৃশ্যমানতার বাইরে চলে যায়। মহাবিশ্ব জুড়ে নেমে আসে অন্ধকার যুগ (dark age)।

প্রায় ২০০ থেকে ৫০০ মিলিয়ন বছরের মধ্যে, মাধ্যাকর্ষণ বলের প্রভাবে সেই আদিম মহাবিশ্বের ভর বিভিন্ন স্থানে একত্রিত হতে শুরু করে এবং প্রথম প্রজন্মের তারাগুলি জন্ম নিতে শুরু করে। ব্রম্ভান্ডে পুনরায় আলোর উন্মোচন হয়। নক্ষত্রদের এই আদি প্রজন্মকে এখনও জ্যোতির্বিদ্যাগতভাবে (astronomically) পর্যবেক্ষণ করা সম্ভব হয়নি। কিন্তু ধারণা করা হয় তারা হয়ত বিশাল আয়তনের (১০০ - ৩০০ গুন সৌর ভর) এবং অ-ধাতব (non-metalic) ছিল। এখন মহাবিশ্বে আমরা যে তারাদের দেখতে পাই, তাদের তুলনায় প্রথম প্রজন্মের নক্ষত্রগুলির জীবনকাল অনেক কম ছিল। এই সব নক্ষত্রদের পেটে প্রচুর চাপ ও তাপে ভারী মৌলগুলি (heavy elements) জন্ম নিতে শুরু করে। যখন সুপারনোভা বিস্ফোরণের (supernova explosion) মাধ্যমে এই তারাগুলির মৃত্যু হয়, তখন এই ভারী মৌলগুলি ব্রম্ভান্ডর সর্বত্র ছড়িয়ে পরে।

৬. পরিশিষ্ট (Annex)

১ বিলিয়ন বছর থেকে প্রায় ১২.৮ বিলিয়ন বছর ধরে, এই মহাবিশ্ব প্রায় একই চেহারায় বর্তমান এবং এই চেহারার ব্রম্ভান্ডকেই আজ আমরা দেখতে পাই এবং ভবিষ্যতে অনেক বিলিয়ন বছর ধরে এটিকে একই রকম দেখতে পাবো। আমাদের ছায়াপথ প্রায় ১৩.৬ বিলিয়ন বছর আগে তৈরি হতে শুরু করে এবং সৌরজগৎ

(solar system) সৃষ্টি হয় ৪.৫ বিলিয়ন বছর আগে, পৃথিবীতে জীবনের প্রথম চিহ্নগুলি প্রায় ৩.৭ বিলিয়ন বছর আগে আবির্ভূত হয়েছিল।

এই মহাবিশ্বের ভবিষ্যৎ কি? ব্রহ্মান্ড কি এই ভাবে চিরকালই প্রসারিত হতে থাকবে নাকি কোনো এক মুহূর্তে গিয়ে এই প্রসারণ বন্ধ হয়ে স্থিতিশীল অবস্থা তৈরী হবে? নাকি কোনো এক মুহূর্তে শুরু হবে সংকোচন এবং সংকুচিত হতে হতে ব্রহ্মান্ড আবার একটি বিন্দুতে পরিণত হবে? এই সমস্ত প্রশ্নের যথার্থ উত্তর আজও বিজ্ঞানীরা খুঁজে চলেছেন। বহু রহস্যের উন্মোচন হওয়া এখনও বাকি। প্রচলিত ভর এবং মাধ্যাকর্ষণ বল ছাড়াও আরও কিছু অনন্য সাধারণ ভর এবং শক্তি এই বিশ্বব্রম্হান্ডের প্রসারণকে নিয়ন্ত্রণ করছে। তাদেরকে আমরা ডার্ক ম্যাটার (dark matter) এবং ডার্ক এনার্জি (dark energy) বলে জানি। এই বিশ্বচরাচরে যত ভর আমরা দেখতে পাই, তা মোট ভরের ৫%। বাকিটা এই ডার্ক ম্যাটার এবং ডার্ক এনার্জি দ্বারা পরিপূর্ণ। এই ডার্ক ম্যাটার এবং ডার্ক এনার্জির কোনোরকম চরিত্রগত বৈশিষ্ট্য আজও আমরা জানতে পারি নি। তবে আমরাও হাল ছেড়ে দেব না কোনোদিন। গবেষণা চলতেই থাকবে। সত্যের প্রকাশ হবেই।

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A Review of Rail Tracks by Thermit Welding

Amit Rakshit

Lecturer, Department of ME, RIST

Abstract: The Thermit welding of thermal effect dependent on the arc of the electrical and temperature field of it in work piece which is the major enter of analytical in addition to optimization of this process from which the major goal of this paper has been distinct. The persuade through which the parameters of welding for each mode depends **[1]** on the shape and dimensions of the welds on their ferrite contents is investigate. In spite of these simplify and modifications, the model could be aided to analyzed the thermal conditions using thermit welding with sufficient accuracy. The Heat Affected Zone, temperature check-ups and welds spots profiles were in good agreement with the investigational measurements in laboratory welds and found the weld gap which was the most dominant welding parameter for rail thermit welding**[2].** In this paper, we have to study about the review where the thermit welding is applicable mostly in the railway tracks.

Keywords: Welding; Thermit Welding; HAZ; Rail Tracks

1. Introduction:

Metal amalgamation process means welding process to anywhere in coalescence produced by heating the metal to appropriate temperatures by means of or without the application of pressure and with or without the use of filler metals **[5].** Welding is a quick, reliable and flexible manufacturing technology used in machine building, construction and maintenance of structures, plants and machinery. There are many welding process. The types of welding which is most important to discuss about welding processes is given below in the flow chart format-

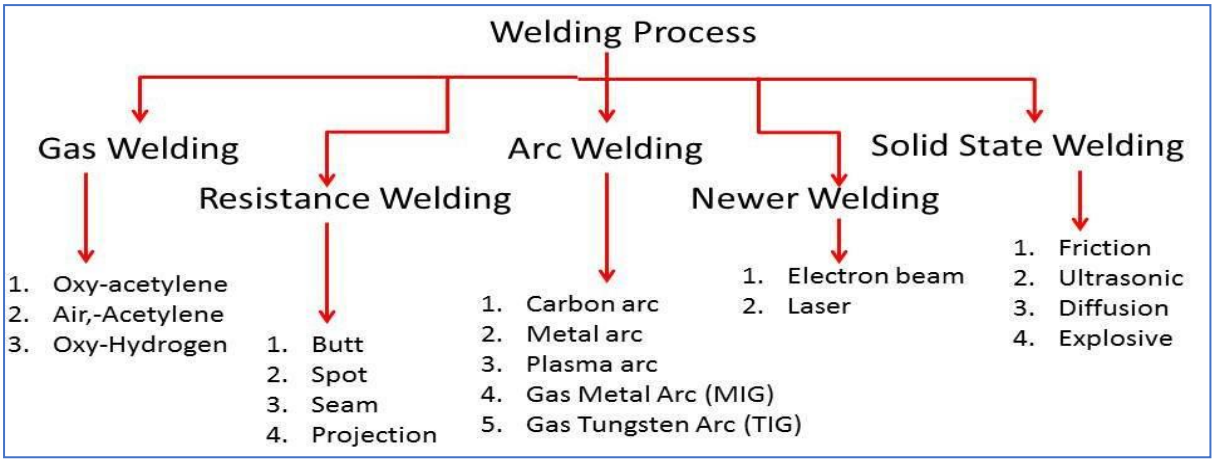

Figure 1: Types of Welding illustration in flow chart

The main focus of our research area based on thermit welding, where it is used to maintenance and improvements of railway tracks.

2. Advantages & Disadvantages of Welding Process:

2.1. Advantages:

1. A good weld will be stronger than the parent or base metal.
2. Faster process compared to riveting and casting.
3. Complete rigid joints can be provided with the welding process.
4. Applicable to all metals and alloys.
5. Difficult shapes can be produced by welding.
6. Welding equipment is portable and can be easily maintained.
7. No noise is produced during the welding process as in the case of riveting.
8. The welding process requires less workspace in comparison to riveting.
9. Any space of the joint can be made with ease.

2.2. Disadvantages:

1. Gives out harmful radiation, fumes, and spotless (a sudden sprinkle of spark).
2. Joints of welding are additional breakable.
3. Results in distortion and induces internal stresses.
4. It needs certain jigs and fixtures to hold metals properly.
5. Skilled workers and electricity are needed for welding.

3. Discussion on Thermit Welding:

Exothermic welding also known as exothermic bonding, thermite welding (TW) and thermit welding is a welding process that employs molten metal to permanently join the conductors. It is a fusion welding process where exothermic heat produced by a chemical reaction of thermit mixture of metal oxides is used for welding **[3,4].** The base metals are brought to plastic state and mechanical pressure is applied to complete the weld **[15].** In the process of exothermic welding, dust of Al powder reduces the oxide of a different metal mostly iron oxide since Al is highly reactive. Fe (III) oxide is commonly used:

$$Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$$

The products are Al_2O_3, gratis elemental iron in addition to a large amount of heat **[8].** The reactants are generally powdered and assorted with a binder to keep the material solid and prevent separation **[9].** The thermit welding process is worn in a restrictive manner. However, in the past, thermit welding was used widely for repair work.

