

VIGYAN PRASAR

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## DATA ANALYTICS PROJECT MANAGEMENT INSEPARABLE PARTNERS

MANAGING  
STRESS DURING  
TURBULENT TIMES

SNIFFING NEW  
FRONTIERS IN SCIENCE  
& TECHNOLOGY

ERNEST RUTHERFORD:  
FATHER OF NUCLEAR  
PHYSICS

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स्वतंत्रता का अमृत महोत्सव

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**MY WORD**

NAKUL PARASHAR

**Intriguing yet Important  
World of Data Analytics****CELEBRATIONS**

have begun. We have entered the 75th year of Indian Independence. Year-long and much longer festivities shall be in the limelight all over the country. With different languages, different cultures, and different geographies, this is bound to be a riot of colours. Amidst this vast diversity, we remain one and united in projecting a strong and resilient India, proud to be one. Reasons for this unity are many, and one of the strong rationales is that we produce a large workforce of scientists and technocrats every year. Institutions of scientific, technical, and medical importance and international repute today are proud to have Indians at their helm of affairs. This is something that we have evolved organically over some time. This has happened through the base that our scientific revolutionaries had built during the independence movement. Do send us if you have any such inspiring story that highlights the sacrifice and contribution of our scientists, science communicators, and science teachers.

In the Internet era, humans have experienced a new revolution — easy access to information. Life has hence become a lot easy and far more efficient. In fact, this ease of access is not merely confined to the speed of accessibility but to the volume of data as well. This has thus opened up a plethora of associated fields of research & development in itself, particularly for applications like decision making and process and project management; data analytics is one of the most prominent ones. With the advent of artificial intelligence and fast computing

systems evolving rapidly, data analytics has become much more relevant and talked about. Indeed, data analytics has traversed a long path so far. Data Analysts, in this journey, have faced many impediments in the growth of this field — in the form of format and source of the data: unstructured data form and disparate source of data. Since data analytics is highly dependent on computers, it was necessary to properly structure the data before it could be processed for decision making. However, with machine learning and NLP techniques, data analytics has overcome a lot of these impediments.

Data analytics involves necessary steps like data aggregation, data classification, data summarization, and data structuring. For all of this to happen quickly and in a fully automated manner, it is important to convert the unstructured data that has been amassed from disparate sources into a structured one so that the machine could assist the data analysts in analysing the huge pile of data quickly, correctly, and accurately.

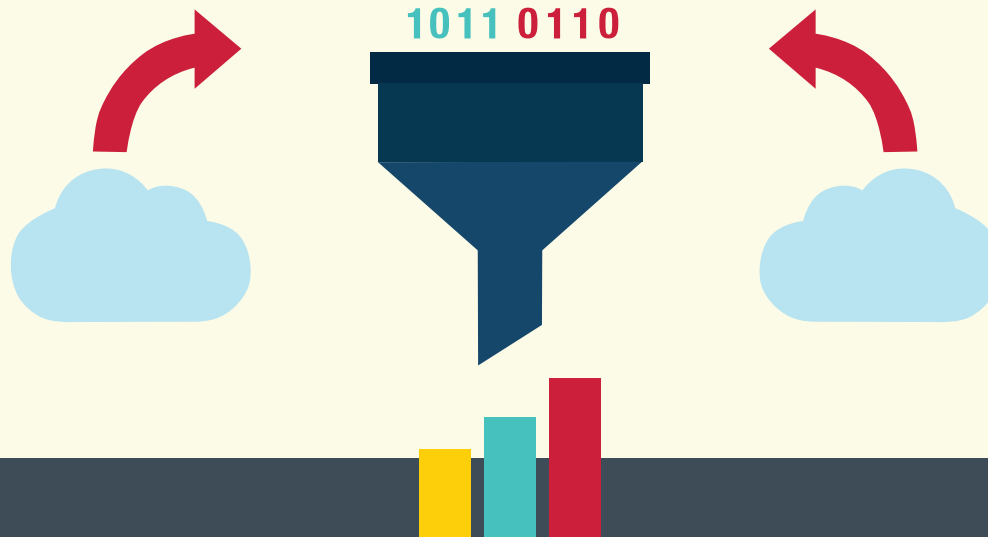
Be it any walk of life process and project management, they are solely dependent on either one or all four types of data analytics — descriptive, diagnostic, predictive, and prescriptive. It's indeed a wonderful and intriguing field, which is why there is a massive demand for data scientists. Fortunately, India continues to be one of the top leading nations in meeting the global need of quality data scientists. A proud moment for all of us, isn't it! Jai Bharat!

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# COVER STORY

BOHITESH MISRA

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## PROJECT MANAGEMENT AND DATA ANALYTICS – INSEPARABLE PARTNERS

**A**s we enter the 75th year of independence, we realise how important it is for us to make our nation a developed country from a developing one within coming two decades. This means we would need to manage numerous projects of various sizes at the same time. So, irrespective of the magnitude of the project, data associated with it comes to the fore. We would need tools to handle the projects smartly and manage it efficiently. This is where Data Analytics surfaces as the most effective solution, making it an inseparable partner of effective project management.

Managing projects means making decisions. This process can

be supported by data mining and machine learning techniques based on selecting and analysing project data to make better decisions and resolve some typical project problems.

Data plays a significant role in any organization. Using analytics, managers and executives can watch for early signs of slippage in budgets, costs, and timelines and take corrective action. Analytics also helps managers capture the rate of work to easily predict whether the project will be completed on time. For instance, they can use a burn-down chart, which is a graphical representation of work left to do overtime.

Deep and insightful analytics helps in improving resource utilization and better forecast on revenue and

costs. Organizations use analytics to take a broader view and combine unrelated data streams in obtaining deep insights into projections and early warning signs in complex projects. This role can be taken by Program Management Office (PMO) in an organization.

Experts say, about 80% of today's Project Management tasks will be eliminated by 2030 as Artificial Intelligence (AI) takes over. AI will not be replacing anyone's jobs just yet; however, it will help make better decisions, improving the chances of delivering projects on time and budget. Machine Learning algorithms will take over traditional project management functions like planning, data collection, tracking, and reporting.

The role of the project manager will gradually evolve into one that is more strategic as opposed to the current tactical position. AI shall be a work augmentation tool, not a human replacement, and AI cannot manage a project. So, Project Manager's tedious status reports and messy resource scheduling could be significantly improved with AI, Machine learning, and Robotics Process Automation (RPA). Organizations will have to adopt the use of AI in projects, and hence they have to merge the power of humans with that of machine learning to manage their critical projects better.

With AI applications already disrupting industries ranging from finance to healthcare, technical project managers have to grab this opportunity and learn how AI project management is distinct and how they can best prepare for the changing landscape for the use of AI in project management. AI and Machine Learning will help in enabling a fully digital program management unit (PMU) in the future.

With Data Analytics techniques project managers use various analytical reports and drill-down charts to break down complex project data and predict their behaviour and outcomes in real-time. They can use this predictive information to make better decisions and keep projects on schedule and budget. A data-driven analytics approach enables project teams to analyse the defined data to understand specific patterns and trends. Executives can use this analysis to determine how projects and resources perform and their strategic decisions to improve the success rate.

A leading global management consulting company discovered that nearly US \$66 billion was "lost" across 5000



separate projects. This was due to them exceeding their lifecycles, poor planning, and the wasteful expenditure on the wrong kind of talent.

### Data Analytics in Project Management

As we say, learning from the past help make our future better. As Project Manager, we should always connect the dots looking backward and forecast the projected path to the end using Earned Value Management. This will bring a perspective on whether the current projected path and pace will take us to the desired destination. The past performance and remaining quantum of work in the project will help us with the course correction. The project manager always balances various 'Constraints set' at the start of a project. To be in control of the project, they always require checking on project performance matrices. Project Performance Analysis is critical for a project manager to decide the revised efforts rate to achieve desired goals.

One of the ways to manage this complexity and the need for changing world is using digitization. Digitization of the Project Development phases will provide all synchronized databases available to each stakeholder appropriately, and the same can be used for managerial decision making. Building Analytics on this database, Risks affecting Project Performance Parameters – Time, Cost, and Quality – can be effectively predicted and controlled. In addition, the status will be available for each project to individual project teams, whereas Portfolio Dashboard will provide a bigger picture for managerial decisions on strategies and organizational priorities. Because of its real-time nature, it can be available across the world while providing a common platform to network and a common language to interact with the team.

Effective management of projects entails efficient management of the uncertainties and risks of the project. Project managers need to use analytical techniques to monitor and control the risks and estimate project schedules and costs more accurately with analytics-driven prediction. Project-based data with analytics can enable them to measure, observe, and analyse project performance objectively and make decisions and commitments based on facts.

Digitization of the Project Management process and application of Analytics will provide strategic value creation for the organization.



## BENEFITS OF AI IN PROJECT MANAGEMENT

- Automate repetitive, tedious tasks so that one can spend more time on problem-solving;
- Create a Project database and use historical data of completed previous projects to perform calculations and predictions, improving the accuracy of the results;
- Perform risk modelling and analysis based on any changes to scope, available resources, budget, etc. and
- Optimize resource scheduling and allocation on projects.

### AI AND MACHINE LEARNING CAN BE USED IN PROJECT MANAGEMENT TO:

- Assess the type of resources the project needs to be based on the tasks required, such as time to build a custom workflow and then perform quality assurance testing;
- Use historical data to calculate the length of time for tasks;
- Reference a database of people and their skills and select the best person for the tasks required;
- Review the work and time-off schedules of all the people available to work on a project;
- Estimate how many tasks an individual could complete when compared to their weekly report of productivity;
- Compare the proposed resource schedule against historical data to identify inconsistencies and improve the accuracy of the proposal and
- Propose the best possible schedule of resources with the team available.

### Quality of deliverable

Managing a new project can be a scary task. There are different stakeholders, approvers, teams, budgets, outcomes, and high expectations to work. Analytics has therefore become a significant part of modern-day project management.

As a project manager, you must understand to use analytics for reducing workload, improving processes and enhance the outcomes of the project. Quality is an ultimate measure of your project's success upon delivery. Analytics help you plan, monitor, and review the quality throughout your project.

### Assisting strategic decisions

Analytics helps organizations make decisions that are based on facts instead of using any random data. Real-time project analytics offers lots of information that helps an organization align with its strategic objectives. With Analytics one can understand how on-going and proposed projects would fit into the overall portfolio and organization vision.

### Lowers project costs

With Big Data Analytics one can collect more and more data to predict future events and trends within an industry. Tasks like resource forecasting and planning process become more efficient as one has a library of relevant data in determining the right timetable, budget, estimates, and more for cost-effective project implementation.

### Improves resource management

With Data Analytics you can extract correct information for understanding your project needs. This helps in assessing available resources and match with project needs for efficient resource allocation and, in turn, seamless project operations. You can also predict project outcomes better and make strategic decisions to ensure the most cost-effective resource spending.

### Enhances project risk management

Project management is dynamic and affected by many internal and external factors, leaving it open to various risks that could negatively impact your delivery outcome.

Identifying and managing your project management risks regularly and actively are needed. Also, all risk events must be documented and followed up with troubleshooting and fire-fighting activities.

Data Analytics provides opportunities to sharpen the skills and optimize project management implementation process. Regardless of the objective, one can always find data to influence project results. One can leverage data to analyse past, real-time, and future information to view the probability of the project outcomes and use it to make data-based decisions and improve efficiencies.

The market for Data Analytics and business intelligence is predicted to grow humongous. According to the Project Management Institute, there will be a demand for 87.7 million project managers by 2027. With both these disciplines growing at an explosive rate, it only makes sense to use powerful tools interwoven into the organization's fabric to create a more sustainable competitive advantage.

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The author is a Project Management Professional, winner of multiple CIO awards and the Co-founder of Decisiontree Endeavour.

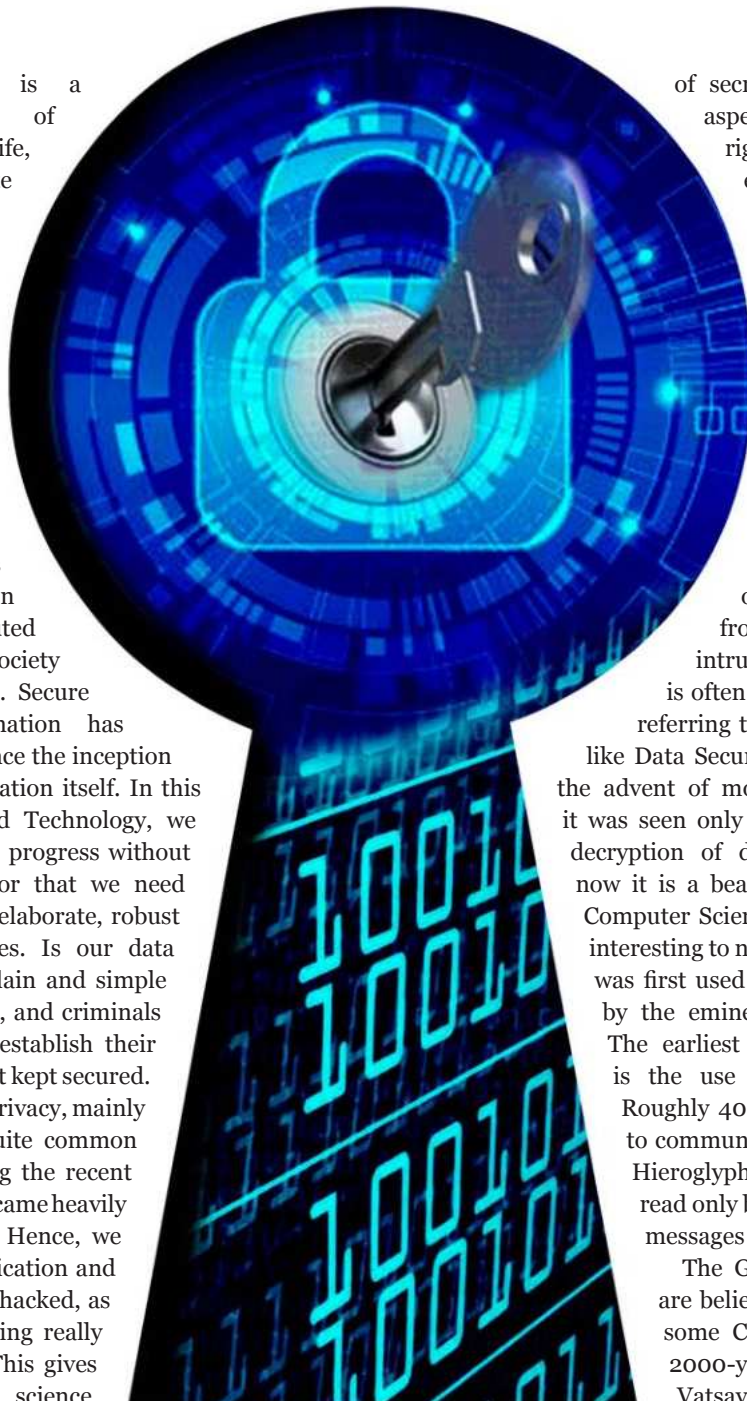
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# Ibq'p Gpetarv!