4. Literature Review:

In this paper, the literature is done on the basics of thermit welding which uses in the field of various sectors to superiority of welded rail joints alumino-thermic modus operandi is described [12]. It is extremely important that the quality of mictures intended for welding corresponds of types and course group of rails. The review papers are given below in the following Table 1 with the effective area where it is dealt with-

Table 1: Review Papers Consecutively:

Sl No	Title of the Paper	Author	Area
1	Ultrsonic Testing of Aluminothermic Welded Joints of Rail Tracks	B. Sladojevic	Manufacturing with Railway
2	Thermite Rail Welding: History, Process Developments, Current Practices and Outlook for the 21st Century	C. P. Lonsdale	Manufacturing with Railway
3	Study of Heat Affected Zone (HAZ) in Friction Welding Process	Moarrefzadeh	Manufacturing
4	Analysis of the Causes of the Cracks in the Thermit Welds of the Tram Rails Type 60R2	K. Dariusz	Manufacturing with Railway
5	Recent Trend of Welding Technology Development and Applications	O. Kenj, M. Masatoshi	Manufacturing
6	A Study on Metal Transfer Mechanism in	T. Choudhary	Manufacturing

	Gas Metal Arc Welding	K. Chaudhary	
7	Parametric Optimization of Gas Metal Arc Welding Process by Taguchi Method on Weld Dilution	M. Aghakhani E. Mehrdad, E. Hayati	Manufacturing
8	Finite-Element Simulation of Aluminum Temperature Field in Laser Welding	Moarrefzadeh	Manufacturing
9	Trends in Rail Welding Technologies & our Future Approach	K. Saita, K. Karimme M. U. K. Iwano, T. Y. K. Hiroguchi	Manufacturing with Railway
10	Shielded Metal Arc and Thermite Welding effect to Residual Stress, Hardness and Crack of R54-Rail Weld Joint	Yurianto, G. D. Haryadi, Nugroho, Sulardjaka, S. A. Widayanto	Manufacturing with Railway
11	A Review on Advance Welding Processes	K. Chaudhary	Manufacturing
12	Submerged Arc Welding-A Review Paper	M. Hassan, S. K. Jha, V. Pandey	Manufacturing
13	Numerical simulation for thermal and electrical optimization of Submerged Arc Welding (SAW) process	Moarrefzadeh	Manufacturing
14	Optimal Parameter Determination on Friction Stir Welding Process of AA6061 using Grey Taguchi Method	P. Gopu, M. D. Anand	Manufacturing
15	Heat transfer modelling of rail thermite welding	Y Chen, F V Lawrence, C P L Barkan, J A Dantzig	Manufacturing with Railway

In the railway tracks, most articles of Thermit Welding are used for selection to perform better surface finish of the railway tracks and also absorb the HAZ **[11]. Chart 1** shows that the little bit of papers in print which were practical to the various sectors of Thermit Welding-

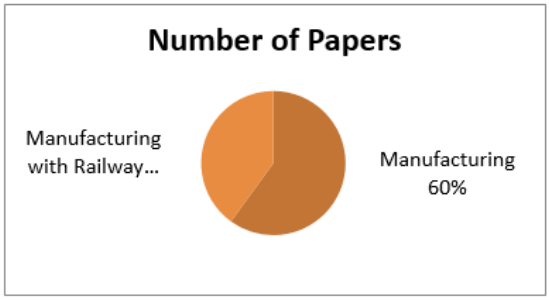

Chart 1: Percentage shows for the use of Thermit Welding in Railway Tracks

5. Applications of Thermit Welding:

I. Welding of rails, rail tracks, side frames of locomotives, engine cross heads, connecting rods, crank shafts and driving wheels.
II. Repairing of teeth on gears and pinions and spokes of driving wheels.
III. Welding of pipes, cables, conductors and shafts.

IV. Broken frame on machines
V. Defective portions of casting such as shrinkage cavities can be filled by thermit welds.

6. Conclusion:

In this paper, an effort has been made to appraisal and analyzed the study of different papers of Thermit Welding. The articles used in different areas somewhere thermit welding of manufacturing were inserted. Thermit welding is one of the most important applications to do the useful of railway tracks. Here the analysis has been made to about the sectors where thermit welding technology is mostly aided and to observe the working gap analysis in the literature review portion. So, after the observation it concluded that the Thermit Welding is mostly used **for manufacturing of railway tracks** to analysed and deduce the advanced effectiveness.

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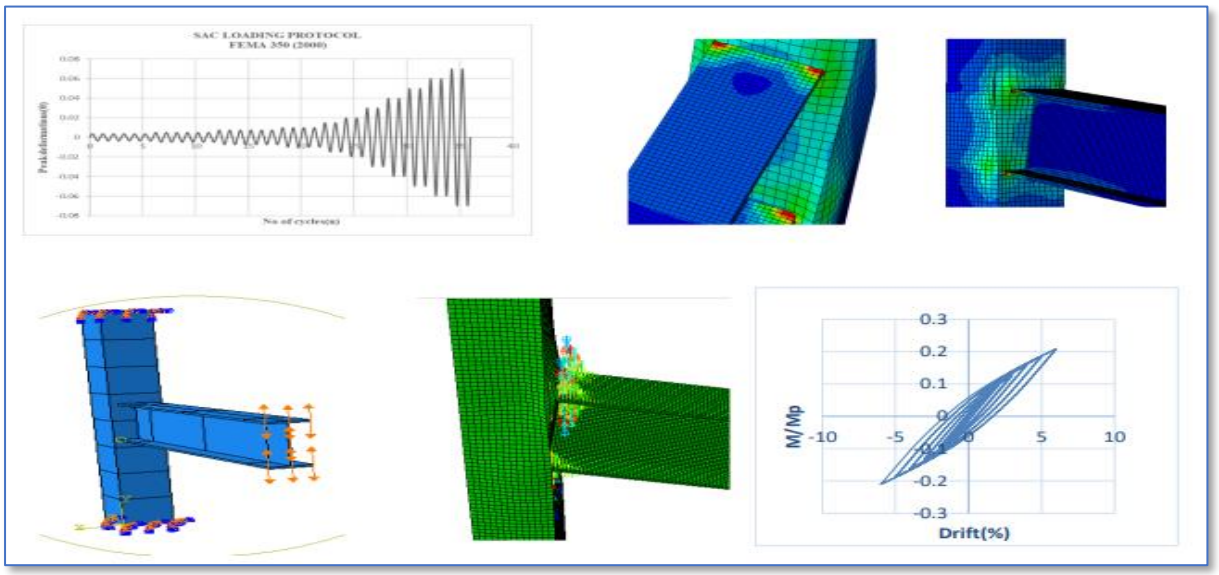
Improving Seismic Behaviour of Steel Moment Frame Beam-Column Connections

Subhrajyoti Mandal

Lecturer, Department of CE, RIST

Structural steel moment frames are used as a part of the seismic force-resisting system in high seismic regions. But, after the 1994 Northridge and 1995 Kobe earthquakes, severe damages incurred in the beam-column connections in these moment frames caught attention. The beam-column connections in buildings during the above seminal earthquakes were mainly due to moderate imposed inelastic demands. Typical failures included the fracture of the bottom beam flange-to -column flange complete joint penetration groove welds, cracks in beam flanges and cracks through the column section. Adopting capacity design criteria and strong column-weak beam philosophy are intended to develop strength hierarchy between structural actions within a member and across members during strong earthquake shaking; members are expected to fail predominantly in ductile flexural actions and ductile flexural actions are expected to occur in select members like ends of beams and column bases. AISC pre-qualified connections developed following the above design method through



extensive experimental and analytical testing post-Northridge earthquake, are recommended to be provided in steel moment frames to help resist future earthquakes reasonably well.

Of the available steel connections, the most common is the I-Beam to Wide Flange (WF) I-Column connections (IBIC). Investigations on seismic behaviour of I-Beam to Hollow Box Column connections are reported in literature. This paper presents numerical investigations on AISC pre-qualified WUF-W (Welded Unreinforced Flange-Welded Web) connection. Numerical studies on WUF-W beam-column sub-assemblages are performed in commercial finite element software ABAQUS for the purpose, to propose improvements in the WUF-W connection for any short comings in its seismic behaviour.

Sections selected are WF for beams and Hollow Box for columns subjected to cyclic displacement-loading conforming to AISC cyclic loading protocol. Mode of failure of the pre-qualified connection is studied and improvement proposed in connection detailing based on the hysteretic response of the members and connection.