“The enemy knows the system”

Claude Shannon

Information or data is a fundamental element of almost all forms of life, ranging from intricate microscopic one to the vast and exceedingly complicated societies in which we live. Along with knowledge and data, communication is also extremely important for the entire mankind. Exchange of information between individuals, organizations, and nations through numerous methods of communication has enormously contributed to the betterment of the society and the world in general. Secure communication of information has played indispensable role since the inception of the concept of communication itself. In this modern age of Science and Technology, we cannot make any significant progress without large-scale collaboration. For that we need huge source of data and an elaborate, robust system to transfer messages. Is our data secured? The answer is a plain and simple NO. Third-parties, intruders, and criminals would look for chances to establish their access over our data if it is not kept secured. Examples of such breach of privacy, mainly by cyber criminals, were quite common in the banking sector during the recent lockdown, when the world became heavily dependent on the Internet. Hence, we need to secure our communication and protect our data from being hacked, as having privacy over something really crucial is a justified right. This gives birth to Cryptography, the science



of secret writing! It has countless aspects and application, ranging right from telecommunication, e-commerce, banking to password storage, military intelligence etc.

## Origin and development

The word “Cryptography” is derived from two old Greek Word, “kryptos”, meaning hidden, and “graphein”, meaning “to write”. It can be defined as the process or study of techniques, which secure our communication and data from unintended third parties or intruders. The word Cryptography is often used as an umbrella term for referring to a number of different fields like Data Security, Cyber Security etc. Until the advent of modern Cryptography systems, it was seen only as a tool for encryption and decryption of data or messages. However, now it is a beautiful nexus of Mathematics, Computer Science and Modern Physics. It is interesting to note that the word Cryptograph was first used in the novel “The Gold Bug” by the eminent author Edgar Allan Poe. The earliest occurrence of Cryptography is the use of hieroglyphics, in Egypt. Roughly 4000 years ago, Egyptians used to communicate with each other through Hieroglyphic messages, which could be read only by scribes who used to transfer messages on behalf of the king.

The Greeks of the Classical Times are believed to have the knowledge of some Crypto systems. In India, the 2000-year-old text “Kamasutra” by Vatsayana cites two different kinds of



Egyptian Hieroglyphics (Courtesy: Britannica.com)

cryptography, known as Kautilyam and Mulavediya. The province of Sassanid, Persia had two kinds of secret scripts: one used for official purpose and one for foreign communication.

Any article about crypto system is incomplete without the mention of the legendary Alan Turing and the famous Enigma Machine. Enigma was the almost flawless German cryptography machine which worked on the principle of electromechanical rotor mechanism. It scrambled all letters present in a word, and the huge number of possibilities generated by it made the decryption process extremely difficult. It was famously used by the Nazis in the German Military during World War II. Excessively complicated and easily portable, it was one of the main weapons of the Germans. In fact, it seemed almost unbreakable. The only possible flaw with the machine was that it never encoded a letter by itself. In other words, the encoding function of enigma had no fixed points. This was a major hint for

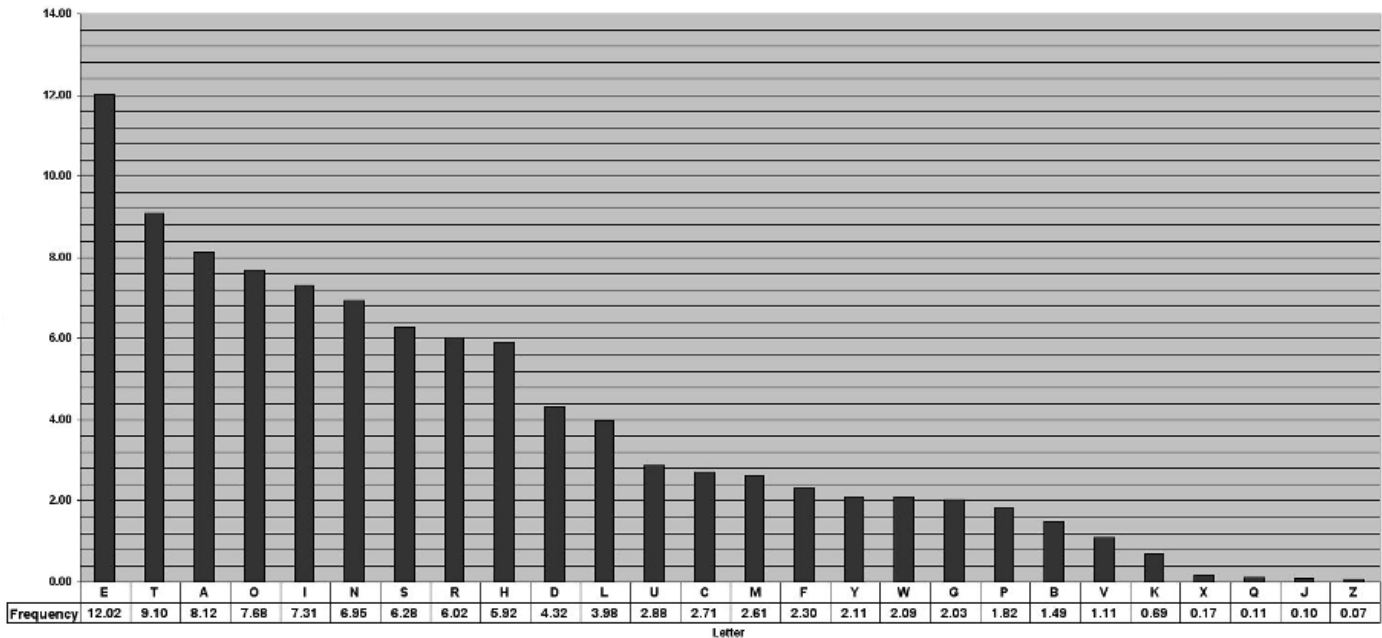
the code breakers.

Alan Turing, the brilliant Cambridge University Mathematician, Computer Scientist, Cryptanalyst, and Philosopher, was the first to break the Enigma code. Victory of the Allied Force in WWII can be credited to Turing for his

pioneering decryption technique, which revolutionized cryptography. Thus, secure encryption techniques that are used in WhatsApp profiles of individuals today were once used as a principle weapon in one of the most deadly wars ever fought in the human history!



Alan Turing and The Enigma Machine (Courtesy: Wikipedia)



Diagrammatic representation of frequency analysis (Courtesy: pi.math.cornell.edu)

**Some definitions and concepts**

In a cryptosystem, the person or organization, who sends the message, is called the sender, and the one who receives it is the receiver. The message, in original form is popularly known as “plaintext”. The encrypted text, which is received by the receiver is called the “crypto text” or “ciphertext”. The process of converting plaintext into encrypted text is called “encryption”, and the reverse process is called “decryption.” “Key” is the complex parameter which is used in the encryption process and plays a vital role. An encrypting algorithm can encrypt a continuous stream of symbols (stream encryption) or divide it into blocks (block encryption). Important to note here is the fact that, if *f* is an encoding function, then it should preferably be injective, i.e., it should never map two different plaintext symbols into the same ciphertext symbol, for a particular message.

The union of Mathematics and Cryptography is old and well established. In fact, almost all encrypting algorithms mainly rely on hard and sometimes even open problems of topics like Ring Theory, Polynomials, Commutative Algebra etc. A simple and good example can be the use of number bases. We know that if  $k \geq 2$  then every positive integer *x* can be

represented uniquely in the form:

$$x = \sum_{i=0}^n a_i k^i, a_n > 0; a_i \in [0, k-1]$$

This is the base-*k* representation of integer *x*. Base 10, or the decimal base, is the most common form of representation, followed by the binary or base 2 representation. Any number can form a base for another number. For cryptographic purposes, any number in the plaintext can be encrypted into another number in some random base in the cipher text, and if the receiver knows the correct key (here, the number used as base), they can surely decipher the message, while the eavesdropper or third party will be left clueless!

The concept of Computational Hardness is central to almost all cryptosystems. The problems from mathematical topics to be used must be classified as computationally “easy” or “hard”, so that they can be used accordingly. In fact, computational hardness guarantees the strength of the algorithm.

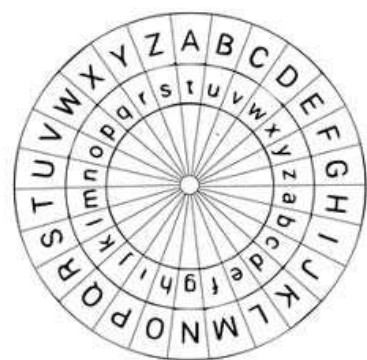
Whenever text messages are encrypted, cryptographers generally prefer a certain rule. Statistical observations say that ‘*e*’ is the alphabet with more or less

the highest frequency of occurrence in any English text. Likewise, there is a table of letters based on their frequency of occurrence. The cryptographers basically exploit this rule. They try to encrypt their plaintext in such a way that the letter with lowest statistical occurrence gets replaced with that with the highest occurrence and vice versa. Like-wise the encryption becomes robust.

**Types of cryptography**

**1. Secret Key Cryptography:** It is also called, “Symmetric Key Cryptography.” In this form, the key assumes a tremendously important role, as its knowledge remains confined only to the two parties communicating, and not to the third party. The secret message would thus make sense only to the sender and receiver, who are aware of the key, while the intruder would find the cipher text absurd. As the Kerckhoffs’s principle states, “any cryptographic system should be secure even if every bit of information about it, except the key, is public.”

**2. Public Key Cryptography:** It is often dubbed as “Asymmetric Cryptography.” Here, a pair of keys, known as the private key and public key (generated from a big pool of random number) is used. The working principle here is one-



A Caesar Wheel

(Courtesy: boxentriq.com)

way functions, i.e., the functions where the inverse operations are tougher to perform than input operations. It is slower than symmetric cryptography. It can be helpful for authentication purposes as well. The RSA system, which is based on the degree of difficulty of factoring the product of two large prime numbers, is one of the most distinctive examples of Public Key systems.

**3. Hash Functions:** This can be defined as a function  $f(x)$  which maps the message to be encoded to a bit array of a fixed size. Decrypting them becomes immensely difficult, as some precise measures are followed.

These have huge application in databases and portals, where people protect their data and accounts using passwords. The hash function is applied on the password.

**Caesar Cipher** is one of the most popular and simple forms of Cryptographic systems, which replaces a letter in the plaintext with another one down the alphabets, where both are separated by a fixed number. This is called the key. Let us get this mathematically. Label the alphabets  $a, b, c, \dots, z$  as  $0, 2, 3, \dots, 25$ . Then the encrypted alphabet, after shift by an integer  $n$  is –

$$A(n, x) = (x + n) \pmod{26}$$

The formula for decryption is similar:

$$D(n, x) = (x - n) \pmod{26}$$

If  $n > 0$ , then the shift is called right, else left. The “mod” notation used here signifies that 26 needs to be added to  $(x \pm n)$  if they do not fall in this range -  $[0, 25]$ . To illustrate this, let's consider an example. Take the sentence (plaintext) “Meet me now.” Suppose the key is 7 right shift. So, every letter gets shifted by 7 places, and the sentence gets converted into –

Me e t m e n o w



T l l a t l u v d

Hence, the message is encoded. Often, the key right shift 13 is used. An interesting conclusion which can be made from this is that every plaintext is actually a cipher text, with security key 0!

The reason why this system is considered unsafe is the key can be easily guessed. In fact, many methods of Classical Cryptography, based on various visual principles and statistical laws on frequency of letter occurrences are not that secure today, as they were in previous days, and the reason is pretty trivial. People with the intention of breaking sophisticated and secure cipher codes do have equal access to the ever-growing technology and computational developments like the encoders, so they may design efficient algorithms to decode crypto systems like this one, rail fence cipher, or any shifting key cipher. Heavy computation using brute force is also an important thing in cryptanalysis.

#### Some modern developments

We would end by discussing two relatively new but powerful cryptographic techniques, which are deeply mathematical.

**The word Cryptograph was first used in the novel “The Gold Bug” by the eminent author Edgar Allan Poe.**

**1. Elliptic Curve Cryptography (ECC):** In Mathematics (or specifically Algebraic Geometry), an elliptic curve is a smooth algebraic curve of the form:

$$y^2 = x^3 + ax + b$$

The curve contains no self-intersections (equivalent to the condition that  $4a^3 + 27b^2$  is non-zero). ECC is primarily based on algebraic structures of these curves over a finite field, using a special operation called “Scalar Multiplication”. They became popular in the first decade of the 21st Century. The main advantage of ECC is the high level of security it offers, using considerably low storage. ECC is used nowadays in cryptocurrencies, digital signatures, and pseudo number generators.

**2. Quantum Cryptography:** Advent of Quantum Mechanics has changed the face of Modern Science, and Cryptography is no exception. Quantum Cryptography is the process of using various Quantum Mechanical processes to carry out Cryptographic tasks. Principles like Entanglement and Uncertainty can provide unprecedented amount of security, which is impossible to achieve by using Classical methods. In fact, the advent of Quantum Computing has opened up the possibility of emergence of something called Post Quantum Cryptography.

Thus, the crucial role played by Cryptography and Information Security can never be overstated. A very simple and short exercise for the reader to check their prowess in Cryptography would be an attempt to decipher the title of this article! The only hint which I can give is that the key to be used in decrypting the cipher title lies between -5 and +4 and is not same for the first and last word. All the best! Let this be your first step in becoming a pro code breaker!

Please see Page 18 to verify your answer.

The author is a Science and Mathematics enthusiast, a college freshman at IACS Kolkata and a Life Member of the Indian Mathematical Society.

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# Managing Stress during Turbulent Times

**C**OVID-19, the global pandemic has taken its toll in such a glum manner that it is humanly impossible for any of us to turn a blind eye to what is happening around us, in our city, in our state, in our country and in the world. This unprecedented phase is, undoubtedly, disturbing for each one of us. This ambiguous and stressful phase brings along with it a new threat as well, a surge in cases of mental stress and anxiety.

With the rising number of COVID-19 cases each day, with numbers now turning into names of our loved and close ones, with newer and rarer fungal diseases showing up, with near and dear ones getting affected, and amid unending lockdowns, stress, anxiety, depression, and frustration are at an all-time high.

We are all faced with new realities of life, altogether. Everything that was normal during the pre-covid era has changed. The way we lived, worked, socialized, almost everything that we did earlier is not possible today.

Millions have lost their jobs, or shut down their businesses. Those who still have a job are working from home, and there is obviously a lack of physical contact with other family members,

friends and colleagues. Let us also not forget young children and youngsters, because they too are equally living a different lifestyle altogether. Online education with no playing or interacting with peers can be even more stressful for this age group.

While the lockdown may help in breaking the chain of this pandemic, the society at large is in danger of deterioration of mental wellness. Hence, it is crucial to be highly sensitive to the mental health impacts of a long-drawn-out lockdown. In fact, these challenging times may even have long-term sequel effects.

The second wave has been more severe not only because of the bigger numbers, the higher mortality rate, and the ever shrinking resources but also because it came down on us suddenly when we were starting to feel that everything was getting back to normal even if the normal were a 'new normal'.

However we need to remind ourselves the words of Caryn Sullivan, *'In the face of adversity, we have a choice. We can be bitter, or we can be better.'*

Looking around, we find that in this pandemic situation, everywhere, every second person is under high stress which could be because of losing a loved one, losing a job, loss of a business, depleting financial resources, emotional stress, loneliness, and so much more. At times we are not weighed down by the load we carry or that breaks us down, it is the way we carry it.

Yet, there is nothing abnormal about all the fear, worry, and stress that we are experiencing during these uncertain and unknown times, these are absolutely normal responses to apparent or actual threats. It is normal and understandable that people are undergoing mental stress because of the pandemic.

However, we cannot press the panic button and allow negativity and pessimism to control us, neither can we afford to break down because if we do, the consequences are going to be even more deadlier than the pandemic itself.

We need to put a stop on overflowing ourselves with all the negative information of loss of lives due to this deadly virus and the lack of resources, both medical and financial. No, I don't mean that we turn a blind eye to all

suffering around us but it is definitely high time we start talking about recoveries and brave acts by people who are going out of their safe zones to help others and hence try creating a positive environment around us.