Deregulated Power System in Electricity Markets of India

Dr. Arindita Saha
Assistant Professor, Department of EE

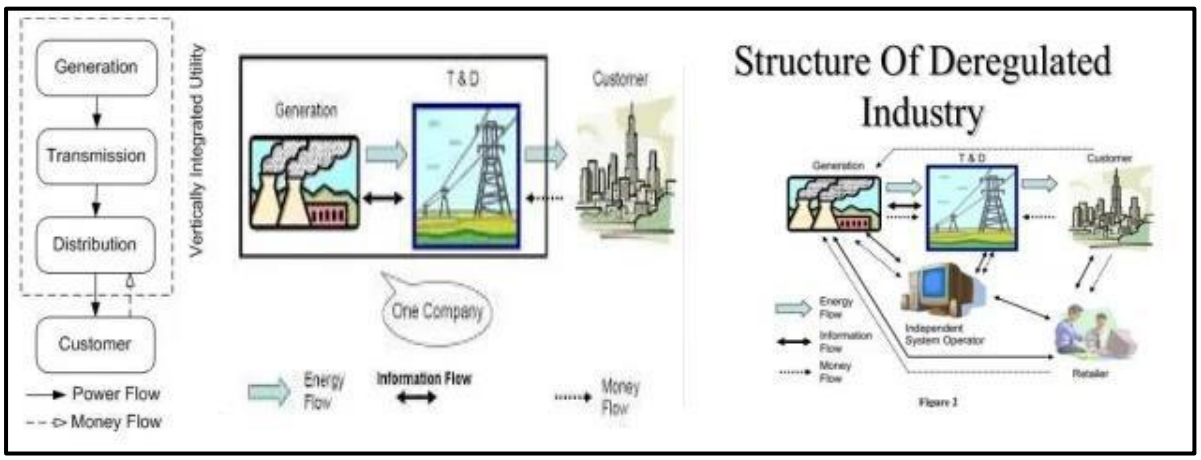
In the present era, there is a huge upsurge in power demand which calls for an increase in power supply to meet the necessities. As per the previous vertical structure of the power system, there is a single company which looks after the generation, transmission and distribution. But, due to the present increase in demand, it becomes problematic for a single company to handle each task. In order to maintain quality and reliable power supply, it is needed to encourage competition in electricity markets, thus breaking the age-old monopoly of a single association. This is possible by inculcating restructuring and deregulation in the power system. Deregulation is stimulating the alteration in power system assembly by involving the private applicants and growing the customer part in pool electricity markets.

Reasons for market deregulation

1. Inspire economic development:

Deregulation includes eliminating laws and guidelines for original trades hence increasing competition in the market. Involvement of more

business in market leads to more economical activities thus economic upliftment.



2. Inspire invention: Since deregulation rises competition, organizations must be advanced if they are to triumph over other companies and rule the marketplace.

3. Confirm business independence: In deregulated power systems organizations can carry out businesses without worrying about government regulations. So, companies can launch new varied products, have tough competition with different companies or become partners, and also network with consumers without any distress of being accused.

Advantages of deregulation

1. It inspires economic action because it eradicates limitations for new traders to enter the market, which grows competition.

2. Since there is added competition in the market, it advances novelty and rises market development as businesses contest with each other. When added businesses contest with each other, charges go down for clients.

3. Firms no longer need to use resources and money to meet limitations and obey guidelines. They can utilize the possessions to finance in research and progress.

4. Trades can function without worrying about limitations and regulations to administer them. They are permitted to produce original goods, set their own charges, endeavour into foreign countries, and interrelate with clients without limitations to hold them back.

Challenging structure from the restructuring of India

1. Odisha Model

Orissa was the first Indian state to undertake the reform program as soon as the State Electricity Reform Act became operative in April 1996. Soon after that, the Orissa State Electricity Board is partly dispersed into three different units namely Orissa Hydro Power Corporation OHPC, Orissa Power Generation Corporation OPGC and Grid Corporation of Orissa GRIDCO. Generation and distribution have undergone privatisation in different phases. Generation was foremost privatized in June 1998. AES had purchased a 49% share in OPGC. During the second phase, the distribution of possessions, belongings and employees of GRIDCO is fragmented into four distribution corporations. BSES purchases three of them (NESCO, WESCO and SOUTHCO) in April 1999 and one (CESCO) is shifted to AES Transpower (a joint venture of

AES and Jyothi Structures Ltd) in September 1999.

2. Delhi Model

The Delhi Electricity Reform Act comes into strength in March 2001. After two months, the state electricity board, Delhi Vidyut Board DVB has launched six main organizations namely holding organization, generation organization, transmission organization and three distribution organizations to be functional. Here, in Delhi, distribution was first privatized where 51% of the equity in three distribution organizations was sold to two private companies in India: BSES and Tata Power. DVB was replaced by holding, generation and transmission organizations. Holding organization holds all unusable responsibilities.

3. Andhra Pradesh Model

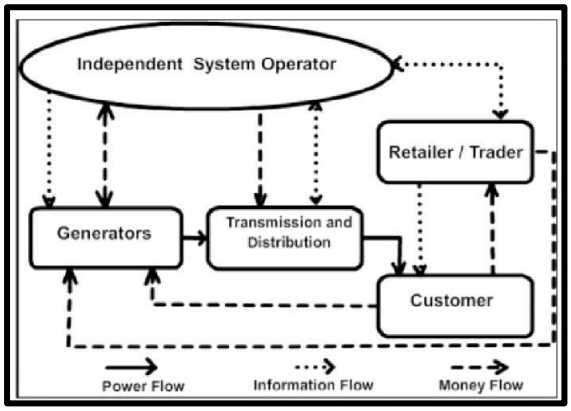
In Andhra Pradesh the state reform act came into action in February 1999. Andhra Pradesh State Electricity Board dispersed into Andhra Pradesh Generation Company Ltd. and Andhra Pradesh Transmission Company Ltd. In April 1999, the Andhra Pradesh Electricity Regulatory Commission has been effective.

4. Haryana Model

In Haryana, the State Reform Act was effective from 14.08.1998. SERC became operative w.e.f. 17.8.1998. SEB dispersed into Haryana Vidyut Prasaran Nigam Ltd., a Trans Co. (HVPNL) and Haryana Power Corporation Ltd. Two Government possessed distribution corporations viz. Uttar Haryana Bijli Vitaran Nigam Ltd. (UHBVNL) and Dakshin Haryana Bijli Vitaran Nigam Ltd. (DHBVNL) have been recognized. Until these two corporations become autonomous, they will function as companies of HVPNL.

5. Uttar Pradesh Model

In Uttar Pradesh, the State Reform Act was effective from 15.01.2000. According to the verdict of the Government of Uttar Pradesh, the actions of generation, transmission and distribution of former UPSEB have been handed over to: Uttar Pradesh Rajya Vidyut Utpadan Nigam Ltd. (UPRVUNL), Uttar Pradesh Jal Vidyut Nigam Ltd. (UPJVNL), Uttar Pradesh Power Corporation Ltd. (UPPCL). UPPCL looked after the transmission and distribution roles of former UPSEB.



Electricity improvement procedure in India is by now in action but at a sluggish step. Some state electricity boards are being dispersed into three different organizations namely Generation, Transmission and distribution. The system operation performed at the regional or national level can be with a central transmission utility, whereas state transmission utilities may accomplish load dispatch centres along with TSO.

The Future Aspects of Chalcogenide Glass Systems

Dr Dipankar Biswas
Associate Professor & HOD, Department of ECE

Introduction

In recent times, Chalcogenide glasses, and thin films have attracted the attention of many researchers owing to their potential applications in IR optics, photonics devices, reversible optical recording, antireflection coating, photovoltaic solar cell, optical data storage, remote sensing, and energy conversion devices [1-3]. These materials exhibit large non-linear properties with an order of two times larger than that of the standard glasses. Due to their high refractive index (ranging between 2.0 and 4.0) and optical band gap lying in the sub-bandgap region, chalcogenide glasses are used as core materials for optical fibers which are further used for transmission and also used as eminent semiconductor materials. One of the most beneficial characteristics of these materials is phase-change optical memory technology. Phase change recording materials are designed to have at least two structural forms, amorphous and crystalline, which can coexist at room temperature. Phase change applications utilize differences in optical and electrical properties between the amorphous and crystalline phases of the same material. Optical storage applications utilize small differences (approximately 20%) in reflectivity, while electronic applications utilize a large difference (a factor of approximately 10^3) in electrical conductivity. These materials can be optically switched between the amorphous and crystalline states by the energy contained in a laser beam. Infrared optical fibers operating at the 2–12 μm wavelength region are required for infrared sensing applications such as radiometric thermometry, and CO_2 laser power applications such as laser surgery [4]. The Te-based chalcogenide glasses are used for such applications because their infrared absorption edges are located in a wavelength region above 12 μm

controlled incorporation of impurity, which is used in the fabrication of glassy semiconductors. These impurity atoms are supposed to satisfy all the valence requirements when they enter the glassy network and therefore are not supposed to play the role of acceptors or donors. The effect of impurity atoms in chalcogenide glasses depends upon the composition of the glasses and the value of impurity content. Several authors have reported the impurity effects on structural, optical and electrical properties in various chalcogenide glasses [5-6]. In recent times, emphasis has been given to the research of metal-incorporated quaternary chalcogenides systems. Besides that, TM (Transition metal) doped chalcogenides gained worldwide attention and are being researched in medical science also as these materials possess some antibacterial effects. This doping improves the characteristics of the multifunctional device materials and full filling the purpose of increasing efficiency.