We have to keep reminding ourselves that we are not alone in all that we are going through. Also, the entire situation and its consequences are beyond our control. It is time to think of all the passionate hobbies that we had shelved because we had no time due to the hectic mechanical life we were living. Now we have time for indulging in our old lost hobbies like reading, gardening, cooking, drawing, painting, and so many more.

While working from home could mean stress for some, it also means we have more time at hand, because we are saving time that we spent in commuting to our workplaces. We just need to use this time in a more healthy and productive way.

Get into a routine that says, 'Early to bed and early to rise makes a man healthy, wealthy and wise'. A good sleep is always crucial for our physical as well as mental health. A healthy and nutritious diet also goes a long way in improving our physical and psychological stress tolerance quotient; we don't burn out easily.

Another important aspect is exercise which releases chemicals called endorphins that interact with the receptors in our brain and trigger a positive feeling in the body and in fact are known to be natural painkillers, hence help minimize discomfort.

Technology helps us connect with our family and friends whom we are unable to meet during this phase. Connect with them. We don't need to discuss the same old Corona-related speculations and become depressed neither depress

others; talk about more interesting things of common interest, discuss our sudden surge of creativity, our long-forgotten hobbies, like writing, reading, dancing, and more.

All emergency situations and pandemics do lead to large-scale impact on the mental wellness of the masses. The fear of the virus, fear of death, grief, isolation, and anxiety related to the ripple effect of the consequences of the pandemic is bound to worsen the already existing problems.

The decline of income generation owing to frequent lockdowns and travel and work restrictions is adding to the distress that people are experiencing due to destruction of community fabric, resources and trust.

In such challenging times people are becoming even more vulnerable to stress and this can affect their health, happiness, emotional, psychological and social well-being. Seeking help is the only way forward and a positive way as well. We all need to do away with the stigma of reaching out for help. Stress is just a psychological state and we should not fear reaching out for support. Unfortunately, both social stigma and self-stigma exist and have always been associated with seeking mental health counselling and the usual perception is that a person seeking psychological treatment will be undesirable or socially unacceptable or the belief that if one needs psychological treatment he or she is inferior.

The pandemic has shown that even the healthcare providers are at a risk of experiencing distress. A huge population in India is in need for mental health care and counselling and there exists a huge treatment gap.

Commendable initiatives to provide 24/7 help lines have been launched

by Government as well as many other organizations. One such applaudable initiative is the 24x7 Toll-Free Mental Health Rehabilitation Helpline KIRAN (1800-599-0019), to provide counselling and support to all, in view of the growing incidence of mental stress, particularly in the wake of pandemic COVID-19. The helpline provides services in 13 languages, with the objective of screening and identifying stress in the early stages and consequently providing the psychological support to all persons experiencing psychological stress, panic attacks, post-traumatic stress disorders and more similar conditions.

National Institute of Mental Health & Neurosciences (NIMHANS) has also come up with dedicated helpline for psychosocial support and mental health services during disasters. The helpline addresses the psychosocial issues of disaster survivors and creates a tertiary-level support system for them during emergencies caused by disasters. The Toll-free number is 0804611 0007.

Another such initiative is 'iCall' which is a field action project of School of Human Ecology, Tata Institute of Social Sciences and the impact summary is very positive.

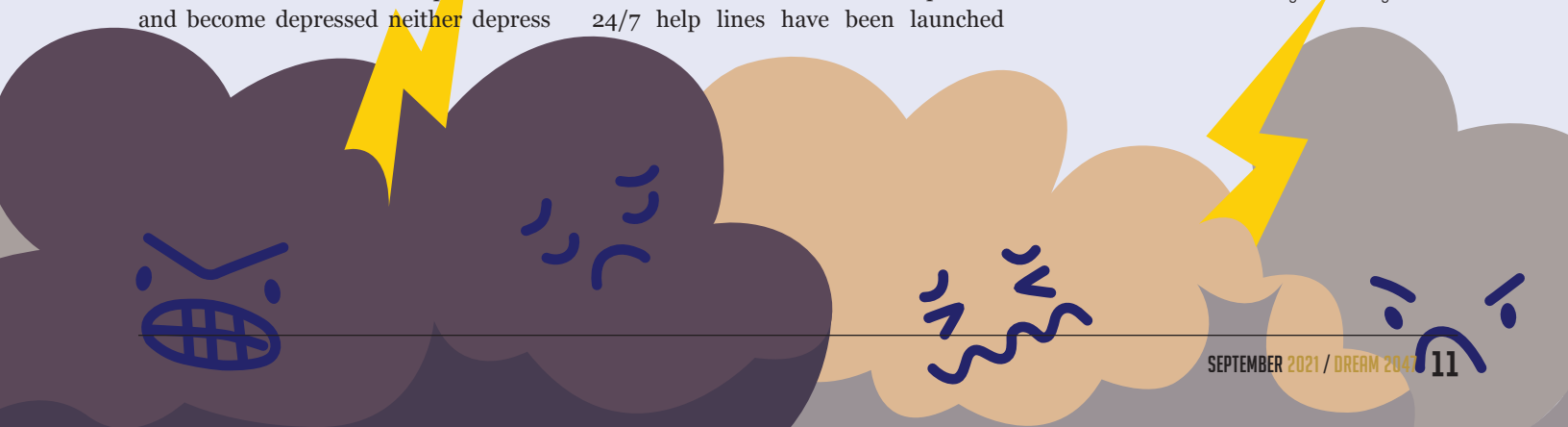
It is high time we let our faith win over fear. Only our optimistic approach would arm us in winning the psychological war that we are fighting every moment against the virus. Don't forget that our resilience is our weapon in these challenging times.

Please wear an appropriate mask and stay indoors. Stay safe, stay healthy, and stay blessed!

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# Sniffing new frontiers in Science & Technology

**H**ave you ever wondered why some of us can whiff something from a distance while others cannot get the smell even if the source is right under their nose? And why that many animals like dogs can detect the odour even if the source is taken away from the place with only a faint trace of it remaining? In fact, many animals are able to survive just because their sense of smell is powerful enough to detect and differentiate between their preys and foes. This helps them in hunting as well.

Unlike animals, humans are however not so dependent on their sense of smell and it is not that developed. But occasionally it can be a case of life and death if odour of a specific source is not detected at the right time. A very apt example is a gas leak in the kitchen or in an industrial establishment, or for that matter, detection of explosives or drugs for which trained dogs are employed. At the same time, there are many professions that depend on this sense, like the beverages, wine, and fragrance industries, wherein there are dedicated professionals who make use of their keen sense of smell to discern between the varying quality of the products. But, what if you were told that in the years to come, these professionals will become redundant, and dogs would no longer be required to detect drugs, explosives or other chemicals? Well, it is certainly not implied that people will stop enjoying their Darjeeling tea or wine or stop using fragrances, or for that matter the world is going to become a safer place and so we may not require to detect explosives or drugs. What is in offing is an exciting new world of electronic nose or E-nose as it is popularly known, that is poised to bring about nothing less than a revolution!

E-nose refers to a growing research

area called biomimetics that involves development of human-made applications on a pattern that nature works with; functions similar to human ability to smell, identify, compare, and quantify odour.

In the first stage of E-nose development, the researcher needs to determine what it wishes the E-nose to smell, and then comes the question – how it would smell? The material to be used, number of sensors, and the electronics play key roles in its development. In order to make the E-nose, inputs are primarily taken from a variety of sensors and then later combined with a data processing algorithm.

Microelectromechanical systems (MEMS)-based sensors and Nano-bio sensors are the two most popular sensors used in the development of E-nose. Of the two, Nano-bio sensors are applied for very sensitive and selective operations.