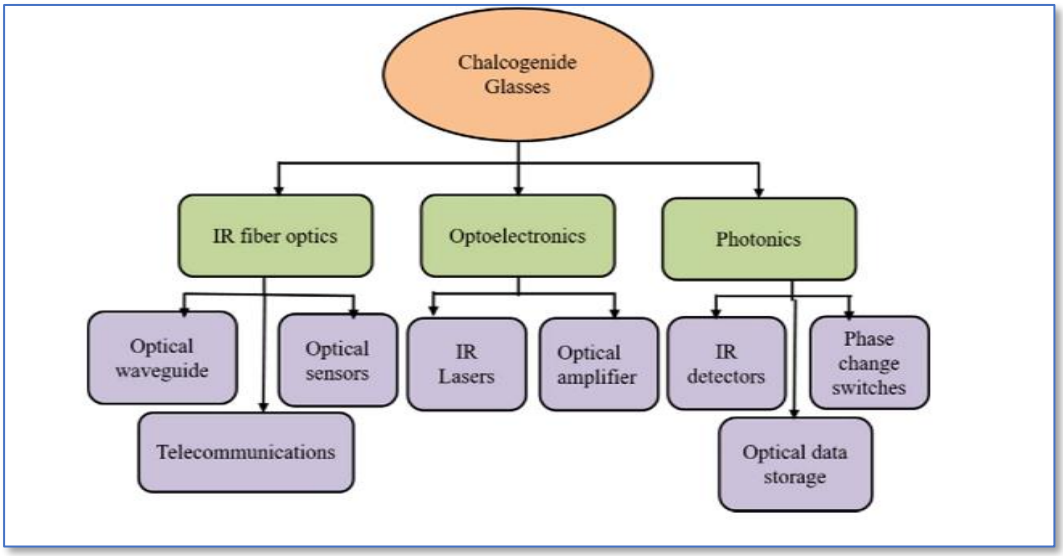
Sample Preparation (glass and thin films)

Chalcogenide glassy bulk samples have been prepared by using the well-known melt quenching method through stoichiometrically mixed highly pure constituents. The properly weighed assortments have been sealed within quartz ampoules under vacuum conditions and placed inside an electric furnace. At first, the temperature of the furnace have been raised rapidly up to 400°-500° C, then the furnace has been heated at a slower rate of 4° C /min till 1000°C-1200°C depending upon the composition of the sample. The temperature of the furnace has been kept at the final temperature for 8 hrs. To attain the homogeneity of the melt properly a ceramic rod has been rotated slowly within the melt. Then the ampoules are taken out from the furnace and quenched with ice water. The powdered sample was kept on the molybdenum boat inside the coating unit. The prepared films are deposited on a glass substrate. The thin films are prepared by the thermal evaporation method with a vacuum coating unit on a glass substrate. The pressure of $\sim 5 \times 10^{-5}$ Torr has been maintained inside the chamber and the substrates are rotated at a slow speed continuously. The crystal thickness monitor attached to the coating unit controls the deposition rate of 0.5 nm/sec to make the desired thickness.

Scope of Work:

One of the parts of the investigation is to study the spectroscopic properties of the chalcogenide glass/ thin films. The absorbance data of the investigated sample are recorded by using a UV-Vis spectrometer. By deploying Tauc's parameter the optical band gap energy can be determined. The obtained energy band gap provides the necessary information regarding the semiconducting property of the material under study. By knowing the optical band gap energy and refractive index, the applicability of the material for different photonic applications like photovoltaic cells, solar cells, optical switches, etc. can be determined. By applying some empirical equations refractive index and polarizability of the material can also be calculated from the optical band gap energy data. The oscillator energy of the material can be determined by deploying the dispersion energy data.

The transitivity and reflectivity of the prepared glass/ thin films can be inspected. By examining these data, the transmission property in the visible, ultraviolet, the near-ultraviolet region can be analyzed. Besides that, some important optical parameters like absorption coefficient, extinction coefficient, the VELF and SELF functions, optical conductivity, skin depth etc can be determined. By analyzing these parameters of the material, different application domains like IR lances, Fiber infrared (IR) lenses, optical communication devices, waveguides, etc. can be explored, which is extremely significant in the technological aspect. The scope in the different application domain of these materials are furnished below



Conclusion:

Thus it has been concluded that the preparation and investigation of chalcogenide bulk glassy samples or, thin films are extremely important from theoretical as well as technological points of view. By improving the properties of chalcogenides, the efficiency of some equipment like lasers, optical sensors, and amplifiers, can be improved which will help to improve several sectors of science and technologies.

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A Mathematical Poem: Fourier's Theorem

Dr. Saurav Ganguly

Assistant Professor, Department of ECE

In the year 1822, a French mathematician, Jean Baptiste Joseph Fourier in the developmental study of a problem of heat flow showed that any arbitrary periodic function may be represented by an infinite series of sinusoids of harmonically related frequencies.

The above statement seems quite obvious today, to the students and experts of engineering studies and applications, but the scientific community of the early 19th century Europe were taken aback by the outstanding statement. Nevertheless, it was not accepted enthusiastically at all when it was presented. In fact, Fourier could not get his results published as a paper.

During his lifetime, Fourier was better known as a serious Egyptologist and able government official than as an able mathematical physicist. Today, we remember him by the mathematical tools that bear his name. In electrical engineering, it is central to the areas of communication, signal processing and several other fields, including antennas. Any alert students of 2nd year onwards in electrical or electronics engineering can identify its applications in circuit theory, signal analysis, etc

But actually, Baron Fourier did not have any idea about signals and systems at the time of his proposition and only tried to solve a partial differential equation leading to heat flow due to diffusion. At that time, Fourier series representation also helped to completely solve and understand the mechanics of vibration of strings. Here, I make an effort to represent a brief historical note on Baron Fourier and the problem of heat flow and vibration of strings which are mostly unknown to the students and undergraduates nowadays. One will be astonished to see that we get the same look alike differential equations in RLC circuits, heat flow and string vibration. In the early 19th century, no solutions of these partial

differential equations were available. Fourier series representation was the first positive attempt for solving the specific partial differential equations. Although, at as early as 1740s, mathematical physicists Leonhard Euler and Daniel Bernoulli first suggested the existence of an infinite series of sinusoidal nature while developing the mathematical analysis of vibrating musical strings. However, Bernoulli and Euler were unable to determine the values of the coefficients of the series.

The discussion presented here would be purely qualitative as much as possible, attempting to dodge all mathematical rigour.

Fig.1. Baron Jean Baptiste Joseph Fourier (1768-1830)

[Picture Courtesy, 'Men of Mathematics', Bell E. T; Simon and Schuster, New York, 1937]

Life and Work

The concept of using sums of harmonically related sines or cosines or periodic complex exponentials to describe periodic phenomena goes back as far as the Babylonians, who used these ideas to predict astronomical events.

The modern history of the subject began in 1748 with Leonhard Euler, who examined the motion of a vibrating string. When one plucks a violin or a guitar string, the vibration of it exhibits sound, due to their hollow case. The oscillating string vibrates the surrounding medium (air) and waves are produced. The speed of these waves depends on the tension of the string and mass density. The frequencies we hear depend on the string shape or the allowed wavelengths. These systems are governed by partial differential equations, more precisely in this case, by a one-dimensional wave equation.

In 1742, Jean le Rond d' Alembert (1717-1783) derived the wave equation for a vibrating string of length l, rigidly clamped at two ends at x = 0 and x = l as:

$$\frac{\delta^2 y}{\delta t^2} = v^2 \frac{\delta^2 y}{\delta x^2}$$

with the subsequent boundary constraints as;

y(x,0) = f(x)

y(0,t) = 0

y(l,t) = 0

$$\frac{\delta y}{\delta t}(x,0) = g(x)$$

Where y is the vertical deflection (plucked or bowed) of the string at time t and at a distance x along the string. v is velocity of the wave.

In 1753, Daniel Bernoulli viewed the solution as the superposition (i.e., summation) of simple harmonics. Such superposition amounted to looking at solution of the form:

$$y(x,t) = \sum_k a_k \sin\left(\frac{k\pi x}{\ell}\right)\cos\left(\frac{k\pi vt}{\ell}\right)$$

Where the string extends over the interval [0,l] with fixed ends at x=0 and x=l. The initial conditions of these superposition are:

$$y(x,0) = \sum_k a_k \sin\left(\frac{k\pi x}{\ell}\right)$$

Where a_K, for k=0, 1, 2,…… are the coefficients of the harmonics.

Thus, the solution consists generally of an infinite series of trigonometric functions. Bernoulli argued on physical grounds that all physical motions of a string could be represented by linear combination of normal modes, but he did not pursue this with further mathematical competency.