E-nose incorporates an odour delivery system including an air pump, a sensor array, and an electronic signal



Detecting diabetes through breath



Sensors for E-nose

conditioning module that converts analogue signals into digital. Once the smell has been converted into an electrical signal, the domain of the electronic and software engineers comes into play. When the data is good and huge, the machine can be trained through a machine learning system to identify and differentiate between good and bad smell patterns and for quantification of smell.

In India, CDAC Kolkata pioneered the development of E-nose for commercial use emphasising on various applications while the basic technology remains the same.

## E-nose for Tea

Tea is normally graded by human tea tasters who evaluate it subjectively on a scale of 1 to 10 based on its flavour, aroma, colour, and strength. To make the grading process more objective, CDAC Kolkata identified appropriate sensors based on their sensitivity to major aroma-producing chemicals. This sensor array was then exposed to black tea samples and the computational model was developed based on artificial neural network methods to correlate the measurements with the tea taster's scores. CDAC developed two versions of this E-nose, an onsite one and another hand-held portable type.

This E nose opens up immense scope for future research for quality assessment of tea and the standardization of tea aroma and flavour.

## E-nose for Rice

Conventionally, the quality of rice is graded by humans for aroma as one of the key parameters. This process is slow, non-repeatable, and laborious and is subject to error due to individual bias and decrease in sensitivity of the human nose due to prolonged exposure or infection. An E-nose has the potential to eliminate such problems by standardizing the aroma characterization.

## E-nose for unpleasant odours

Pulp and paper industries generate poisonous gases and unpleasant odours harmful for humans both within and outside the paper mills. Some of these

offensive smells are due to the presence of reduced sulphur compounds that have a very low odour threshold and are mostly volatile.

A metal oxide sensor based-E nose was jointly developed by CDAC, Kolkata and CSIR-National Environmental Engineering Research Institute (NEERI), Nagpur for quick measurement of the intensity and concentration of the odours. The gas samples collected from the surroundings of major source points of industry were exposed to the sensor array and the change in voltage was measured and analysed.

### E Nose for jasmine application

The extract of jasmine flower petals (concrete) is exported and is well known for its unique fragrance quality. The quality testing of jasmine is traditionally carried out by human sensory testers who judge it by its fragrance and the Bud Opening Indicator or BOI. The judgement is often inaccurate as it is subjective and non-repeatable.

CDAC Kolkata profiled the fragrance of the flower with a custom hand-held and battery-operated E nose or HEN. Three specific species of Jasmine were applied to the E-nose one by one. Analysis of the responses revealed that distinct clusters were formed for different species. Results revealed that concrete produced with BOI level 1.5 emitted maximum aroma generating volatiles. These observations showed that E-nose can be a potential gadget for fragrance profiling as well as for standardizing the selection of best quality flowers for concrete extraction.

### E-nose for diabetes

Our liver produces ketones that are used by our body as fuel. However, in diabetes ketone production increases and remains unused. Acetone that is a form of ketone emits a fruity smell and a person's breath can indicate if the person is diabetic but then there is no means to measure it.

To find a solution to this issue a non-invasive and cost-effective E-nose has been developed jointly by CDAC and Medical College, Calcutta. These instruments have an accuracy of around 97-98% as compared to the



Technology platforms developed by Nanosniff Technologies



E-nose for poisonous gases



E-nose for Rice

standard method that uses finger prick or the venous blood draw samples. Its uniqueness lies in diagnosing within a minute and after a short gap of a few minutes it can be reused again.

Apart from CDAC, IIT Bombay in particular is working on various technology platforms for detection of explosives and other gases. To start with, they developed micro-heater—based sensor to detect explosives. Nanosniff Technologies, incubated at IIT Bombay, developed a product capable to detect explosives in the trace phases as low as 10 nanogram. This approach known as detonation involves ramping the temperature of the micro-heater to about 600-700 degrees Celsius within a span of few milliseconds giving a thermal shock to the collected sample. So in case it is an explosive, it will explode due to its innate nature and the temperature sensor built within the device itself picks up the small change in temperature.

Another type of sensor being developed at IIT Bombay is micro-cantilever based that are extremely small (200 micron ×40 micron) and bends if an explosive molecule comes and

sticks to it. Each of the chips has four cantilevers on it and interestingly each of the four cantilevers reacts differently to different types of explosives. The data is taken electrically and processed using proprietary algorithms to detect an explosive.

A third optical fibre-based platform utilizes 23 nanogram of TNT, smaller than one micron speck, and tests it to six levels of transference, implying that if someone touches TNT and places his or her finger on the table and then if someone else touches that place and places his finger at some other point on the table and if six people do likewise, it brings 23 nanogram on the table, and this too can be detected.

A fourth application being developed by IIT Bombay is a paper-based sensor to detect acetone in breath that is a marker for diabetes. In this work, a simple and compact filter paper-based sensor configuration has been demonstrated and tested with spiked real breath samples, without compromising its stability, sensitivity, and specificity. All of these sensors are extremely inexpensive and the idea is to deploy them on a mass scale.

New areas of research and applications are now emerging in the domain of E-nose technology. One of them is Electronic Sensing System for safe management of potato, onion, and tomato in storage. Often termed as e-POT, this technology aims to identify and quantify Volatile Organic Compounds generated by pathogens during the spoilage of potato, onion, and tomato during storage. Another emerging technology in this area involves quality evaluation of litchi fruit while using a hybrid technology involving smelling through E-nose and vision through E-vision systems.

Sources of information: Dr Nabarun Bhattacharyya, C-DAC, Kolkata; Prof. Soumyo Mukerji, Department of Biosciences and Bioengineering, IIT Bombay; Dr Nitin S. Kale, Nanosniff Technologies Pvt. Ltd., IIT Bombay.

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Nuclear Science is no longer confined to physics alone. It has breached its boundaries to percolate in to other areas of science, be it chemistry, biology or biotechnology, medical science and agriculture. Not only it has now become the mainstay of the high profile nuclear bombs and power generators or the powerful rockets that launch the spacecrafts, but also the small battery of the implantable pacemaker, the microscopic tip of the needle that treats cancer, the devices used to combat pests and diseases in crops, increase livestock production, food processing as well as preservation and many such kinds that greatly influence our everyday life. For the development of this epoch-making branch of science, without which the world would have been quite different, humankind must remain obliged to the immortal scientist Ernest Rutherford, who is very rightly called the Father of Nuclear Physics.

### Early life

Ernest Rutherford was born a century-and-half ago on 30 August 1871 at Bright Water, New Zealand. His father, James Rutherford, was a farmer and mother, Murtha Thomson, was a school teacher. They originally belonged to Essex, England but migrated to New Zealand before the birth of Earnest. His early education began at the local Havelock School and he then joined the Nelson College from where he earned a scholarship to study at the Canterbury College, University of New Zealand. In 1893 he graduated MA with a double first in Mathematics and Physical sciences and continued his research work there to receive his BSc degree in the following year. He was awarded an 1851-Exhibition Science Scholarship in 1894 and joined the Trinity College, Cambridge as a research student at the Cavendish Laboratory, where he worked under the guidance of the legendary scientist J.J. Thomson. He was awarded



## Ernest Rutherford: Father of Nuclear Physics

the BA Research Degree along with Coutts-Trotter Studentship of the Trinity College (1897). The next year he left for Canada as he was offered the Macdonald Chair of Physics at the McGill University, Montreal.

He returned to England in 1907 to become the Langworthy Professor of Physics in the University of Manchester and in 1919 accepted the post of the Cavendish Professor of Physics at Cambridge. He also became the Chairman of the Advisory Council, His Majesty's Government, Department Science and Industrial Research and side by side the Professor of Natural Philosophy, Royal Institute, London as well as the Director of Royal Society's Mond Laboratory, Cambridge.