The simplest mode of vibration occurs when the string vibrates as a whole, as shown in fig. 2. In the first case or mode, $\ell = {}^{\lambda_1}/_{2}$ i.e., $\lambda_1 = \ell$. In the next mode, the string vibrates in two segments, as shown in the second pic. from the top. Hence $\ell = \lambda_2$. In the third mode, the string vibrates in three segments so that $\lambda_3 = {}^{2\ell}/_{3}$. When the string vibrates in four segments, then $\lambda_4 = {}^{2\ell}/_{4} = {}^{\ell}/_{2}$ and so on. When the string vibrates in one segment, the frequency emitted by it under a given tension T and mass m, is the lowest and the note is $f_1 = {}^{1}/_{2\ell}\sqrt{\frac{T}{m}}$. f_1 is known as the *fundamental frequency*. When it is vibrating in two segments, the frequency is doubled and the corresponding note is its *second harmonic* $f_1 = 2 \times {}^{1}/_{2\ell}\sqrt{\frac{T}{m}} = 2f_1$. In the third mode of vibration, the frequency is thrice that of the fundamental and the note is called the *third harmonic* $f_3 = 2 \times {}^{1}/_{2\ell}\sqrt{\frac{T}{m}} = 3f_1$ and so on. In general, if the string vibrates in n segments, then the

frequency of vibration is n times that of the fundamental and the corresponding note is the n^{th} harmonic, given by $f_n = 2 \times {}^{1}/_{2\ell}\sqrt{\frac{T}{m}} = nf_1$. Hence, a string is therefore capable of emitting a full harmonic series, that is, a fundamental f_1 and all its multiples.

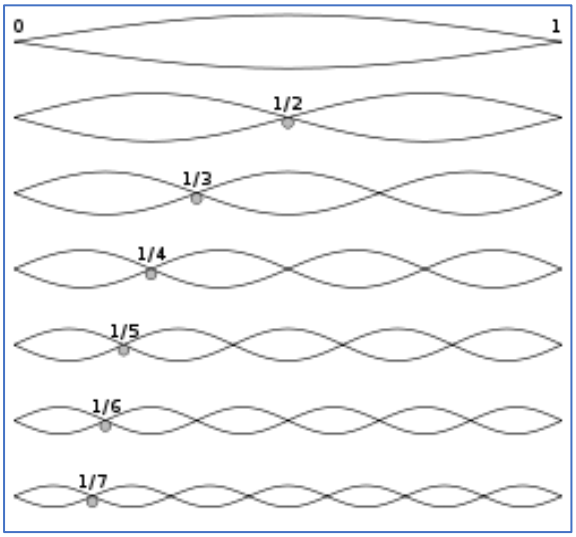


Fig 2. Normal modes of a vibrating string

Bernoulli's ideas were not widely accepted at that time. In 1759, J. L Lagrange strongly criticized the use of trigonometric series in the examination of vibrating strings. His criticism was based on his own belief that it was impossible to represent signals with corners i.e., with discontinuous slopes using trigonometric series. Since such a configuration arises from vibrating string, Lagrange argued that trigonometric series were of very limited use.

It was in this somewhat argumentative and incredulous environment that Jean Baptiste Joseph Fourier presented his ideas half a century later.

Fourier was born on March 21, 1768, in Auxerre, France about 100 miles southeast of Paris. Fourier was the ninth of twelve surviving children born to the tailor Joseph Fourier and his second wife. Little is known of Fourier's early childhood beyond the fact that he became orphan before his ninth birthday. A Madam Moitton rescued the orphaned Fourier from total misfortune by paying his tuition at the Ĕcole Royale Militaire, the local military school run by the Benedictine order. It was here that Fourier first discovered the joys of mathematics, devoting all of his spare time to his newfound joy. He was preparing for a career as a military officer after graduation, but the Benedictines prevailed upon the young genius to choose the priesthood as his profession. He became a novice at the Benedictine abbey of St. Benoit –sur-Loire in the town of Fleury, near the city of Orleans. In short time, he was put in charge of the abbey's teaching programme.

Fourier's first significant mathematical research was conducted at abbey. In 1789, he submitted a paper on a problem in the theory of equations to the Academy of Sciences in Paris. The noted mathematicians Adrien-Marie Legendre and Gaspard Monge recommended the paper for publication in the fall. However, the paper's publication was disenchanted, when, on July 14, 1789, a mob stormed the Bastille and the French revolution began. Fourier matched his actions with his passions and supported the revolution by joining the people's party. He left the abbey and returned to his hometown to join at Auxerre's municipal committee on surveillance, which was charged with enforcing government decrees. But in its early days, the French revolution, like most revolutions of its kind, liquidated a large segment of intelligentsia, including outstanding scientists such as Antoine Lavoisier (a French nobleman, considered as the father of modern Chemistry). This maltreatment caused many intellectuals to leave France to save themselves from the rapidly rising tide of barbarism.

Disheartened, Fourier aligned himself from fundamentalist revolutionary Jacobin Party and its leading Jacobin, Robespierre. But at the national convention, the Jacobins overpowered the more tolerant and liberal Girondist Party and the guillotinisation continued.

Fourier started losing enthusiasm on the revolution and actively moved up to protect Auxerre's citizens from the reign of terror that Robespierre and his committee of public safety inflicted on France. In 1794, Fourier's stinging criticism led the committee to issue a decree for his arrest and execution by the guillotine.

Fourier narrowly escaped guillotine as the public outcry in his support was so great that the order was repealed. Eight days later, however, Fourier was arrested and imprisoned after the order was reinstated under the pressure of the committee of public safety in Paris. But again, Fourier narrowly escaped guillotine as the reign of terror suddenly ended when Robespierre and other leading Jacobins were arrested and executed by the more liberal Girondist party, which took over the control of the administration. A general amnesty followed and Fourier was released.

The new government that replaced Robespierre was, in many respect no better than its predecessor. It suspected conspiracies around every

corner. It arrested Fourier again because of his earlier Jacobin connections although Robespierre himself had ordered Fourier's guillotine.

It was to the everlasting credit of Napoleon Bonaparte that he stopped the discrimination of the intelligentsia and founded new schools to restock their ranks.

The 26-year-old Fourier was appointed chair of mathematics at the newly created school Ĕcole Normale in 1794. The Ĕcole Normale offered a wide range of course taught by the best scholars in France. Its mathematics faculty included the renowned mathematicians like Joseph Louis Lagrange, Pierre Simon de' Laplace and Gaspard Monge.

In 1797, Fourier succeeded Laplace as professor of analysis and mechanics even though he had hardly completely any original research in physics or mathematics. In 1798, he published a vastly simplified proof of the Descartes' rule of signs.

The success of his first publication was short lived and his teaching/research career was suddenly interrupted as in 1798 itself, he was chosen as a scientific member of an expedition to Egypt, headed by Napoleon.

Fourier proved to be a capable administrator of the newly formed Institut d' Egypte, which incidentally was responsible for the discovery of the Rosetta Stone. The inscription on this stone in two languages and three scripts (hieroglyphic, demotic and Greek) enabled Thomas Young and Jean Francois Champollion, a protégé of Fourier, to invent a method of translating hieroglyphic writings of ancient Egypt.

In the few months they had spent together on the expedition, Napoleon had become impressed with Fourier's diplomatic, scientific and military talents. By 1801, Napoleon had assumed absolute power in France and appointed Fourier as the prefect of Isère (with its headquarters in Grenoble, near the Italian border). Fourier served the position with distinction and in 1809; Napoleon elevated Fourier to the title of Baron.

While diligently acting as a prefect, Fourier yearned to be free of governmental responsibilities so that he could pursue his scientific interests. He began to suffer bad attacks of rheumatism in Grenoble's chilling winds.

Somehow, Fourier found enough time in 1807 and carried on his elaborate investigation on propagation of heat in solid bodies. Later that year, he presented an essay

entitled on the propagation of heat in solid bodies to the Institut de' France. This essay was an antecedent to the analytical theory of heat that would appear fifteen years (1822) later, which led him to the Fourier series and Fourier integrals (transform). But his ideas were rejected in 1807.

Finding few rewards to his scientific researches, Fourier turned his attention to the multivolume Description of Egypt, for which he was the general editor. It ultimately ran to twenty volumes and took twenty years (1808-1827) to complete.

Later, when Napoleon was exiled to Elba, his route was to take him through Grenoble. Fourier had the route changed to avoid meeting Napoleon, which displeased the new king Bourbon Louis XVIII. Within a year, Napoleon escaped from Elba and reconsolidated himself as the king. He visited Grenoble where Fourier was brought before him chained, as he was a part of the earlier monarchy (a year back) that was against Napoleon. But he only scolded Fourier for his ungrateful behaviour and reappointed him as the prefect of Rhone at Lyons. Within four months, Napoleon was defeated at the 'battle of Waterloo' by the combined forces of Great Britain, Austria-Hungary and Prussia led by the great captain Nelson and was exiled to St. Helena, where he eventually died due to slow poisoning. On July 8, 1815, king Louis XVIII re-entered Paris and the Bourbon monarchy was re-established.