### Important work

Initially, while in New Zealand, Rutherford had begun his research work on magnetic properties of iron exposed to high frequency oscillation and had produced a thesis titled "Magnetization of Iron by High Frequency Discharges". He had designed a highly original experiment with high frequency alternating currents followed by magnetic viscosity, which was published in the Transactions of the New Zealand Institute in 1896. It contained a description of measuring the time interval of a hundred thousandth of

a second. At Cambridge, he had the opportunity of working with J.J. Thomson at the Cavendish Laboratory. There he invented a detector for electromagnetic waves (1897). It was an essential feature being an ingenious magnetizing coil containing tiny bundles of magnetized iron wire. With Thomson he worked on the behaviour of ions observed in gases, which had been treated with X-rays. In the same year (1897) they also worked on the mobility of ions in relation to the strength of electric field and the related topics such as the photoelectric effect. In 1898, while at the McGill University, he had identified  $\alpha$ -rays and  $\beta$ -rays in the radiation coming out from uranium and studied some of their properties. Then he discovered the concept of radioactive half-life and with R.B. Owens studied the "emanations" of thorium and discovered a noble gas, an isotope of radioactive element, radon. These work earned him the Noble Prize in Chemistry in 1908.

He collaborated with Frederick Soddy, who came to McGill from Oxford in 1900 and created the "disintegration theory" of radioactivity. It regarded radioactive phenomena as atomic and not molecular processes. The "theory" helped in the discovery of new radioactive substances, and their positions in the series of transformations were fixed. The discoverer of the process of atomic fission, Otto Hahn, had worked under his guidance at the Montreal Laboratory in 1905-1906.

At Manchester (1907) Rutherford had continued his work on the properties of the radium emanation of  $\alpha$ -rays. He, along with H. Geiger, developed a method of detecting a single  $\alpha$ -particle. Therefore, it could be possible for them to count the number of such particles emitted by radium.

In 1910 he began to investigate into scattering of  $\alpha$ -rays and the nature of inner structure of atom, which led him to develop the concept "nucleus". He pointed out that almost the entire mass

of the atom is concentrated in this minute centre along with all the positive charges. To come to this conclusion, he had conducted his famous gold-foil experiment along with the coworkers, Hans Geiger and Ernest Marsden, in which he had bombarded a thin gold foil with  $\alpha$ -rays and found that most of the rays passed through it, while only a few retraced their paths. So, he visualized most part of the atom to be almost empty through which the  $\alpha$ -rays passed and the deflection of the few was caused by dense centre (1911). It gave a death blow to the Thomson's plum-pudding structure of atom. In 1919, Rutherford discovered proton, the positively charged particle which according to him constituted the centre of the atom and deflected the  $\alpha$ -rays. Later he also put out the idea that there could be another type of particle with mass but no charge. He called it neutron and imagined it as a pair of negatively charged electron and positively charged proton.

From all these he visualized the planetary model of atom in which the massive protons and neutrons constituted the centre or nucleus, while the electrons with negligible masses moved around it in various orbits as do the planets around the sun. In 1932, James Chadwick discovered neutron. Rutherford also suggested that the numbers of protons in the nucleus are equal to the numbers of electrons moving around it, which matches with the atomic number of the atom. In order to account for the stability of the atom he proposed that the electrons revolve in closed orbits. Thus their centrifugal force balances the force of attraction and keeps them in their paths.

However, according to the classical electromagnetic theory, a moving charge must use some energy. So the electrons should do it. As a consequence, those should lose energy and come closer



Rutherford at Manchester in 1910



Rutherford with Hans Geiger

and closer to the nucleus and fall into it, destroying the atom. But it does not happen. It was considered as a major drawback of Rutherford's atomic model.

In 1912, Niels Bohr joined him. He accepted his concept of nuclear structure of atom, adopted it to Max Plank's quantum theory and postulated that moving electrons do not lose energy as long as they move in certain definite paths each having a specific energy. Those are called as energy levels or orbits. With later improvements, taking into account the Heisenberg's concepts, it remains valid even today.

In 1913, Rutherford, in association with H.G. Moseley, bombarded cathode rays to atoms of various elements. They showed that the inner structures of those correspond with a group of lines which characterise the element. During his last year at Manchester (1919) he discovered that the nuclei of certain light elements like nitrogen could be "disintegrated" by the impact of energetic  $\alpha$ -particles coming from the radioactive source, and

during the process fast protons would be emitted. Later, Patrick Blackett proved with the cloud chamber that nitrogen in this process could be transformed in to an oxygen isotope.

Rutherford was an inspiring leader of the Cavendish laboratory that produced many Nobel Laureates like Chadwick, Blackett, Cockcroft, Walton, G.P. Thomson, Appleton, Powell and Aston. Most of their prize-winning research had begun by Rutherford's direct or indirect suggestions. He also published several books such as Radioactivity (1904); Radioactive Transformation (1906); The Electrical Structure of Matter (1926); The Artificial Transmutation of Elements (1938); The Newer Alchemy (1937); and Radiation from Radioactive substances (1930, co-authored with James Chadwick and C.D. Ellis).

Rutherford was Knighted in 1914, appointed to the Order of Merit (1925), elected Fellow of the Royal Society (1903) and was its President (1925-1930). He won the Faraday Medal from the Institution of Electrical Engineers (1930) and received the D.Sc. degree from the University of New Zealand as well as honorary doctorates from many other renowned Universities including the Wisconsin, the Pennsylvania, the Oxford, the Cambridge and the Leeds. In 1931 he was made the first Baron Rutherford of Nelson, New Zealand and Cambridge.

Rutherford was married to Mary Newton in 1900 and had a daughter from her. He died in Cambridge on 9 October 1937. His ashes were buried at Westminster Abbey, near the tombs of Sir Isaac Newton and Lord Kelvin.

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# VIDYARTHI VIGYAN MANTHAN 2021-22

INDIA'S LARGEST SCIENCE TALENT SEARCH EXAMINATION FOR NEW INDIA USING DIGITAL DEVICES

Vidyarthi Vigyan Manthan (VVM) is an initiative of Vijnana Bharati (VIBHA), in collaboration with Vigyan Prasar, an autonomous organization under the Department of Science and Technology, Government of India and National Council of Educational Research and Training (NCERT), an institution under the Ministry of Education. VVM is a national program for popularizing science among school students of standard VI to XI, conceptualised to identify the bright minds with a scientific aptitude among the student community.

## STRUCTURE OF VVM (JUNIOR AND SENIOR):

- School Level Examination:** VVM is a unique online examination to be conducted at national level. The registered students will take the exam using his/her own digital device namely a laptop/ tablet / smart phone (mobile with any OS - Except Apple devices) with internet connectivity. Level-I (School Level) examination will be conducted nationwide, on 30 November and/or on 05 December, 2021 anytime between 10:00am to 08:00pm. Evaluation of student will be based on their individual performance at every level.
- State Level Camp (SLC):** Top 20 rankers per class per state will be identified to participate in the one or two days State Level Camp (SLC). The camp will be organised anywhere within the state.
- National Camp (NC):** From each State Camp, top two students from each class i.e. total 12 students per state, will be invited to a two-day National Camp.

## SYLLABUS FOR VVM:

CONTENT	CONTRIBUTION	MARKS	DURATION	CURRICULUM
Indian Contribution to Science	20% (20 questions) [1 Mark each]	20	30 Minutes	VVM Study Material*
Life story of Acharya Prafulla Chandra Ray and India's Freedom Struggle & Science	20% (20 questions) [1 Mark each]	20		VVM Study Material*
Science and Mathematics from Text Books	50% (50 questions) [1 Mark each]	50	60 Minutes	NCERT Curriculum
Logic and Reasoning	10% (10 questions) [1 Mark each]	10		General Reading

\* VVM Study Materials will be made available in PDF format on <https://vvm.org.in> by 15 August 2021. No printed copies will be provided.