Fourier once again was in ignominy as a Bonapartist and had to wager his effects to keep himself alive. But through the intervention of a former student, The Comte de Chabrol de Volvic, who was now a prefect of Paris, he was appointed as the director of the statistical bureau of the Seine, a position that allowed him ample time for scholarly pursuits. Later, in 1827, he was promoted to the perpetual secretary of the Paris Academy of Science.

On May 4, 1830, Fourier was stricken with severe attack of rheumatism. He died on May 16, 1830 due to nervous angina and heart problems. He never married, although his acquaintances said he was extremely fond of the company of intelligent women, among them Sophie Germaine was a first prominent female mathematician.

Propagation of heat in solid bodies

The physical motivation for Fourier's work was the phenomenon of heat propagation and diffusion. Astonishingly, the differential equation of it was that of the wave equation, similar to that of vibrating strings, but in three dimensions, as:

$$\frac{\delta y}{\delta t} - \alpha \nabla^2 y = 0$$

Where ∇^2 is the Laplace operator and α is a constant.

In 1807, Fourier had found a series of harmonically related sinusoids to be useful in representing the temperature distribution through a body. He also claimed that 'any' periodic signal (function) could be represented by such series. While his treatment of this topic was significant, many of the basic ideas behind it had been discovered by Euler, de' Alembert and Bernoulli earlier, while investigating vibration of strings. Fourier's mathematical arguments were still inaccurate and it remained for P. L Dirichlet in 1829 to provide precise conditions (Dirichlet's conditions) under which a periodic signal could be represented by a Fourier series. However, he did have the clear insight to see the potential for this series representation and it was to a great extent his work and his claims that spurred much of the subsequent work on Fourier series.

In addition, Fourier took this type of representation a large step further than any of his predecessors; he obtained a representation for aperiodic signals, not as weighted sums of harmonically related sinusoids, but as weighted integrals of sinusoids that are not all harmonically related. This extension from Fourier series leads to Fourier integrals or Fourier transform. Both of these methods remain the most powerful tools in analyzing the LTI systems.

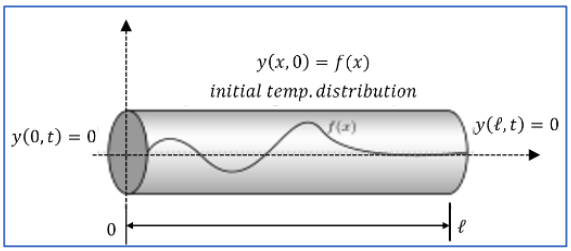


Fig. 3. Idealized physical setting for heat conduction in a rod with homogenous

The solution technique of the heat equation was proposed by Fourier in his treatise Théorie analytique de la chaleur, in the year 1822.

This immediately gives the coefficient a_k of the trigonometric series $y(u)$ for any function which has such an expansion. Under suitable convergence assumptions,

the integral $a_k = \int_{-1}^{+1} y(u)\, cos(\frac{\pi y}{2})\, dy =$ $\int_{-1}^{+1} [a_1\, cos(\frac{\pi y}{2})\, cos(2k+1)\frac{\pi y}{2} +$ $a_2 cos\frac{3\pi y}{2}\, cos(2k+1)\frac{\pi y}{2} + ...]$ can be carried out term-by-term. But all terms involving $cos(2j+1)\, cos(2k+1)$ for $j \neq k$ vanish when integrated from -1 to $+1$, leaving only the k^{th} term.

In these few lines, which are close to the modern formalism used in Fourier series, Joseph Fourier revolutionized both Mathematics and Physics.

Four distinguished mathematicians and scientists were appointed to examine the 1807 paper of Fourier. Three of the four- S.F Lacroix, G. Monge and P.S de Laplace were in favour of publication of the paper, but the fourth, J.L Lagrange, remained adamant in rejecting trigonometric series, as he had done fifty years earlier. Because of his vigorous objections, Fourier's paper never appeared. After several other attempts to have his work accepted and published by the Institute de France, Fourier undertook the writing of another version of his work, which appeared as the text *Théorie analytique de la chaleur*. This book was published in 1822, fifteen years after Fourier had first presented his results to the Institute.

Fourier demonstrated that any arbitrary function $f(x)$ can be expressed in the interval $[-\pi, +\pi]$ as an infinite trigonometric series as;

$$a_0 + \sum_{n=1}^{\infty} a_n \cos(nx) + \sum_{n=1}^{\infty} b_n \sin(nx)$$

The above equation is similar to that as predicted by Bernoulli in 1753, but he was unable to determine the values of the coefficients. Determining their values was Fourier's great accomplishment. In the 1807 essay, Fourier had demonstrated the followings:

$$a_0 = \frac{2}{\pi} \int_{-\pi}^{\pi} f(x)dx$$

$$a_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \sin(nx)dx$$

$$b_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \cos(nx)dx$$

Fourier's ideas not only solved the partial differential equation for heat propagation, it also gave birth to the topic of 'harmonic analysis', whose tools were successfully used to completely understand the mechanics of vibration of strings.

Towards the end of his life, Fourier received some of the recognition he deserved, but the most significant tribute to him has been the enormous impact of his work on so many disciplines within the fields of mathematics, physics and engineering. The theory of integration, point set topology and eigenfunction expansions are just a few examples of topics in mathematics that have their roots in the analysis of Fourier series and integrals. There are numerous other problems in physics and engineering in which sinusoidal signals and therefore Fourier series and transforms, play an important role. Sinusoidal signals arise naturally in describing the motion of planets and the periodic behaviour of the earth's climate. Alternating current sources generate sinusoidal voltages and currents and the tools of Fourier analysis enable us to analyze the response of a LTI system or circuit to such sinusoidal inputs. Signals transmitted by the radio and television stations are sinusoidal in nature as well.

Fourier analysis can be elegantly extended to the understanding of discrete time periodic/aperiodic signals and systems as well. Equations for the processing of discrete sets of data points to produce numerical approximations for interpolation, integration and differentiation were being investigated by Sir Isaac Newton in the 1600s. The problem of predicting the motion of a heavenly body, given a sequence of observations of the body spurred the investigation of harmonic time series in the 18th and 19th centuries by eminent mathematicians and physicists including K. F Gauss.

In the mid-1960s, an algorithm known as Fast Fourier Transform (FFT) was discovered. FFT proved to be perfectly suited for efficient digital implementation and it reduced the time required to compute transforms by orders of magnitudes. With this tool, many interesting but previously impractical ideas utilizing the discrete time Fourier series and transform suddenly became practical.

With the help of MATLAB™ programming language techniques, the FFT algorithm simulation to represent the Fourier series analysis of a periodic square wave is depicted in fig. 4, as shown below:

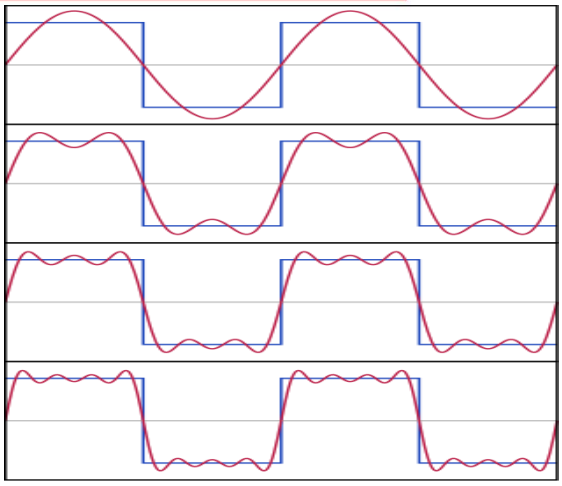


Fig 4. Fourier series representation of a square wave, implemented by MATLAB for $N = 1, 3, 10$ and 20 sinusoids respectively in Fourier series representation.

The determination of the Fourier coefficients, which were done analytically earlier are now computed by various programming languages. The computation is obviously fast and error free.

The coefficients can also be determined by using a parallel LC resonant circuit, by taking the output across the L or C through a cathode ray oscilloscope (CRO) while the input is being connected to a function generator. Keeping in mind that, the exponential form of Fourier series, as written below:

$$f(x) = \sum_{-\infty}^{\infty} C_n e^{jnx}$$

the coefficients of the *fundamental* (for $n = 0$) and the coefficients of the other *harmonics* (for $n = \pm 1, \pm 2, \pm 3, \text{etc}$) can be determined by the parallel LC resonant circuit. The values of L and C are fixed and hence the value of resonance frequency $f_r = \frac{1}{\sqrt{(LC)}}$ is known and fixed too. Let the signal given at the input of the circuit from the function generator is a periodic square wave. Keeping its amplitude fixed, we keep on changing the frequency of the square wave until it matches with the resonant frequency f_r of the parallel LC circuit. As soon as the two frequencies match, a pure sine wave will be observed in the output CRO. Hence, this frequency of the square wave is the fundamental frequency and the amplitude of the sine wave (peak to peak, as measured from the CRO) gives the value of the coefficient at fundamental frequency.

The higher frequency terms (harmonics) and their coefficients of the square wave can be determined in similar way, but as the value of L and C and hence f_r is fixed, we cannot go on increasing the frequency of the square wave from the function generator. Instead, we would decrease it and keep on decreasing until we again observe a pure sinusoid in the output CRO. This reduced frequency now becomes the fundamental frequency and the earlier frequency measured becomes

the first harmonic. The value of the coefficient is determined by measuring the peak-to-peak value of the sinusoid observed from the CRO.

This method of decreasing the frequency of the square wave and determining the harmonics and their coefficients can be continued, but for a normal laboratory setup using standard quality and values of L and C, function generator and CRO, coefficients may be up to five harmonics can be determined.

Fourier's accomplishment in physics revolved around his solution of the problem of heat diffusion in solid bodies. This problem stood outside the scope of rational and celestial mechanics that had dominated physics since the days of Sir Isaac Newton. From this perspective, Fourier's work formed a major achievement in the field of mathematical physics. In the course of his work, he developed a new mathematical technique that would not likely have arisen otherwise. It paved the way for many advances in both mathematical physics and pure mathematics during the remainder of the nineteenth century and remains a primary analytical tool in both areas.

The great British mathematical physicist Lord Kelvin would later write of him.

Fourier's theorem is not only one of the most beautiful results of modern analysis, but it is said to furnish an indispensable instrument in the treatment of nearly every recondite question in modern physics..... ***Fourier is a mathematical poem.***

Suggested Readings

1. Mémoire sur la propagation de la chaleur dans les corps solides - Joseph Fourier, (1807)
2. Mechanical Radiation, Lindsay, McGraw Hill publications, New York (1960)
3. Advanced Acoustics, Raychaudhuri D. P, TNBS (Calcutta), (1992)
4. Acoustic Measurements, Taylor, Archtech House (1952)
5. A Tale of Two Cities, Dickens Charles, Chapman & Hall (London), (1859)
6. Signals & Systems, Lathi B.P, Oxford University Press, (1998)
7. The Analytical Theory of Heat (translated from French), Fourier J. B. J, Cambridge University (1850)
8. High quality sound production, Moir, VN publishers, New York (1928)
9. Signals & Systems, Oppenheim, et al, Prentice Hall of India (New Delhi) 2011
10. God Created the Integers: The Mathematical Breakthroughs That Changed History, Hawking Stephen, Penguin Books (New York), 2007

Dear Little Yani

Anushree Saha

3rd Year, CSE, RERF

"*There is still music in the way you breathe*," somebody whispered, and before she could react, she fell into the dark whirlpool and the alarm rang. It was a fine summer morning, the birds were chirping, and little Yani woke up. She took a bath and got ready for school with her favourite '*aalo ke parathe'* in her tiffin box. The school bus arrived, and as usual, she sat on the leftmost window-side seat in the second-last row. The bus stopped at the petrol pump for a while, and then a pretty lady went in and sat beside little Yani and greeted her "good morning!" with a wide smile. Yani shield and stared at the lady for a while; the bus stopped and the school arrived. All the students went down and rushed toward their respective classes. Yani, amazed by her (the lady's) charm, thought about her subconsciously throughout the day. On her way back home, she wondered if she could meet that lady again.

Many days passed and the summer vacation started. Yani was busy completing her homework. One day, a lady entered her room; Yani turned back and found that it was that lady whom she had met on the bus once. The lady waved her hand and said, "*Hello!! I am your new neighbour, Yani.....* "Before she could finish, little Yani hugged her and said, "Same pinch, my name is also Yani, and I am 6 years old." The lady smiled and said, "I'm Yanika, but if you want, you can call me Yani di." Little Yani was blushing and tried to hide her face with her hands. Yanika comforted her and asked if she wanted to play any games. Little Yani rushed towards the almirah and bought all her toys to show and play with Yanika. Both of them played and talked for hours. From that day, Yanika used to come to Yani's place and help her complete her homework. They used to talk a lot and play many games with each other. Yanika even sang many songs for her. As days passed, their bond became stronger and stronger; Yani started idolizing Yanika. One day, she told Yanika that she wanted to be like her in the adulthood phase. Yanika smiled in relief and murmured to herself, "I'm

glad Yani, thanks for these words. They mean a lot to me. The next day, Yanika gifted a book, beautifully covered with brown paper, to Yani. The little girl was happy to receive a gift from her idol. She wanted to know the story written in the book and asked Yanika to help her out. Yanika opened the book and said it was a story about Inya. Yani clapped and put her head on Yanika's shoulder.

Yanika started, "*Little Inya was a brave girl, whose blood group and nature were both the same, i.e., B+.*" She was smart and intelligent but suffered from autophobia. She was an innocent child with a pure heart. Things were not so smooth in her childhood; she was being bullied for her looks. Although she looked pretty, the other girls in her class didn't find her beautiful. Inya used to handle the situation bravely and studied hard to score good marks. Years passed, Inya's school changed. It was a new place, and the environment was quite friendly. With a lot of hope, she made a few new friends and gradually discovered her passion for the arts and culture, especially music. Soon, music became an integral part of her life.

She used to take part in cultural activities like dance, painting, and music. She also got training in music from a teacher. People used to appreciate and praise her sweet voice. She improved a lot in this field, but with time, her practice time was reduced, and a time came when she had to take a break from music classes, as she was in higher classes in school and her grades suddenly started dropping in the range of good-to-average. She was mentally sad but studied hard to pass out with a decent score. Finally, her exams were over, and she had a long break, which she thought she could use for her passion.

In the beginning, it was hard for her, as her voice was broken and she was out of tune, which further saddened her. But she didn't give up; she practised day after day, which showed some improvement. Later, her college life started, and she got to know new people from different backgrounds and their struggles. Inya finally got motivated and decided not to give up. She managed both her studies and her passion for music and found a new belief in herself. She became more confident and improved in all respects. She started loving herself and got the courage to express herself more than before, naturally reaching a stage where she beautifully carried an amazing aura.

By 25, she had almost set up a home studio for recording and had also composed a few music scratches and was all ready to celebrate her 26th birthday and also the launch party for her first book, which got a lot of appreciation from her family. Invitations were sent to all the guests, the venue was booked, and there was only a week left. It was a beautiful Sunday morning. She went out to buy a new dress for the celebration. She roamed around a lot of shops, enjoyed the weather with her favourite bike, and tried some new cuisines. On her way back home, she stopped at the tailor shop and told the old lady to do the necessary fittings on her dress. A few kilometres before her home, she noticed some men were harassing a girl, and suddenly, they pushed the girl in front of Inya's bike. Inya lost control and somehow saved the girl from being injured, but she ended up crashing into a lamppost and getting badly injured on her head. She was immediately hospitalized by the locals. One of the locals took Inya's phone to inform her family, and then a message popped up: "*Hello Inya, we have listened to your music compositions and they are pretty impressive*." We are really looking forward to working with you. The date, time, and place will be sent to you soon. "Yanika closed the book and said that she had to leave, as it was almost late. Yani cried a little and was upset. She told Yanika to stay at her place and complete the story, as she wanted to know the end. But Yanika refused and requested that she complete the story on her own. Yani somehow agreed but asked her about the writer and whether the story had a happy ending. For this, Yanika asked Yani if she was proud of her or not. Yani replied that she is really proud of her and wants to become like her. Yanika replied that she is the author of this book. Yani was shocked. She was so happy that she started crying. Yanika hugged her tightly. She comforted her and asked her to complete the book by today. She also told her to tear the brown cover. Yani promised to do so and asked her if she would come tomorrow with another storybook. Yanika uttered, "Thanks for inspiring me" and left her with a smile. Little Yani sat again with the book and tore the brown book cover. There was a note: "*This is the first copy of the book. I have saved it for you, Yani!* "Yani smiled, but after looking into the name of the book and the author's name, she immediately went to the first page, and it left her in a great shock. And she uttered, "*There is still music in the way you breathe*" and everything blacked out.

This time she wasn't falling into the black whirlpool, rather she was coming out. A low to high sound was coming from the Holter monitor (ECG machine). The doctor was using a defibrillator as the heartbeat was dropping. All of the family members prayed, and after two days, Inya awoke from her coma. The doctor informed the family members that Inya was out of danger, but she needed to be kept under observation. Many days passed, and slowly, Inya recovered. She asked her parents to reschedule the party dates and requested the book publisher to pay her a visit as she wanted to add a few more things to the book. Later, she replied to that message and informed the music producer about the accident she had met and asked for another opportunity. After a month, Inya finally decided to throw the launch party, and arrangements were started again. She even met the producer and contributed to composing the music, and also sang the female part in the song.