- Bhaskara Scholarship of Rs. 2000/- per month to the National Winners (Himalayans) for one year. Extensive training cum internship of 1 to 3 weeks for all National Winners (Himalayans and Zonal) in any one reputed National Lab or Research Institute like ISRO, CSIR, DRDO etc.**
- Registered students will be a part of Eat Right - Mega Science Experiment. Students will get to know about the nutritional value and environmental impact of our food habits.**

## KEY POINTS:

<b>Eligibility</b>	Students from classes VI to XI
<b>Language of Exam</b>	English, Hindi and 10 major regional languages
<b>Exam Venue</b>	<b>Open Book Exam</b> (Students will write exam from their home)
<b>Fee</b>	Rs. 100/- (without late fee)
<b>Registration</b>	Online on <a href="https://vvm.org.in">https://vvm.org.in</a>



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A DST-Vigyan Prasar Initiative

# INDIA'S OWN 24X7 SCIENCE & TECHNOLOGY CHANNEL

India Science is an Internet-based Over-The-Top (OTT) TV channel. This 24x7 video platform is dedicated to science and technology knowledge dissemination, with a strong commitment to spreading scientific awareness with Indian perspectives, ethos and cultural milieu.

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## FILMMAKERS COME TOGETHER TO REFLECT ON INDIAN INDEPENDENCE AND SCIENCE THROUGH CINEMA

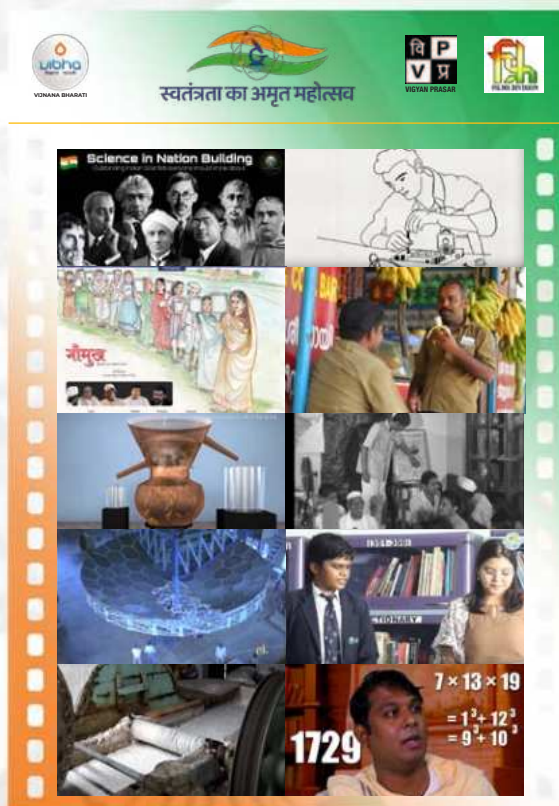
A unique film festival, Swatantrata ka Vigyan Filmotsav, was organised virtually by Vigyan Prasar in collaboration with Vijnana Bharati (VIBHA) and Films Division of India during 13-15 August 2021. The festival highlighted and showcased films on Indian scientists, Indian scientific institutions and the role they played in India's freedom struggle and nation-building. The Festival was a part of 'Swatantrata ka Amrit Mahotsav (SwAM)', the celebrations of 75th year of India's independence.

The Festival was inaugurated by the Chief Guest, Shri Siddharth Kak, senior filmmaker and television producer. Welcoming the dignitaries, Dr Nakul Parashar, Director, Vigyan Prasar said, "Vigyan Prasar has decided to do its bit to contribute to the year-long celebration of 75th year of our independence. Vigyan Prasar will highlight the saga of Indian scientists and remember their contribution to the development of Science & Technology during the hard times through various formats and means." Shri Jayant Sahasrabudhe, National Organising Secretary, Vijnana Bharati explained the motivation behind SwAM campaign. Dr Mukesh Sharma, Jury Chairman, Vigyan Filmotsav; Ms Smita Vats Sharma, Director General, Films Division of India, Ministry of Information & Broadcasting and Shri Nimish Kapoor, Festival Convener and Scientist E, Vigyan Prasar addressed the inaugural function.

The Festival had a competitive section in which 38 films were submitted. After reviewing, the Jury selected 13 films for screening. In addition, 20 films from Films Division were screened as a part of the Retrospective category screening. This included 100 Years of Indian Institute of Science Bangalore (directed by Jimmy Luke); GD Naidu-The Edison of India (directed by K. Ranjit Kumar); The Man Who Lives in The Future (directed by K. Jayadev); and Vikram Sarabhai (directed by Homi D. Sethna & G. Ashok).

Further, the Festival also hosted a special screening of biopics on Indian scientists made by Vigyan Prasar. This included 'Taming of chance P C Mahalanobis' (directed by R Ramachandran and Dilip Banerjee); 'JC Bose' (directed by Matiur Rahman); and 'Ramanujan' (directed by Nandan Kudhyadi). The special screening of films on Indian scientific institutions, produced by Vigyan Prasar, was also organised.

The Festival also hosted two masterclasses by



Shri Matiur Rahman and Shri Nandan Kudhyadi, senior science filmmakers. These were attended by filmmakers who had submitted their entries for the contest and other film enthusiasts.

A panel discussion on the topic "The emergence of scientific consciousness in India's Independence" was arranged. Dr S. Krishnaswamy, Veteran Documentary Filmmaker, Chennai; Shri Matiur Rahman, Sr. Science Filmmaker, New Delhi; Shri Nandan Kudhyadi, Sr. Science Filmmaker, Pune; Shri Indranil Sanyal, Director, North East Zone, NCSM, Kolkata; Shri Amrit Ganger, Film Historian and Film Academic, Mumbai and Shri Santosh Pandey, Managing Editor, India Science Wire, Vigyan Prasar addressed the session.

The festival jury was headed by Dr Mukesh Sharma, Ex-DG, Films Division, Ex ADG, Doordarshan. The jury members were Prof. Danish Iqbal, AJK, MCRC, JMI; CM Nautiyal, Consultant, INSA; Shri Abhay Kumar, Sr. Faculty Producer, CIET, NCERT; and Shri Rizwan Ahmed, Director, MANUU, Hyderabad. The jury examined the competition entries and bestowed seven awards.

The first prize of Rs. 1,50,000 with trophy and certificate was shared by two entries: 'Seekers of the Sun' directed by Rakesh Rao and 'Sarkar' (a film on Dr ML Sircar) directed by Manoj Patel.

The Second prize of Rs. 1,00,000 with trophy and certificate was also shared by two films: 'Haathkaagaj Sanstha Pune-Bharat ki ek Virasat', directed by Dr Balkrishna Digambar Damle and 'Kamala: The Swadeshi Nutriindian', directed by Sameer Sahasrabudhe.

The third prize of Rs. 75,000 with trophy and certificate was shared by three films. These were: 'His Experiments with Science' (highlighting Mahatma Gandhiji's experiments with various scientific processes such as health, modern medicine, and naturopathy), directed by Aditya Seth; 'Ramanujan: The Man who knew Infinity', directed by Rahul Khadia; and 'Sciendependence', directed by Suman Banerjee.

The particular highlight of the festival was the panel discussion on "Visualizing Science on the themes of Swatantrata ka Vigyan Filmotsav" in which all the jury members took part and answered the queries raised by filmmakers and enthusiasts from all over India.

The chief guest of the concluding session guest Prof. K.G. Suresh, Vice-Chancellor, Makhn Lal Chaturvedi National University of Journalism and Communication, Bhopal announced the competition's winners. Delivering valedictory remarks Shri Jayant Sahasrabudhe said the country's people needed to know how several Indian scientists fought against attempts to suppress them. Special Guest Ms Smita Vats Sharma emphasised the need to encourage popular media like films to create awareness on aspects like the role played by scientists in the independence movement.

The sessions of master-classes and panel discussion are available on the YouTube channel of Vigyan Prasar. Films screened during the event are available on the YouTube channel of Vigyan Prasar for public viewing till 15 September 2021.

Prepared by: Chavi Bhatnagar,  
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Answer to the Cryptograph  
Decrypted title - Let's Encrypt  
Reasoning - The key used is -3 for the first word of the title and +2 for the second word. Hence, Changes to I, E to G and so on.