Finally, the day arrived, and it turned out to be a successful launch. She even cut the cake to celebrate her belated birthday. She carefully kept the first copy and said that it was for someone special. Her friends got suspicious and started pulling her leg, as they thought that it was for her crush. Inya gave them a hint to search for that person in the book. Later that night, Inya opened the book. It started as, "*Little Yani was a brave girl,....*" Then, she turned to the last page of the book, which ended as"

"Dear little Yani, Thanks for believing in me. I know you suffered so much at such a young age and still have the courage to fight back. Trust me, you are stronger than you believe. So, remember not to give up. Maybe situations will get worse in the future, but please don't give up, cutie. I know it will be hard, but you can do it. And sometimes it's OK to not be okay. Keep loving and exploring yourself. Don't limit yourself under the pressure of the situation; allow yourself to fly.

Yani, your 26-year-old"

[*The name of the book which little Yani was reading is "Dear Little Yani" and the author is (the 26-year old)* Yani.]

পুনর্জন্ম

বৃষ্টিভেজা যদি তুমি হও,
তবে বৃষ্টি ধারার বিন্দু হবো আমি।
কথা যদি তুমি হও,
তবে সেই কথার বক্তা হবো আমি।
শাসন যদি তোমার হয়,
তবে তোমার ছাত্র হবো আমি।
স্নেহশীলা যদি তুমি হও,
তবে স্নেহ হবো আমি।
উপেক্ষা যদি তোমার হয়,
তবে কথা দিলাম, ফিরে আসবোনা আর আমি।
রয়ে যাবে তোমার দেওয়া শিক্ষা---
আর কিছু অবহেলিত সুখস্মৃতি ;
স্মৃতিরোমন্থন যদি কোনোদিন করো,
একবার তোমার হয়ে পুনর্জন্ম চাই আমি॥

অনিব্রত পাল

Assistant Professor, CE

চুপকথা

চুপ করে থাকা চুপকথা

পূর্নতা পেল আজ,

যে মেয়েটার স্বপ্ন দুচোখ ভরে

সময় তার কাটল সকল সাজ |

আঁকিবুঁকি কাঁটা সেই মেয়েটা

গল্প যার রূপকথাদের দেশে,

কান্নারা অবাধ্য ভারি

ফিরে আসে সব কাজ শেষে |

সেই মেয়েটার স্বপ্নবিহ্বল মন

এক্কাদোক্কা খেলার সাথী তার,

একলা ঘরে চুপকথাদের সাথে

স্বপ্নগুলো পূর্নতা পেলো আবার |

অস্মিতা গুহ চৌধুরী
Assistant Professor, EE

অসীম

প্রচণ্ড গতিতে ধেয়ে আসা ধূমকেতুর মতো
হানা দিই তোমার শহরে..
অবাক বিস্ময়ে অভিভূত হও তুমি।
ঝিম ধরা সূর্যের আলোর নিরন্তর প্রবাহ চলে
শকুনের ডানায়..
নিগূঢ় তত্ত্বের মত সত্যি হয় তোমার ভাবনা!
আমি একটুকরো মেঘ চেয়ে হারিয়ে যাই বৃষ্টির আশ্বাসে।
ভেবে দেখেছ আমিও রডোডেনড্রন হতে চেয়েছিলাম..
কালো মেঘের ওপারে থাকা বজ্রবিদ্যুত খসে পড়ে তোমার বাড়ির উঠোনে।
জঞ্জাল আস্তাকুঁড় থেকে উঠে আসা নিথর মানবদেহের মত শান্ত..ক্ষুদিত!..
পাষাণ গলে যাওয়া তরলের আস্তরণ..
গলে যায় তোমার মিথ্যে আবরণের চাঁদে!

দিব্য ভট্টাচার্য্য
2nd Year, MBA, RERF

নারী -সর্বগুণে সম্পূর্ণা

নারী তুমি অপরূপা, রূপে গুনে সম্পূর্ণা,
নারী তুমি মমতাময়ী, দয়াময়ী,অবতার রূপে অন্নপূর্ণা।
দুষ্টের দমন আর সৃষ্টির পালনে একাই তুমি সিদ্ধহস্তা,
কখনো তুমি শিশুর মাতো সহজ সরল, কখনো বা তুমি শত্রু নিধনে তুমি ছিন্নমস্তা ।
সংসার ধর্ম পালন, সন্তান লালনে, তুমি একাই দশভূজা,
কখনো বা দময়ন্তী,কখনো বা সরস্বতী, কখনো বা ষোড়শী রূপে চতুর্ভূজা ।
তুমি একাই সর্বংসহা, স্নেহময়ী, মাতৃরূপে তুমি সংস্থিতা,
নির্ভিক, স্থির-অবিচল রূপে, লাস্যময়ী রূপে পূজিতা ।
তুমি জায়া, জননী, কন্যা, বন্ধুরূপে, সুস্বাস্থ্য, সুশিক্ষার অধিকারিণী,
জয়ের ধজ্বাধারী, সমগ্র পুরুষসমাজ মাঝে,একা তুমি রনরঙ্গিনী ।
নারী তুমি মহান সৃষ্টি, কল্যাণময়ী রূপে বর্ণিতা,
দুঃখ লুকিয়ে, হাস্যমুখে,দয়াময়ী রূপে তুমি,অন্যের কষ্টে তুমি সহমর্মিতা ।
জাত পাতের উর্দ্ধে তুমি, স্নেহশীলা রূপে বন্দিতা,
পরাধীনতার গ্লানিভেদে, মুক্তির আশায়, আশাবাদী তুমি ললিতা ।
ধৈর্য্যশীলা তুমি,সেবাদানে তুমি অতুলনীয়া,
অদ্বিতীয়া তুমি, বুদ্ধিমতী তুমি,জ্ঞানদাময়ীরূপে ধরণীতে হলে অবতীর্ণা ।
অগতির গতি তুমি, অনাথের নাথ তুমি, রাধিকরূপে কখনো বিরহী,কখনো বা উচ্ছলি প্রেমিকা, ডাক্তার, ইঞ্জিনিয়ার, শিক্ষিকা, পুলিশ, সর্বক্ষেত্রে পারদর্শী তুমি, কখনো বা সফলতম বিমানসেবিকা।
একই অঙ্গে যার এতরূপ, সকল বাধা যার কাছে হয় প্রতিহত,
একবিংশ শতাব্দীর জাগ্রতদ্বারে আধুনিক হয়েও আজ সে হয় অবলুণ্ঠিতা ।
নদীর মতো, নিজ ছন্দে যে হয় প্রবাহিনী, তাকে আটকে রাখা সবারই প্রায় অসাধ্য,
বরং সৃষ্টিকর্ত্তার শ্রেষ্ঠ নিদর্শনধারী সেই 'নারীকে' কুর্নিশ জানানো আমাদের সবারই সহজসাধ্য ।
নম: নম: জননী মম, নারীরূপে তুমি প্রণমিতা,
দেশ, সমাজ, কাল, জাতির শীর্ষে 'নারী' তুমি আজ প্রশংসিতা ।।

এনাক্ষী নন্দী
Assistant Professor, EEE

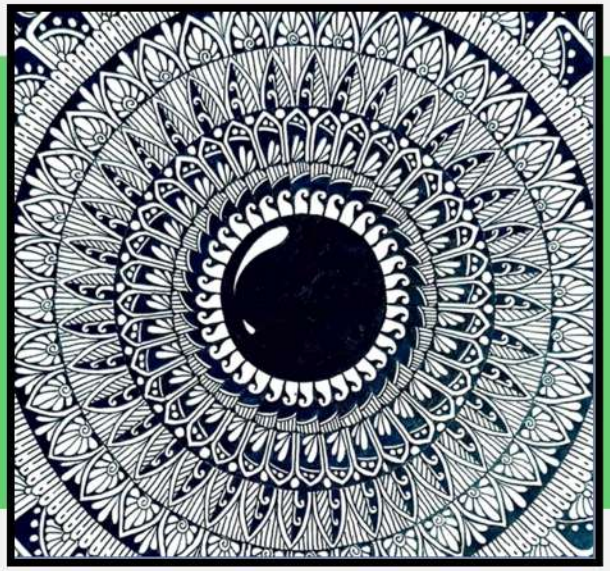
"Inspiration exists, but it has to find you working."
— Pablo Picasso

Sketch
Medium: Pencil

Sujoy Mondal
2nd Year, ECE

Doodle
Medium: Pen

Joysree Saha
1st Year, CSE



Painting
Medium: Pastel

Bikram Saha
Assistant Professor, EE

"Painting is just another way of keeping a diary."
— Pablo Picasso

Dr. Dipankar Biswas
Associate Professor & HOD
ECE Department

Photography

"In photography there is a reality so subtle that it becomes more real than reality."

– Alfred Stieglitz

Amartya Ghosh
Assistant Professor, CSE

Subhajit Dey
MBA, 1ST YEAR

Sandip Chakraborty
Assistant Professor, EE

Ashmita Guha Chowdhury
Assistant Professor, EE

Photography

"The picture that you took with your camera is the imagination you want to create with reality"

– Alfred Stieglitz

Sayan Konar
CSE, 3RD YEAR

Sayan Konar
CSE, 3RD YEAR

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CSE, 3RD YEAR

Avik Ghosh Dastidar
Assistant Professor, BSH

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